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INTERNATIONAL DEVELOPMENT ASSOCIATION

PROJECT APPRAISAL DOCUMENT

ON A

PROPOSED CREDIT

IN THE AMOUNT OF SDR 243.4 MILLION
(US\$350 MILLION EQUIVALENT)

TO THE

FEDERAL REPUBLIC OF NIGERIA

FOR THE

NIGERIA ELECTRIFICATION PROJECT

May 31, 2018

Energy and Extractives Global Practice
Africa Region

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CURRENCY EQUIVALENTS

(Exchange Rate Effective April 30, 2018)

Currency Unit = Naira

Naira 305 = US\$1

SDR 0.69538128 = US\$1

FISCAL YEAR

January 1 - December 31

ABBREVIATIONS AND ACRONYMS

AFD	<i>Agence Francaise de Developpement</i> (French Development Agency)
AfDB	African Development Bank
AtRE	Access to Renewable Energy
BoI	Bank of Industry
BPE	Bureau of Public Enterprise
CAPEX	Capital Expenditure
CBN	Central Bank of Nigeria
CPF	Country Partnership Framework
CPS	Country Partnership Strategy
DA	Designated Account
DBN	Development Bank of Nigeria
DFID	Department for International Development is a United Kingdom
DISCO	Distribution Company
E&S	Environmental and Social
ECOWAS	Economic Community of West African States
EEP	Energizing Education Program
EIB	European Investment Bank
EIRR	Economic Internal Rate of Return
EPC	Engineering, Procurement and Construction
ERGP	Economic Recovery and Growth Plan
ESCO	Energy Service Company
ESDP	Energy Sector Directions Paper
ESIA	Environmental and Social Impact Assessment
ESMAP	Energy Sector Management Assistance Program
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management Systems
FGN	Federal Government of Nigeria
FM	Financial Management
FMPWH	Federal Ministry of Power, Works and Housing

FOB	Free (or Freight) on Board
PPFMD	Federal Project Financial Management Division
FRCN	Financial Reporting Council of Nigeria
GBV	Gender-based Violence
GDP	Gross Domestic Product
GENCO	Generation Company
GIFMIS	Government Integrated Financial Management Information System
GIZ	<i>Deutsche Gesellschaft für Internationale Zusammenarbeit</i> (German Development Agency)
GRM	Grievance Redress Mechanism
GRS	Grievance Redress Service
GVE	Green Village Electricity
GW	Gigawatt
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IDA	International Development Association
IFC	International Finance Corporation
IFR	Interim Financial Reports
IPF	Investment Project Financing
IPP	Independent Power Producers
ISA	International Standards on Auditing
kVA	Kilo Volt Amperes
kW	Kilowatt
kWh	Kilowatt Hour
M&E	Monitoring and Evaluation
MFD	Maximizing Finance for Development
MIGA	Multilateral Investment Guarantee Agency
MSME	Micro, Small, and Medium-sized Enterprise
MTF	Multi-tier Framework
MW	Megawatt
MYTO	Multi-year Tariff Order
NBET	Nigerian Bulk Electricity Trading Company
NCB	National Competitive Bidding
NEAF	Nigeria Energy Access Fund
NEP	Nigeria Electrification Project
NERC	Nigerian Electricity Regulatory Commission
NESP	Nigerian Energy Support Programme
NETAP	Nigeria Electricity Transmission and Access Project
NGO	Non-governmental Organizations
NPV	Net Present Value
O&M	Operations and Maintenance
OAGF	Office of the Accountant General for the Federation
OHS	Occupational Health and Safety
OP/BP	Operational Policy / Bank Policy
OPEX	Operational Expenditure
PAYG	Pay-As-You-Go

PDO	Project Development Objectives
PFIs	Participating Financial Institutions
PHCN	Power Holding Corporation of Nigeria
PIU	Project Implementation Unit
PMU	Project Management Unit
PPA	Power Purchase Agreement
PPSD	Project Procurement Strategy for Development
PRSD	Procurement Strategy for Development
PSRP	Power Sector Recovery Program
PV	Photovoltaic
RAP	Resettlement Action Plan
REA	Rural Electrification Agency
REF	Rural Electrification Fund
RESIP	Rural Electrification Strategy and Implementation Plan
RPF	Resettlement Policy Framework
SBDs	Standard Bidding Documents
SDG	Sustainable Development Goal
SDR	Special Drawing Rights
SEforALL	Sustainable Energy for All
SHS	Solar Home System
SPD	Small Power Distributor
SPP	Small Power Producer
STEP	Systematic Tracking and Exchanges in Procurement
SUNREF	Sustainable Use of Natural Resources and Energy Finance in Nigeria
TCN	Transmission Company of Nigeria
TEM	Transitional Energy Market
ToR	Terms of Reference
UNDP	United Nations Development Programme
US\$	United States Dollar
US¢	US Dollar Cent
USAID	United States Agency for International Development
USTDA	US Trade and Development Agency
VAT	Value-added Tax
VLD	Voluntary Land Donation
W	Watt
Wp	Work Peak
WBG	World Bank Group

Regional Vice President: Makhtar Diop

Country Director: Rachid Benmessaoud

Senior Global Practice Director: Riccardo Puliti

Practice Manager: Wendy E. Hughes

Task Team Leaders: Jon C. Exel, Kyran O'Sullivan, Muhammad Abba
Wakil



BASIC INFORMATION

Country(ies)	Project Name	
Nigeria	Nigeria Electrification Project	
Project ID	Financing Instrument	Environmental Assessment Category
P161885	Investment Project Financing	B-Partial Assessment

Financing & Implementation Modalities

<input type="checkbox"/> Multiphase Programmatic Approach (MPA)	<input type="checkbox"/> Contingent Emergency Response Component (CERC)
<input type="checkbox"/> Series of Projects (SOP)	<input type="checkbox"/> Fragile State(s)
<input type="checkbox"/> Disbursement-linked Indicators (DLIs)	<input type="checkbox"/> Small State(s)
<input type="checkbox"/> Financial Intermediaries (FI)	<input type="checkbox"/> Fragile within a non-fragile Country
<input type="checkbox"/> Project-Based Guarantee	<input type="checkbox"/> Conflict
<input type="checkbox"/> Deferred Drawdown	<input type="checkbox"/> Responding to Natural or Man-made Disaster
<input type="checkbox"/> Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
21-Jun-2018	31-Oct-2023
Bank/IFC Collaboration	Joint Level
Yes	Complementary or Interdependent project requiring active coordination

Proposed Development Objective(s)

The development objective is to increase access to electricity services for households, public educational institutions, and underserved micro, small and medium enterprises.

Components

Component Name	Cost (US\$, millions)
Solar Hybrid Mini Grids for Rural Economic Development	330.00



Stand-alone Solar Systems for Homes and MSMEs	305.00
Energizing Education	105.00
Technical assistance	25.00

Organizations

Borrower: Federal Ministry of Finance

Implementing Agency: Rural Electrification Agency

PROJECT FINANCING DATA (US\$, Millions)

SUMMARY

Total Project Cost	765.00
Total Financing	765.00
of which IBRD/IDA	350.00
Financing Gap	0.00

DETAILS

World Bank Group Financing

International Development Association (IDA)	350.00
IDA Credit	350.00

Non-World Bank Group Financing

Counterpart Funding	5.00
Borrower	5.00
Commercial Financing	410.00
Unguaranteed Commercial Financing	410.00

IDA Resources (in US\$, Millions)

	Credit Amount	Grant Amount	Total Amount
National PBA	350.00	0.00	350.00



Total	350.00	0.00	350.00				
Expected Disbursements (in US\$, Millions)							
WB Fiscal Year	2018	2019	2020	2021	2022	2023	2024
Annual	0.00	45.00	70.00	85.00	95.00	55.00	0.00
Cumulative	0.00	45.00	115.00	200.00	295.00	350.00	350.00

INSTITUTIONAL DATA

Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Climate Change and Disaster Screening

This operation has been screened for short and long-term climate change and disaster risks

Gender Tag

Does the project plan to undertake any of the following?

a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF	Yes
b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment	Yes
c. Include Indicators in results framework to monitor outcomes from actions identified in (b)	Yes

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	● Substantial
2. Macroeconomic	● Substantial
3. Sector Strategies and Policies	● Substantial
4. Technical Design of Project or Program	● Substantial



5. Institutional Capacity for Implementation and Sustainability	● Substantial
6. Fiduciary	● Substantial
7. Environment and Social	● Substantial
8. Stakeholders	● Moderate
9. Other	● Moderate
10. Overall	● Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

Yes No

Does the project require any waivers of Bank policies?

Yes No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04		✓
Forests OP/BP 4.36		✓
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11		✓
Indigenous Peoples OP/BP 4.10		✓
Involuntary Resettlement OP/BP 4.12	✓	
Safety of Dams OP/BP 4.37		✓
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants



Sections and Description

The PIE shall, no later than one month after the Effective Date, adopt the Project Implementation Manual, which shall include provisions set from (i) to (vii) set out in Section I, B(a) of the Project Agreement.

Sections and Description

The PIE shall ensure that the Beneficiaries of Sub-Financings and Subprojects are selected in accordance with the procedures, guidelines, eligibility criteria and other provisions set forth in detail in the PIM. The PIE through the PIU shall submit appraisal documents of all Subprojects during the first year's Project Implementation to the Association for prior approval, including data on any resettlement.

Conditions

Type

Effectiveness

Description

Subsidiary Agreement has been executed on behalf of the Recipient and the respective Project Implementing Entity



FEDERAL REPUBLIC OF NIGERIA
NIGERIA ELECTRIFICATION PROJECT

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I. STRATEGIC CONTEXT

A. Country Context

- 1. The 2015 elections marked, for the first time in Nigeria's history, a peaceful democratic transfer of power between two political parties, but the new administration faced a fast-deteriorating macroeconomic environment.** Gross domestic product (GDP) growth fell from 6.3 percent in 2014 to 2.7 percent in 2015, and to negative 1.6 percent in 2016, bringing Nigeria's first full-year of recession in 25 years. In 2016, global oil prices reached a 13-year low and oil production was severely constrained by vandalism and militant attacks in the Niger Delta. While the oil sector represents only 8.3 percent of total GDP, it provides the majority of foreign exchange earnings and three-quarters of government revenues.
- 2. The Nigerian economy emerged from the recession with GDP growth of 0.8 percent in 2017.** The recovery was driven by higher oil prices and production. Agriculture and non-oil industry grew by 3.4 percent and 0.6 percent, respectively. Services, which account for over half of GDP, continued to contract (-0.9 percent). Unemployment increased in 2017 to 18.8 percent of the labor force, with a further 21.2 percent underemployed in Q3. Inflation remained at just below 16 percent, despite monetary tightening from the Central Bank. The parallel exchange rate premium vis-à-vis the official exchange rate remains stable at just under 20 percent. Total government revenues performed below expectations as oil revenues remained below pre-crisis levels and non-oil revenues largely stagnated in the absence of significant tax reforms, leading to a larger fiscal deficit. The recovery is expected to be slow and largely oil driven, with real GDP growth just over 2 percent in the World Bank's medium-term baseline growth scenario.
- 3. The Government launched the National Economic Recovery and Growth Plan (ERGP) for the period 2017-2020 in March 2017.** The ERGP sets out to restore macroeconomic stability in the short-term and to undertake structural reforms, infrastructure investments and social sector programs to diversify the economy and set it on a path of sustained inclusive growth over the medium- to long-term. The priority areas of action under the ERGP are: stabilizing the macroeconomic environment; achieving agriculture and food security; ensuring energy sufficiency in power and petroleum products; improving transportation infrastructure; and driving industrialization through focus on small- and medium-scale enterprises.

B. Sectoral and Institutional Context

- 4. Access to energy is low, with approximately 80 million people lacking access to electricity.** Nigeria has the largest absolute access deficit in sub-Saharan Africa and the second-largest in the world, after India.¹ The national electrification rate is 55 percent, and the rural electrification rate is only 39 percent.² To achieve universal access to electricity by 2030, Nigeria would need to connect between 500,000 to 800,000 households per year. Both grid extension and off-grid solutions will be needed to provide quality services to unserved and underserved households and businesses in a timely manner.

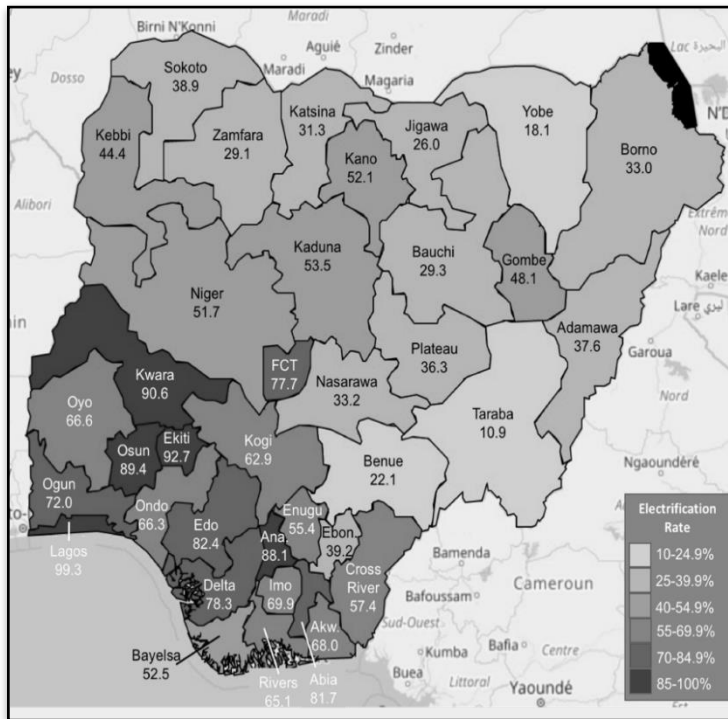
¹ Energy Access Outlook 2017, International Energy Agency, 2017.

² For electrification rates by States see Figure 1. Source: National Population Commission (2014, June). Nigeria Demographic and Health Survey 2013. Retrieved August 12, 2014, from National Population Commission [Nigeria] http://www.population.gov.ng/images/ndhs_data/ndhs_2013/2013_ndhs_final_report.pdf



While female-headed households are more likely to be connected to the grid (72 percent) compared to male-headed households (53 percent), female-headed households tend to consume less³.

Figure 1. Electricity Access Rate (Percent)



5. **Nigeria’s power sector is unbundled and largely privately-owned.** Following the passage of the Electric Power Sector Reform Act (2005), the sector was unbundled into six generation companies (GENCOs), eleven distribution companies (DISCOs) and the Transmission Company of Nigeria (TCN). The privatization of the DISCOs and GENCOs was completed in 2013. Three of the five thermal GENCOs (that use natural gas as fuel) were sold in their entirety to new owners, while three hydropower plants were concessioned to private operators. TCN has remained a fully Government-owned monopoly. The Nigerian Bulk Electricity Trading Company (NBET) fulfills the role of bulk trader, buying electricity from GENCOs (including Independent Power Producers) under Power Purchase Agreements (PPAs)

and reselling it to DISCOs under Vesting Contracts.

6. **The sector is under severe stress as the transition from a publicly-owned to a largely privately-owned power sector did not bring the expected outcomes.** High losses, low collections and lack of cost recovery tariffs have resulted in an annual financial deficit to the sector of approximately US\$1 billion. Sector Aggregate Technical Commercial and Collection (ATC&C) losses are extremely high, averaging 54 percent in 2017.

7. **The Government has prepared the Power Sector Recovery Program (PSRP) to address the causes of poor performance in grid-connected electricity service delivery.** Approved by the Federal Executive Council in March 2017, the PSRP includes measures to improve the financial viability of sector companies, increase power supply, and strengthen sector governance and contract enforcement, de-risking the sector for private investment and putting it on a path to long-term sustainability.

8. **Recognizing the need for action outside the grid-connected areas that the DISCOs currently service, the President approved the Rural Electrification Strategy and Implementation Plan (RESIP) in July 2016.** The strategy states:

“The primary objective of the Nigerian Rural Electrification Policy and by extension this Rural Electrification Strategy and Implementation Plan is to expand access to electricity as rapidly as

³ General Household Survey conducted in 2015-2016.



possible in a cost-effective manner. This implies full use of both grid and off-grid approaches, with subsidies being primarily focused on expanding access rather than consumption. It is assumed that private sector providers will be heavily involved in enhancing access.”

9. **RESIP calls for a particular focus on underserved rural populations and rural institutions** such as schools, health centers, administrative buildings as well as rural businesses, farms and enterprises for job creation and economic development. The strategy aims to facilitate the entry of new market participants, especially the private sector. Furthermore, it provides for diverse approaches, including a “bottom-up” approach through spontaneous initiatives by project proponents as well as a “top-down” approach through organized large-scale procurements.

10. **The Rural Electrification Agency (REA) has been authorized to establish a Rural Electrification Fund (REF)** to help finance rural electrification expansion. The REF promotes “fast and cost-effective expansion of electricity access in un-electrified rural areas evenly among the geopolitical zones in Nigeria” through on-grid, mini grid and off-grid electrification solutions featuring renewable energy and hybrid power systems.

11. **Mini grids will play a significant role in rural electrification.** A Federal Ministry of Power, Works and Housing (FMPWH) study, based on geo-referenced data of population clusters and load centers, concluded that an estimated 8,000 potential load centers are suitable for mini grids, powering 14 percent of Nigeria’s population. Nigerian Electricity Regulatory Commission (NERC) issued a regulatory framework in support of mini grid market development in May 2016. These regulations address barriers to mini grid development such as the treatment of grid extension by DISCOs to mini grid locations so that the mini grids’ assets do not become stranded. Most mini grid sites are likely to be located in areas that are unlikely to be reached by grid extension within the next seven to ten years. Mini grids have yet to achieve the scale needed in Nigeria due to constraints such as limited pre-investment support, the absence of adequate viability gap financing, and the lack of credible market intelligence that has deterred international investors.

12. **Stand-alone solar photovoltaic (PV) systems offer a viable option in areas where mini grids are not sustainable.** Several relatively well-established solar PV companies are now operating in Nigeria, utilizing cash sales and pay-as-you-go (PAYG) business models. For these companies to grow rapidly they must fund an ever-increasing amount of stock in the supply chain and invest substantial amounts in building their ‘soft infrastructure’ to reach and serve new customers. Key regulatory challenges include: 25 percent combined import duties and value-added tax (VAT) on imported solar components (which is transferred as additional cost to customers); streamlining mobile payment systems; and ensuring high product standards. Key financial barriers include a lack of access to local currency loans for operating expenses, and hard currency loans for capital costs.

13. **The electrification of Federal Universities and associated Teaching Hospitals will improve and modernize the services they offer.** The majority of universities are located in rural and underserved communities. Federal universities and teaching hospitals currently use diesel-based self-generation to meet their power needs, due to unreliable service provided by DISCOs. The high cost of fuel and maintenance results in rationing of on-site generated electricity and poor reliability, which disrupts learning. The REA Energizing Education Program (EEP) is providing dedicated power systems for these universities as a first phase of a larger program.



C. Higher Level Objectives to which the Project Contributes

14. **The proposed project supports Federal Government of Nigeria (FGN) goal of increasing electricity access.** In order to meet the FGN access targets, Nigeria will use grid, mini grid and off-grid expansion. The proposed project focuses on mini grid and off-grid expansion. As part of the PSRP, DISCOs are expected to improve and extend services in areas served by their grid networks.
15. **The proposed project is aligned with the Country Partnership Strategy (CPS⁴, FY14 – FY17) for Nigeria.** In particular, the first strategic cluster of the CPS is “*promoting diversified growth and job creation by reforming the power sector, enhancing agricultural productivity, and increasing access to finance.*” The CPS identifies several objectives within this strategic cluster which the proposed project intends to support: (i) “increasing installed power generation and transmission capacity...and providing access to improved energy service”; (ii) “expanding financing opportunities for SMEs”; and (iii) “strengthening the ability of Development Finance Institutions to mobilize private finance for key sectors of the economy.” The project support objectives within the second strategic cluster of the CPS, in particular those of improving the quality of health and education services. Furthermore, the project will provide electricity to power agriculture machinery, thus promoting productivity and job creation in rural areas. The project promotes a participatory community engagement approach with focus on social inclusion and gender equality.
16. **The proposed project will contribute to Sustainable Development Goals (SDG) 7 and 13 (SDG7 and SDG13), Sustainable Energy for All (SEforALL), the World Bank Group (WBG) twin goals, the World Bank’s Energy Sector Directions Paper (ESDP), and is aligned with the Multi-tier Framework (MTF).** SDG7, SEforALL, and ESDP all aim to “ensure access to affordable, reliable, sustainable, and modern energy for all.” SDG13 aims to “integrate climate change measures into national policies, strategies and planning” – a goal that this project supports by implementing solar-powered technologies in place of fossil fuels. Consistent with the MTF approach, the project aims to provide a spectrum of service levels, ranging from Tier 1 and 2 for individual solar home systems (SHSs); Tier 3, 4 and 5 for mini grids; and Tier 5 for power supply to universities and teaching hospitals.⁵
17. **Maximizing Finance for Development (MFD).** The proposed project promotes the MFD approach by incentivizing private sector investments and activities in the following areas: constructing and operating mini grids (Component 1), selling stand-alone solar systems (Component 2), and installing and operating electricity generation systems to power public institutions (Component 3).
18. **The US\$330 million of IDA for investments is expected to leverage an additional US\$410 million in private sector investment, and create a vibrant market for mini grid and off-grid energy solutions.** Project implementation will be coordinated with activities of the International Finance Corporation (IFC) to catalyze private sector investment.
19. **The proposed project has synergies with and is coordinated with the WBG program in the energy sector (Table 1), and in agriculture and other sectors (Table 2).** The project aligns the demand for power in the agricultural and micro, small and medium enterprises (MSME) sectors with the supply of energy by mini grid systems. The performance-based grants under the project complement and will be coordinated with commercial debt mobilization under other supported World Bank projects.

⁴ This CPS (Report No. 82501-NG) is being extended to FY19 through Performance and Learning Review (Report No. 104616)

⁵ World Bank, SEforALL: Beyond Connections: Energy Access Redefined; 2015



Furthermore, it will complement a regional pipeline project that is designed to support deployment of SHSs.

Table 1. WBG Program (Ongoing and Planned) in the Power Sector

Sector Challenges	WBG Instrument	WBG financing
Lack of reliable electricity supply; poor financial viability; weak governance and efficiency	Power Sector Recovery Performance-based Loan (proposed).	US\$1,000 million (proposed IDA Credit) (P164001)
Poor performance of DISCOs	<ul style="list-style-type: none"> WBG lending to strengthen the quality and reliability of power supply to customers by improving the operational and commercial performance of DISCOs. The operation is at the identification stage. (planned) Potential IFC debt and equity investments. 	Up to US\$500 million (planned investment project financing (IPF)). (P166237)
Transmission constraints, including for regional trade	<ul style="list-style-type: none"> WBG lending for the rehabilitation and refurbishment of transmission infrastructure to enhance system stability (ongoing) WBG lending for construction of a new transmission infrastructure for increased electricity trade among Nigeria, Niger, Benin and Burkina Faso in the West Africa Power Pool. (planned) 	Aggregate of US\$786 million for Electricity and Gas Improvement Project (ongoing) (P106172) and Electricity Transmission Project (approved in February 2018). (ongoing IPF) (P146330) US\$420 million for a regional interconnection (planned IPF) (P164044)
Generation and gas supply constraints	<ul style="list-style-type: none"> IFC debt and equity investments to support private brownfield and greenfield investments in power generation and domestic gas supply (ongoing and planned). Multilateral Investment Guarantee Agency (MIGA) political risk insurance to support private investments in power generation and domestic gas supply (ongoing and proposed). International Bank for Reconstruction and Development (IBRD) guarantee support for private investment in power generation. Technical assistance for gas policy development. 	US\$868 million IFC direct or mobilized financing, US\$492 million MIGA guarantee and US\$387 million IBRD/IDA guarantee (ongoing Azura Edo independent power producers [IPP]) US\$112 million IDA guarantee for the Natural Gas Sales Agreement between Accugas Limited and the Calabar Generation Company (P120207).



Table 2. Synergies and Coordination with Other World Bank Supported Operations.

<p>Agro-Processing, Productivity Enhancement and Livelihood Improvement Support Project (P148616) aims to “enhance agricultural productivity of small and medium scale farmers and improve value addition along priority value chains” over the implementation period of 2017-2023. Providing electricity service to these agricultural users through mini grids to energize small mills and other agricultural processing machines, would enhance farmer productivity and support value-adding activities that enable farmers to move up the value chain. Both projects use geospatial tools and merging the geotagged information into a single platform allows for a more optimized matching of demand and supply of electricity.</p>
<p>Third National Fadama Development Project (P096572) aims to “increase the incomes for users of rural land and water resources in a sustainable manner, and to contribute to restoration of the livelihoods of conflict affected households in the selected area in the North East.” The geotagged information from this project will also be entered in the data-platform supported under the Nigeria Electrification Project (NEP). NEP will collaborate with the Fadama project to survey farmers on their energy needs.</p>
<p>Regional Off Grid Electrification Project (P160708). The proposed project aims to enhance shared capacity, knowledge and increase electricity access to households, businesses and communities using modern off-grid electrification technologies in a group of West African countries. Specific design elements of both projects related to enabling environment, product standards and market intelligence will be harmonized. The proposed project also builds on the Lighting Nigeria Program, in particular the promotion and marketing campaigns and value chain integration.</p>
<p>Lighting Global (P163485). This program provides an umbrella for off-grid activities with World Bank and IFC support, including the Lighting Nigeria Program. The proposed NEP will closely coordinate with Lighting Nigeria Program to support activities such as retail market development for solar products, consumer education campaigns, and digital marketing.</p>
<p>Nigeria Development Finance Sector (P146319). The project supports the establishment of the Development Bank of Nigeria (DBN), a wholesale development finance institution licensed and supervised by the Central Bank of Nigeria (CBN), with the objective of addressing the access to finance gaps of underserved MSME in Nigeria. The DBN will support private sector lenders with sustainable and commercially viable longer-term financing in local currency and partial credit guarantees in order to expand their outreach to underserved MSMEs, including those operating in the individual solar systems and solar mini grid sector assuming that they meet DBN’s eligibility criteria and qualify for financing from DBN-supported lenders.</p>

II. PROJECT DEVELOPMENT OBJECTIVES

A. PDO

20. The project development objective (PDO) is to increase access to electricity services for households, public educational institutions, and underserved micro, small and medium enterprises.

B. Project Beneficiaries

21. **Project beneficiaries will be households, MSMEs, students, faculty staff, and patients at Federal Universities and Teaching Hospitals throughout Nigeria.** Approximately 2.5 million people (approximately 500,000 households), 70,000 MSMEs, seven universities, and two associated teaching hospitals will receive new or improved access to electricity services as a result of the proposed project. The project will create an enabling environment for private sector involvement. Women across all beneficiary groups will receive increased opportunities through a range of integrated activities including collecting of sex-disaggregated data, gender-targeted marketing, community outreach, and training



programs that will be delivered at various levels to encourage and facilitate women to participate in the project⁶.

22. **Households in areas without electricity service would receive electricity for the first time.** Some of them will be served by newly established mini grids, while others will be served by SHSs. Numerous studies⁷ have shown a variety of benefits to replacing existing energy sources with electricity. This ranges from increased productivity to significant health benefits from replacing kerosene and candles with electric lighting, to improved security through street lighting and long-term savings over continued consumption of alternative fuels. Households without an electricity connection will benefit indirectly through improved local public services, such as health clinics and community centers with lighting and refrigeration, and access to other services such as food processing and preservation, communication and business services.

23. **MSMEs.** On the supply side, local mini grid developers and local solar companies will benefit from incentives and technical assistance to help them grow their businesses. On the demand side, MSMEs will benefit from access to a reliable, affordable source of electricity offering opportunities to increase productivity and grow their businesses, including cost savings from reduced dependence on diesel generators and extended working hours after sunset.

24. **Federal Universities and Teaching Hospitals will get significantly improved electricity supply.** At present, these institutions are not served with reliable power from the DISCOs. The short-run adverse impact of this unreliable supply is that students' learning is impaired and learning outcomes constrained. The long-run adverse impact is that Nigeria's economic growth is affected by lower-than-possible level of human capital development. Further, patient care suffers in the hospitals when the power supply fails, or the voltage is too low to operate medical equipment. Finally, many of these institutions use costly and polluting diesel-based, back-up power generation sets. To avoid these problems, it is important to provide reliable, affordable, and sustainable power to these institutions.

C. PDO-Level Results Indicators

25. The key results (PDO Indicators) expected are as follows:

- People provided with new or improved electricity service (number)
- Households provided with new electricity services, of which female headed households (number)
- MSMEs with new or improved electricity services, of which female headed MSMEs (number)
- Public educational institutions provided with new or improved electricity services (number)

26. The detailed results framework is presented in Section VII.

⁶ e.g., as managers of local mini grid operations, entrepreneur retailers of SHSs, and entrepreneurs that use mini grid electricity to develop new businesses or increase the productivity of their existing businesses.

⁷ Modernizing Energy Services for the Poor: A World Bank Investment Review – Fiscal 2000–2008.



III. PROJECT DESCRIPTION

A. Project Components

27. **Overview.** The project, which is nationwide in scope, promotes technologies and business models that are emerging in Nigeria. Components 1 and 2 are private sector led, and IDA financing will mobilize significant private sector investment. Component 3 is fully funded by IDA for construction of the power systems as well as operation and maintenance for at least five years by private firms. The project aims to provide electricity to households, MSMEs and public educational institutions in a least-cost and timely manner. Most of the project's funds, including Component 4 – Technical Assistance, will be used to establish an enabling environment for private sector involvement by providing financial incentives and technical support as well as strengthening of key institutions and the development of enabling policies and regulations. The remaining project funds will be used to acquire, by competitive tender, supply systems for selected Federal Universities and Teaching Hospitals.

28. **Sustainable framework for electricity access using off-grid solutions will be created.** The project is designed as a 'large-scale proof of concept.' Given the scale of the energy access deficit in Nigeria, this project alone, even including leveraged investments, is too small to fully address the national and sub-national electricity access challenge. At the same time, a larger project would be difficult to implement at this time, given the substantial risks that have been identified (see Section V Key Risks). Hence, the project aims to build a sustainable framework for continued investments for expanding energy access after the project ends. This framework will build on the project's implementation experience, particularly from the results of the project's mid-term review.

29. **Focus on private investment.** The project is premised on a design that involves large-scale investments by the private sector in off-grid supply of electricity. The project aims to catalyze large-scale investments with one-off support through a minimum subsidy tender for mini grid developers and deployment of a challenge fund for individual solar system companies. In parallel, ongoing deployment of performance-based, viability gap grants will be offered to qualified companies for every new client provided with electricity. In addition, technical assistance for strengthening the institutional and regulatory environment will focus on leveraging private sector investment.

30. **Focus on promoting Nigerian firms and local expertise.** Nigerian firms are expected to participate in the project with the aim of building a strong cohort of local companies for sustainable electricity service delivery. Local companies will benefit from technical assistance to enhance their opportunity of participation, provided they meet the eligibility criteria. Engineering faculties of universities or higher institutions will be able to participate in the project including engineering students in new renewable technologies. The planning and installation of new solar hybrid power systems offer a unique opportunity for students to complement their current curriculum through learn-by-doing on-site. Component 3 (Energizing Education) and Component 4 (Technical Assistance) provide these opportunities.

31. **Project components.** The project has four components, all of which will be implemented by the REA:



Component 1. Solar Hybrid Mini Grids for Rural Economic Development (US\$330 million of which IDA US\$150 million equivalent and US\$180 million equivalent from private sector funding).

32. **Objective and targets.** Under this component, the project will support the development of private sector mini grids in unserved and underserved areas that have high economic growth potential. The target is to provide access to electricity to 300,000 households, and 30,000 MSMEs, with an estimated 15 mini grid operators. Based on initial market studies, early activities are expected in Niger, Sokoto, Ogun, Plateau, and Cross River states. This component will be implemented under a market-based private sector led approach to construct, operate, and maintain economically viable mini grids, supported by subsidies that reduce initial capital outlays. There are two investment sub-components that will be implemented in parallel: a minimum subsidy tender; and a performance-based grant program that will target different sets of private developers.

33. **It is expected that about 850 mini grids will be built by private firms.** At least eight companies are already developing mini grids in Nigeria. Large multinational companies that develop mini grid technologies are interested in the minimum subsidy tender. The estimated total investment cost of the component is about US\$330 million, of which US\$150 million will be provided by IDA and the remaining from private firms participating in the project, commercial debt providers, other development partners and the Government.

34. **Market assessment.** Mini grids are not viable in most cases on a purely commercial basis in Nigeria. Most rural customers would not be able to afford the cost-reflective tariffs that mini grid operators would have to charge without some subsidy. Hence, REA will provide a partial, one-off grant to reduce the CAPEX requirement for each mini grid project to enable operators to charge less than cost-reflective tariffs. Mini grid deployment is also constrained by the significant cost of identifying viable sites and then carrying out the necessary financial, business and environment and social impact assessment for prospective sites. REA will address this by providing market intelligence to the potential subsidy bidders and by offering partial grants for pre-investment activities (see Component 1.1).

35. **Component 1.1: Minimum Subsidy Tender for Mini Grids (IDA US\$70 million equivalent).** To initiate implementation, REA will select 250 sites in areas where there is already significant private sector interest. REA will invite private developers to bid for minimum capital cost subsidies according to their business plans to provide electricity to these sites. Given the substantial number of sites and preliminary market analysis, this tender is expected to attract some international private developers to enter the market in Nigeria. Nigeria presents a high-risk, high-return opportunity. In spite of the risks, a number of large international solar developers already have presence in Nigeria, and several mini grid companies are already operating. An indicator of private sector interest is the participation of several hundred private sector participants from around the world in an Energy Sector Management Assistance Program (ESMAP) hosted mini grid conference in Abuja in December 2017⁸.

36. REA is preparing market intelligence for a portfolio of 250 projects in five states based on geo-spatial assessments combined with on-the-ground validation by REA survey teams. The georeferenced database includes 16,000 telecom towers, agricultural loads and rural enterprises that could function as anchor loads. Bid packages will give bidders significant scope to optimize the design, including specifying the tariff, subject to a tariff ceiling; selecting the technology, subject to minimum technical specifications;

⁸ https://www.esmap.org/action_learning_minigrids_abuja_2017



client selection, subject to a minimum population that should be connected; and promotional sales campaigns, subject to a minimum adoption of productive use appliances.

37. For areas of northern Nigeria that private developers consider too risky although they are not conflict areas, REA is considering fully public financed approaches, with private sector participation in constructing and operating of the mini grid. This could be incorporated as a separate tender under this sub-component depending on uptake of the minimum subsidy tender and private sector interest to enter these areas. The assessment of this approach will be completed during the first year of the project.

38. The minimum subsidy tender and the potential public projects are expected to provide electricity to approximately 110,000 new connections.

39. **Component 1.2: Performance-Based Grants Program (IDA US\$80 million equivalent).** REA will use a market-based approach to support eligible companies to deliver electricity services to new clients. REA will provide performance-based grants to mini grid operators on the basis of new customer connections (US\$/end user)⁹. Performance-based grants will be made available to mini grid developers on a rolling basis. Before project funding is exhausted, REA will prepare an exit strategy or plan for continuation through mobilizing of additional resources. It is expected that the performance-based grants will benefit an estimated 580 mini grid sites, about eight companies, and 230,000 new connections.¹⁰

40. The value of the capital grant will be set to ensure both financial viability for the supplier and affordability for the consumer. There is a cohort of private mini grid developers in Nigeria that has already completed initial stages of project development for about a dozen mini grids. These and other developers will be encouraged to submit their business plans incorporating the preset performance grants in their financial projections for their portfolio of mini grid sites in their geographic areas of operations or new locations of their own choosing. Unlike the minimum subsidy tender, which is focused on kick-starting the market by identifying high-potential sites and providing the scale that may be required for larger or international developers to participate, performance-based grants will be available for sites that developers have themselves identified and developed and for which they have sustainable business plans for the deployment of mini grids.

41. **Energy and agriculture nexus, productive uses and collaboration.** The opportunities for productive uses are important for the commercial operation and long-term sustainability of mini grids. Therefore, the proposed project collaborates with World Bank supported agricultural programs, such as the Agro-Processing, Productivity Enhancement and Livelihood Improvement Support Project (P148616) and the Fadama III Project (P096572 and P131075) implemented by FADAMA¹¹, to identify agricultural load centers.

42. **Technical specifications.** The mini grids will be built to Nigeria's grid code standard in order to allow for future integration with the network grids of DISCOs. It is expected that most mini grids will use solar generation with battery storage, and diesel back-up generation; however, other technologies may be proposed by bidders depending on site-specific circumstances. Solar hybrid mini-grids can be rolled out quickly because the physical generation and distribution infrastructure components, as well as the skills to install them, are readily available in Nigeria.

⁹ Initially, US\$350 per connection but this is expected to change during implementation based on results.

¹⁰ Further details are provided in Annex 1

¹¹ FADAMA is an independent organization under the Federal Ministry of Agriculture and Rural Development supporting small farmers.



43. **Legal considerations, regulations, and tariffs.** NERC's mini grid regulations address many of the legal aspects of owning and operating a mini grid (i.e., registration, licensing, asset transfer in the event a DISCO grid is extended to reach a mini grid site, supervision, and audits, among others). The telecom and banking regulations that might come to bear on mini grids have been reviewed with support from Power Africa, and deemed workable for private sector mini grid developers. The RESIP specifies that the tariffs for rural electricity service will be cost-reflective. Tariffs for mini grids larger than 100 kW (and for smaller mini grids electing for a permit) are subject to a ceiling calculated by NERC using a model specifically designed for mini grids. Registered mini grids below 100 kW are free to set their tariffs by agreement with the community.

44. **Readiness and timeline.** REA has completed feasibility level studies of 97 candidate sites, and additional surveys to be completed by July 2018 are planned to prepare a total of 250 sites for inclusion in the minimum subsidy tender. REA will manage the tendering of standardized mini grid projects through an electronic platform to interested companies and financiers.

Component 2. Stand-alone Solar Systems for Homes and MSMEs (US\$305 million equivalent, of which IDA US\$75 million equivalent and US\$230 million from private sector funding).

45. **Objectives and targets.** The goal of this component is to significantly increase the market for stand-alone solar systems in Nigeria in order to provide access to electricity to more than one million Nigerian households and MSMEs at lower cost than their current means of service such as small diesel gensets. In addition, one million single solar lanterns are expected to be distributed during the course of the project. A market-based approach will be followed based on the conditions in Nigeria as well as experience in other countries.

46. **Component 2.1: Market Scale-up Challenge Grants (IDA US\$15 million equivalent).** This catalytic fund will offer performance grants to qualified, large-scale providers to accelerate their sales to households and MSMEs. A rigorous evaluation process and a tranche-based payout will be used to manage any risk of non-performance. The main purpose of this fund is to de-risk private sector investors and help mobilize capital for well-established firms and potential new entrants that are committed to scaling up rapidly.

47. **Component 2.2: Performance-based Grants (IDA US\$60 million equivalent).** This fund will provide grants of up to twenty percent of the costs of the system to the grantees, for each eligible system installed and verified by the private sector. This support will allow the firms to finance the required investment in people, training, advertising, processes, and logistics. It will also enable integration of women into the workforce as well as collect sex-disaggregated management information that is relevant to fulfil the government's commitments on gender. The grant amount will be fixed for each system size/level of service category, and will be progressively reduced over the life of the program as the market grows. The Performance-based grants will place less emphasis than the Market Scale-up Challenge grants on evidence that the applicant has the ability to go to scale but rather on evidence of their ability to successfully service customers using pre-approved solar products. This will enable established companies to access capital for recurrent operational costs.

48. **A detailed assessment will be conducted to determine if additional financing instruments are required including the possibility of establishing a credit line to serve recurring working capital needs of the solar companies.** The assessment will be carried out during the first year of the project in conjunction with Lighting Africa and the World Bank's Finance, Competitiveness and Innovation Global



Practice to ensure the long-term sustainability of any additional funds, implementation arrangements, and appropriate pricing to avoid creating financial sector distortions.¹²

49. **SHS market assessment.** Nigerian SHS sales are currently about 13,000 units per month and the market has 14 active SHS distributors of the Lighting Global quality verified solar products in Nigeria. Though the market is dominated by four firms, there are new entrants, prospective entrants and start-ups with the capability and ambition to increase the market size by orders of magnitude.

50. **The solar some system market in Nigeria currently has two main business models:** (i) cash sales, typically of smaller and cheaper systems, such as solar lanterns and small plug-and-play solar systems (solar kits); and (ii) PAYG models, typically for SHSs (which are larger). These models make the services more affordable for households that cannot pay upfront the relatively large costs of such systems. The component will support scaling up of both models.

51. **Links to other World Bank supported projects.** The proposed project will be coordinated with the proposed Regional Off Grid Electrification Project for West Africa (P160708). Specific design elements of both projects related to enabling environment, product standards and market intelligence will be discussed with the relevant stakeholders. The regional project will not invest IDA funds in Nigeria to avoid overlap with investments in the proposed Nigeria Electrification project. Hence, the proposed project's funds will complement the regional project. The proposed project also builds on the Lighting Africa Nigeria program, in particular the latter's promotion and marketing campaigns and value chain integration.

52. **Technical specification, selection process and quality assurance.** Only products certified by Lighting Global will be eligible under the proposed project¹³. Larger solar systems and their providers will be subject to additional technical pre-qualification, which will be assessed by a technical consultant funded under the project. Additional pre-qualification criteria will include: business integrity, competence in financial administration, legal compliance, technical delivery, warranty and its delivery.

53. **Readiness and timeline.** The key tasks to be completed are: (i) producing the Project Implementation Manual; (ii) bid documents for the challenge fund and request for proposal package for the Grants Administrator; and (iii) organizing a selection committee for evaluation of challenge fund proposals. It is expected that the bid documents will be prepared by July 2018.

Component 3. Energizing Education (US\$105 million equivalent from IDA).

54. **Objective and targets.** The objective is to provide reliable, affordable, and sustainable power to public universities and associated teaching hospitals. The EEP is expected to have far reaching positive economic impacts.

55. **FGN has launched the EEP program and is funding its Phase 1. Phase 2 is proposed to be financed under the project.** The overall scope of FGN's program is 37 Federal Universities and seven associated university Teaching Hospitals across the country¹⁴. It is expected that they will be powered by electricity

¹² Any instrument designed would need to be in alignment with ongoing financial sector policy dialogue and the World Bank's OP 10.00 Financial Intermediary Financing.

¹³ <https://www.lightingglobal.org/quality-assurance-program/our-standards/>

¹⁴ There are 40 Federal Universities in Nigeria. Three of which already have dedicated power systems. This program includes the remaining 37 universities.



generation systems of 1 MW to 11 MW that can operate either isolated from the grid or connected to the grid.

56. **The proposed project will support the installation of dedicated power systems in seven Federal Universities and Teaching Hospitals (Phase 2).** Sites will be selected in each of the six geopolitical zones following the selection criteria as stipulated in the Project Implementation Manual. The component is expected to provide new or improved service to the entire campus communities of the seven institutions, approximately 120,000 people. In order to improve the learning from implementation, the seven universities have been split into two groups. The implementation of Group A, which has at least three universities, will begin after the implementation of Phase 1 is complete. The implementation of Group B will begin after the implementation of Group A universities is complete and recommendations have been derived from the experience. This will make it possible for the lessons of Group A to inform the implementation of Group B universities. For this reason, it is important that there be detailed, rigorous evaluations of the experience of Phase 1, with a view to deriving recommendations for future phases. Other development partners may finance these evaluations.

57. **The investment cost is estimated at US\$105 million equivalent.** This is based on Phase 1 bid prices and the current REA designs. System design and sizing will be refined based on a more detailed assessment of each university campus (see Readiness and timeline below).

58. **Power station.** The universities currently use expensive on-site diesel generators because DISCO's supply is unreliable and of poor quality. Eventually, as DISCOs improve their performance they may be able to supply university campuses with reliable service at a cost that is competitive with or lower than that of the dedicated power station under the project. Thus, the power systems installed in the universities represent interim power until the DISCOs are able to supply adequate and reliable power to the universities. When improved network supply is achieved, universities may either enter into purchase sale agreements with DISCOs for peak period supply of power to the DISCO, using NERC's net metering regulations or find a buyer for the dedicated power station.

59. The program will install dedicated power stations, which will be able to serve campuses independently of the DISCO's systems, with the technical capability to connect to the DISCO's systems when DISCO's provide reliable and affordable power supply to these campuses.

60. The Engineering, Procurement and Construction (EPC) contracts are expected to include installation of a full capacity power station including new backup generation, though some existing university-owned generators (mostly diesel) may be continued to be used. Solar hybrid systems will be preferred, with gas-fired systems as the backup option. The system would feature a modular design with the initial investment sized to serve the current electricity demand.

61. REA has undertaken an initial assessment of the electricity demand, physical aspects, and other factors for each university campus. REA is following this up with extended demand assessments, which will be the basis for the design to be included in the tender documents. These follow-up activities are expected to be completed during the first year of project implementation, after which the tender documents will be completed and the Phase 2 tender launched.

62. **Street lighting.** A street lighting system will be included to improve quality of campus life, particularly safety. This system will be designed in parallel with the power system design.

63. **Training facilities.** Since EEP includes a power system training component with an emphasis on renewable energy, the EPC contract for each university site will include the construction and outfitting of



a training facility. The purpose of this facility will be to provide practical vocational level training in renewable energy and electrical power systems to students to better qualify them for jobs in the off-grid industry. REA will seek inputs from private firms on their employment needs, and coordinate with the National University Commission as well as universities on the curriculum to be offered.

64. **Existing equipment.** REA will review the campus' electricity distribution systems to assess the need for repairs/upgrades. They will also perform a first-level energy audit to identify major energy savings opportunities. Necessary distribution system repairs/upgrades and energy savings opportunities, as well as the prepayment meters will be included under the World Bank-financed program. These may be part of the EPC contract or financed under a separate contract.

65. **EPC and operations and maintenance (O&M) contracts.** The activities related to building and operating the power systems will cover the EPC contract and the O&M contract. Under the EPC contract, the developer is responsible for building the power system, street lighting, and constructing and equipping a training center. Upgrading of the existing campus distribution system may also be included, as needed. The REA will own the systems.

66. The O&M contracts include at least 5 years of operation and maintenance of the generation facilities. O&M contracts will be offered to EPC contractors upon satisfactory work progress, but may also be offered to other companies, since the EPC contract does not bind REA to the EPC contractor for the O&M contract. The sustainability of this arrangement and the viability of alternate arrangements will be examined based on the experience gained under Phase 1. A strategy will be prepared that goes beyond this project, including financing arrangements, for expanding reliable power supply to other public institutions in a sustainable manner.

67. **University's role.** REA will sign an agreement with each university laying out the roles and responsibilities of the parties. Universities will provide: (i) suitable land for the power station (with REA responsible for any resettlement and/or livelihood restoration planning and implementation processes and associated costs in accordance with World Bank safeguards requirements, including a suitable Grievance Redress Mechanism (GRM)); and (ii) access and security for the EPC and O&M contractor. Universities will also be responsible for maintaining the campus electricity distribution system. In view of the fixed capacity of the power station, system usage will require allocation of the available capacity and energy among the various users on campus. For this purpose, prepayment metering systems, financed under the proposed project, will be installed throughout the campuses. Universities will be responsible for operation of the prepayment metering system. Universities will be encouraged to establish an oversight committee with representation from students, faculty, administration, alumnus and other.

68. **Sustainability.** The sustainability of the component depends upon the availability of funds for operation and maintenance of power systems, particularly after the project ends. At present, there are two sources for the needed funds: user fees and FGN funds. Only actual operating experience will demonstrate how reliable these sources are for this purpose. Thus, it will be important to phase implementation of the component so that later phases benefit from the experience of earlier phases particularly with regard to sourcing funds for O&M.

69. **Readiness and timeline.** REA has drafted a detailed timeline to guide preparation and implementation of EEP Phase 2. Completion of the conceptual design and tender package are the key critical path items. One of the most critical activities is monitoring the electricity demand at each university. While this demand assessment is financed under the project preparation advance, the final tender documents for the procurement of the EPC and O&M contractor are expected to be finalized in



the first year of project implementation. An Owner’s Engineer will also be financed under the project preparation advance.

70. **Bid documents and Project Implementation Manual.** Building on the available data about all the 37 sites and Phase 1 experience, Phase 2 will include: (i) more detailed design and engineering specifications, based on a more thorough demand assessment; (ii) strong emphasis on solar hybrid systems, including for sites initially earmarked by REA for gas-fired generation; (iii) emphasis on both supply and demand-side energy efficiency; (iv) a more comprehensive agreement on roles and responsibilities among the parties (Universities, REA, contractors); and (v) full compliance with World Bank procurement procedures and environment and social (E&S) risk management.

Component 4. Technical Assistance (US\$25 million equivalent, of which US\$20 million equivalent from IDA and US\$5 million equivalent from counterpart funding).

71. This component is designed to build a framework for rural electrification upscaling, support project implementation as well as broad capacity building in REA, NERC, FMPWH and other relevant stakeholders. It will support various activities, including but not limited to:¹⁵

- (a) strengthening implementation capacities of REA, NERC, FMPWH, and relevant project stakeholders, such as, mini grid developers, solar firms, universities and local financial institutions, in E&S safeguards as well as other aspects of project implementation;
- (b) development of strategies and studies, including the development of an electrification strategy, development of a least-cost mini grid and off-grid market assessment and plan; and energy demand studies;
- (c) technical assistance to assess complementary financing instruments such as debt financing through carrying out studies to determine access to finance constraints for development of mini-grids and SHSs as well as developing options and plans to mitigate such constraints;
- (d) improving the regulatory framework through supporting possible amendments to NERC’s regulations for mini grids based on experience with implementation;
- (e) supporting mini grid pre-investment activities, including *inter alia*, geospatial scoping studies, (pre)feasibility studies, business plans, and safeguards assessments;
- (f) carrying out studies to support stand-alone solar systems;
- (g) managing E&S safeguards for the project, including citizen engagement and developing strategic solutions for E&S risk management for the off-grid solar systems; and
- (h) supporting the mapping of supply chain for mini grid industries in Nigeria.

B. Project Cost and Financing

Table 3. Project Cost and Financing

Project Components	Project cost (US\$ million)	IDA Financing (US\$ million)	Counterpart Funding (US\$ million)
1. Solar Hybrid Mini Grids for Rural Economic Development	330	150	180*

¹⁵ Detailed descriptions are provided in Annex 1 as well as the Project Implementation Manual



Project Components	Project cost (US\$ million)	IDA Financing (US\$ million)	Counterpart Funding (US\$ million)
2. Stand-alone Solar Systems for Homes and Enterprises	305	75	230*
3. Energizing Education	105	105	-
4. Technical Assistance	25	20	5
Total	765	350	415

Note: * is private sector funding

C. Lessons Learned and Reflected in the Project Design

72. The project takes account of lessons from relevant World Bank and other projects in sub-Saharan Africa and elsewhere. The key lessons are that successful projects have: (i) pursued solutions at a range of service tiers; (ii) promoted private sector investment; and (iii) incorporated new developments in technology and business models. The proposed project has incorporated these findings (see Table 4).

Table 4. Lessons Learned and Incorporated¹⁶

Lessons Learned	Reflected in Design
Component 1 Solar Hybrid Mini grids	
Deploy where most cost-effective and timely solution.	Grid-compatible mini grids will be built where: (i) the main grid will not reach in a timely manner, with provisions for merging with the main grid; and (ii) stand-alone solar systems do not meet the energy needs in a cost-effective manner.
Tariffs should be affordable.	NERC has regulations for tariffs that the developers will comply with. Subsidies will be provided to developers to make their projects financially viable and affordable by consumers.
Developing mini grids one at a time is not financially optimal.	Project design allows developers to develop several sites in a bundle.
Integrate productive uses in design.	Project is coordinated with other World Bank projects to emphasize demands from irrigation and agriculture among others
Prepare for situation when the main grid arrives.	NERC regulations offer financial and technical options to mini grid developers.
Eliminate lengthy, confusing, and ineffective E&S risk management processes by delegating responsibility to developers in a structured way.	Mini grid developers are required to prepare and implement an Environmental and Social Management System (ESMS) to ensure efficient E&S risk management with oversight and monitoring by the implementing agency and independent.

¹⁶ Further elaboration is provided in Annex 1



Lessons Learned	Reflected in Design
Component 2 Stand-alone Solar Systems	
High quality products are important for sustainability	Only technically certified systems will be supported: Lighting Africa standards where available (will cover most systems) and special standards where they are not available.
Adopt a market-based approach	Project is fully compliant. All systems will be sold by private firms.
Access to working capital is important for sustainability	Grants will be instrumental in developing the market in the early stages, but access to working capital in form of debt financing is important for company growth and long-term sustainability. A solution will be explored during the first year of the project.
Support a variety of business models	Project design will allow for supporting a variety of business models such as cash sales and PAYG
Component 3 Energizing Education	
Balanced technological design between operating cost and operating revenue	Project favors solar-hybrid systems to keep operating costs low to reduce recurrent cost burdens.
Include capacity building of implementing agency, contractors and operators for complex projects	Included in Technical Assistance.
Incorporate finance for O&M	O&M will be financed under the project.

IV. IMPLEMENTATION

A. Institutional and Implementation Arrangements

73. **Project implementation arrangements.** REA will be the Implementing Agency for all components of the project. REA was established in 2005 as a semi-autonomous organization under the FMPWH. The proposed project will be the first World Bank supported project implemented by REA. REA has obtained a project preparation advance to prepare the project. REA has created a Project Management Unit (PMU) to manage the implementation of the project, which will be financed through Component 4 (Technical Assistance).

74. REA has recruited the following staff for the PMU: manager; procurement specialist; commercial/financial management specialist; environmental specialist; social specialist; and an engineer with expertise in solar systems. Federal Project Financial Management Division (FPFMD) has posted a project accountant to the project. The PMU will hire additional staff and technical experts on a needs basis to ensure sufficient capacity for implementation of the project.

75. REA will enhance the capacity of its workforce as well as that of the PMU so that it is fit for purpose, i.e., to have the skills to plan and implement a nationwide, private sector led, mini grid and off-grid electrification program to international standards. This includes: exposure to similar electrification



programs in other countries; twinning with contracted specialised companies and their staff during project implementation (for example grant manager and transaction advisor); as well as training at the World Bank in operational procedures. Funding is also set aside for hiring staff with a track-record of implementing high quality mini grid and off-grid programs.

76. REA's responsibilities will include but not be limited to the following: (a) defining the project areas based on technical and policy development priorities; (b) resolving challenges requiring high-level intervention facing the project; (c) monitoring the implementation of the project; (d) consolidating information on progress of implementation and results reporting; and (e) oversight and monitoring of E&S risk management arrangements for the project.

77. REA responsibilities, including annual coordination meetings with key government agencies and ministries, are further detailed in the Project Implementation Manual. For Component 2, REA will procure through international tender a Grants Administrator. For Component 3, REA will retain an Owner's Engineer to assist REA in all aspects of final site selection, design, procurement, construction oversight, and commissioning.

78. **Project Implementation Manual for Component 1 and 2.** REA has drafted the Project Implementation Manual covering Components 1 and 2, and conducted public consultations with key stakeholders. The section on mini grids of the Project Implementation Manual (Part 1) includes eligibility criteria for qualification of mini-grid project developers, application and evaluation procedures, verification protocols for disbursement, as well as model contract agreements between REA and the participating companies. The Manual also specifies the institutional arrangements for the component, along with E&S safeguards requirements and monitoring and evaluation (M&E) arrangements. The section on solar systems (Part 2) includes eligibility requirements for prequalification of companies for support under the program, quality certification requirements for products, thresholds for the various level of support based on system size and other criteria and verification mechanism. The award of mini grid grants will require a selection committee for proposal evaluation, as stipulated in the Project Implementation Manual. For the solar component, a Grants Administrator will be appointed (see below). The Project Implementation Manual is expected to be adopted by July 2018, and updated regularly.

79. **Implementation arrangements for Component 2.** REA will engage a firm as Grants Administrator. External expertise and delivery mechanism is needed since the design demands the evaluating entity possess: (i) deep technical, financial and commercial expertise in evaluating and appraising larger and often internationally operating solar businesses; (ii) financial and organizational systems that are aligned with the need for timely feedback on operational/administrational issues as well as just-in-time financial disbursements considering the dynamic cash flow nature of the commercial solar sector; and (iii) regular communication and socialization of the support with private sector companies to attract additional market entrants and build trust on support of the public sector to the private sector.

80. **Implementation arrangements for Component 3.** REA is leading the design, installation, operation, and maintenance of the EEP power systems for Phase 1. For Phase 2, REA will contract with competitively selected EPC contractors to build, operate and maintain the power plants at each site, and also build and equip the training center and street lights. The procurement will allow bidders to bid on several sites. Each bidder will also be considered for a five-year O&M contract for the power station (see below). On behalf of FGN, REA will own the installed equipment and oversee construction. O&M expenses of the power stations will be financed by the project for five years. Arrangements for post-project finance



of these expenses, including the option of universities bearing these costs will be finalized during project implementation.

81. When a DISCO is eventually able to provide reliable and affordable service to a university, REA or the universities may either enter into purchase sale agreements with DISCOs for peak period supply of power to the DISCO, using NERC's net metering regulations or find a buyer for the dedicated power station.

B. Results Monitoring and Evaluation

82. REA will monitor all component activities and send progress reports to the World Bank in a form and substance satisfactory to the World Bank. As needed, to review progress and address issues that may arise, REA will convene meetings with relevant stakeholders, including NERC, private sector mini grid developers and stand-alone system providers, universities, and EPC and O&M contractors. Monitoring of results and outcomes, in accordance with the project results framework (Section VII), will be reported in the project progress reports. REA will hire a firm for data collection and processing, integration of MTF data and findings, and coordination with the private sector. Participating companies will have their own E&S management systems in line with the specifications set in the Project Implementation Manual.

83. The project outcomes will be assessed through MTF-surveys before (for baseline), during, and after project implementation. The baseline analysis will be based on the MTF survey results to capture the current levels of electricity service. The results are scheduled to become available by August 2018. The World Bank will supervise the project over its lifetime and monitor its results and outcomes on a regular basis to evaluate the achievement of the PDO and implementation performance.

84. A mid-term review will be conducted within two years after the start of project implementation. The mid-term review will provide the opportunity to thoroughly assess overall project performance in achieving the development objectives and ensure that lessons learned thus far are considered in implementation over the remaining period. Adjustments, including funding reallocation and implementation arrangement changes, and wider restructuring to build on the approaches that work best will be discussed, agreed, and implemented as necessary.

C. Sustainability

85. The design of the project around a market based approach aiming to have commercial services providers meet the energy need in peri-urban and rural areas is to allow for continued growth after the project ends and for overall sustainability. Through the investments under the project, the institutional, financial and regulatory experience and systems should allow the private sector to continue to grow after the project ends. The project will also provide technical assistance to key institutions (for example REA, NERC, Federal Ministry of Environment, FMPWH, States, banks). With the expansion of electricity in more remote rural areas, additional viability gap financing will be needed after this project closes. At the same time, it is important that subsidy levels reduce over time. These funds could possibly be provided through follow-on projects and/or other funding mechanisms. Technical assistance under the project will look into these options.

86. The financial sustainability of mini grids will be supported through capital cost grants and results-based financing. Technical sustainability will be supported by the continued availability of appropriately trained local technicians and operators for maintenance, as well as remote control and monitoring



systems and after-sales service plans. Mini grid developers will have flexibility in setting cost recovering tariffs (subject to a ceiling) and selecting the appropriate generation, distribution, and metering technologies (subject to minimum standards). Beyond the grant support, and to ensure long-term sustainability, the project will assess the inclusion of a credit line for recurring working capital needs of the companies.

87. The proposed project has been designed to support the sustainability of the solar system market by focusing on business models and financing mechanisms that enable the financial and private sector to take informed risks, while providing after-sales service and warranties for the solar systems. The proposed grants will balance affordability for the end users, maintaining an appropriate level of service, and maintaining a competitive marketplace. Emphasis will be placed on ensuring high quality of systems and services. Financing will be provided only to companies selling products in compliance with quality standards of systems, as well as appropriate product guarantees and aftersales service.

88. The sustainability of the Energizing Education component hinges on selecting appropriate EPC and O&M contractors, successful construction and long-term operation of the power plants and training centres at the universities. During project implementation, options for financial sustainability will be worked out, this could include: i) having the universities gradually take over O&M costs; ii) transferring assets to universities or DISCOs; or (ii) leasing these systems to private sector. Substantial technical assistance during each of these activities will help ensure that they are carried out effectively. In particular, the World Bank's expertise in capacity building, involvement of the private sector, procurement and project management will be leveraged to ensure the sustainability of this component.

D. Role of Partners

89. The proposed project is part of FGN's strategy to increase access to electricity in rural areas. Other donors have already supported mini grid developers in Nigeria through the initial stages of project development and piloting by existing programs with either grants and technical assistance (German Development Agency [GIZ -*Deutsche Gesellschaft für Internationale Zusammenarbeit*] Nigerian Energy Support Programme [NESP]), US Trade and Development Agency [USTDA], or concessional credit (United Nations Development Programme [UNDP]/Bank of Industry [BoI]). For the stand-alone solar systems component (Component 2), adoption of Lighting Global standards for solar products in Nigeria is currently being coordinated with Lighting Africa, and the Standards Organization of Nigeria and Economic Community of West African States (ECOWAS) (see Annex 5).

90. In addition, a number of complementary financing efforts exist through commercial and concessional debt and equity for solar providers from a variety of entities, including AllOn, African Development Bank (AfDB), BoI, Shell Foundation, and Solar Nigeria, among others.

V. KEY RISKS

A. Overall Risk Rating and Explanation of Key Risks

91. **Overall, the project risk rating is substantial.**

92. **Political, governance and macroeconomic** (*substantial*). Nigeria has only recently begun to recover from the economic slowdown and income losses that followed the collapse in international oil prices in late 2014. In addition, the security situation in parts of northern Nigeria remains complex.



Escalating security concerns would have a negative impact on foreign investment. The run up to the Elections in February 2019 will bring uncertainty of availability of key government officials. The outcome of the elections might change the leadership team overseeing the recent electrification efforts. *Mitigation:* Move quickly to show results on the ground, particularly in mini grids and stand-alone systems, so that the project has backing from public opinion and there are credible, replicable models that investors can see as providing returns commensurate with the risk. Further, strengthen REA quickly so that it is seen as a credible, non-political institution that can increase electricity access, which would make it less vulnerable to political shifts. Finally, work with other development partners, so that the projects are mutually reinforcing.

93. **Sector strategies and policies risk (substantial).** Overall, power sector strategies, policies and regulations in the case of off-grid electricity supply are adequate and, in many cases, consistent with international good practices. However, sector performance has been unsatisfactory, largely due to inconsistent enforcement of the existing strategies, policies and regulations. *Mitigation:* These risks will be mitigated through the comprehensive measures included in the government's PSRP to reset the power sector for sustainable operation.

94. **Technical and Business Model designs (substantial).** Private investment may be deterred by three types of perceived risks: financial, regulatory, and issues with REA's operational procedures. *Mitigation:* A transaction advisor is being recruited who will engage with the private sector and address their risk perceptions as much as possible, before the minimum subsidy tender for the mini grid component and the challenge grant initiative for the solar individual systems are launched. Furthermore, these risks will be mitigated through project implementation support, and adjustments as dictated by experience gained in the first few years of implementation.

95. There is a risk related to what happens when the DISCO grid networks are extended to reach areas served by a mini grid or stand-alone solar systems. *Mitigation:* To mitigate this risk, NERC has defined options for mini grid developers under the mini grid regulations. It is expected that they will enable mini grid developers to be appropriately compensated for their investment or to continue to earn revenue from their investment. For stand-alone solar system companies, the extension of the grid may pose a risk if customers are still amortizing their systems when the grid arrives. *Mitigation:* It is expected that companies will account for this risk as appropriate in their business models including the adoption of a payback scheme.

96. Additional *Component 1* risks related to limited demand for electricity will be mitigated by selecting areas with high potential for productive uses and actively promoting these uses during implementation. Risks related to dissatisfaction with mini grid service and tariffs will be mitigated through both sensitizing campaigns carried out by mini grid developers at the community level and a formal complaint mechanism established by NERC (developers will also establish their own complains / grievance mechanism as part of their internal Environmental and Social Management Systems (ESMS)). Finally, customer non-payment risks will be mitigated through use of prepaid metering.

97. Additional *Component 2* risks related to market spoilage from low-quality products will be mitigated through both marketing campaigns carried out by companies and project support for only those products who have been certified as high quality. Product companies are expected to address affordability risks through suitable business models.

98. For *Component 3*, risks related to near-term sourcing of operational and maintenance costs are addressed as the project will fund these costs. The strategy for longer term coverage of these costs



depends on the progress of sectoral reforms (see Annex 1). The risk of poor technical performance will be mitigated by using proven technologies that have been implemented at a smaller scale. Procurement risks will be mitigated through the use of Restricted International Competitive Bidding rather than Open Tendering. The risk of stranded assets (when a DISCO extends its network to provide reliable and affordable supply to a university or teaching hospital) obviating the need for dedicated university power systems will be mitigated either by: i) maintaining the system for backup; ii) conversion of the system to an IPP; or iii) relocating the system to another area of need. The risk of universities poorly managing the power produced will be mitigated by requiring universities to prepare viable management plans along with close oversight by REA.

99. **Institutional capacity for implementation** (*substantial*). REA's PMU has little experience implementing World Bank projects. REA has hired additional staff in the PMU, and is procuring a transaction advisor, Owner's Engineer and Grants Administrator under the project preparation advance.

100. For *Component 1*, NERC has approved regulations for mini grids and is accepting applications. NERC will need to update its regulations based on lessons learned and consultations with key stakeholders during implementation. NERC will require technical support for this updating. NERC is also in the process of establishing a mini grid cell to allow for smooth processing of applications.

101. For *Component 2*, the institutional risk relates primarily to political interference with market-based approaches that require robust frameworks but light direct involvement of the Government. This risk will be mitigated by initially working with a Grant Administrator, and, in parallel, building capacity and understanding within the REA.

102. For *Component 3*, the Federal Universities will require substantial support to be able to integrate and manage both a new power supply system and a training centre for students. Hence, selection of institutions for Phase 2 will include a capacity assessment that demonstrates both ownership of the program as well as adequate human and administrative capacity. Additional support in the form of capacity building, advisory services, etc. will be provided as needed.

103. **Fiduciary** (*substantial*). The primary fiduciary risks stem from the Minimum Subsidy Tender for mini grids, and the EEP, though stand-alone solar systems also involve a degree of fiduciary risk. To date the amount of debt made available for companies venturing into underserved areas has been very limited, and REA has scant experience with international competitive procurement. As a result, a relatively steep learning curve is expected for both REA and local commercial banks, and fiduciary risks will be mitigated by staffing REA with competent procurement specialists and providing ongoing training, and supporting capacity building with local commercial lenders.

104. **Environmental and social** (*substantial*). Key E&S risks are limited and their magnitude is mostly proportionate to the small size of subprojects. However, these risks are systemic, and are expected to manifest themselves in all components. The most important are safe disposal/recycling of used batteries (both lead-acid and lithium ion) and land acquisition/land use changes (with the exception of Component 2 where this is not expected). Additionally, for Components 1 and 3, stress on local water use and supply, construction impacts and waste management (in addition to batteries) can become systemic risks. Community engagement has been identified as critical for project sustainability.

105. While risks at the level of individual subprojects are limited, if certain key risks are not properly addressed by REA through putting in place and efficiently executing E&S risk management processes tailored to the specific design of each project component, the resulting risk level can be substantial. This



includes the supervision of the ESMS to be implemented by the private sector. Even though E&S risks are concentrated around a small number of key technical issues, the project design requires REA to define specific risk management mechanisms and to integrate these into each component's operational workflows. As REA has limited experience and capacity in this regard, adopting an E&S management framework, strengthening REA's capacity for oversight and monitoring, and building systems and capacity of all key project stakeholders that will assume substantial responsibility with regard to ESMS (mini grid developers, SHS companies, EPC contractors, universities) will be critical to sound environmental management.

106. Not every community without electricity will benefit from the project. There is a risk that communities not benefitting from the project might obstruct project implementation. *Mitigation:* The design of the proposed project is informed by wide consultations with various government agencies, development partners, the private sector, universities and university teaching hospitals, and beneficiaries. Furthermore, the Project Implementation Manual is transparent on the requirements, procedures, and processes for accessing project funds, as well as various stakeholders' roles and responsibilities.

107. Environmental screening considered the various locations and the types of infrastructure to be constructed under the project that may be vulnerable to various climatic hazards. The screening has confirmed that the project is exposed to these hazards. Nigeria is vulnerable to extremes of temperature, flooding and drought and high winds. Risks will be addressed through proper design, operation, and maintenance of the infrastructure assets.

VI. APPRAISAL SUMMARY

A. Economic and Financial Analysis

108. **The project will produce economic benefits to existing and new electricity customers through the provision of new or improved service.** This service will be made available through the proposed investments in mini grids, stand-alone solar systems, and power stations for universities and hospitals. A full discussion of the economic and financial analysis is given in Annex 3.

109. **Investment costs were derived from estimates provided by private project developers.** The analysis accounted for factors such as: the cost and availability of generation resources, cost of distribution network, and operating costs including maintenance and economic cost of fuel where applicable, as well as cost of imports, operation of retail networks, marketing, and warehousing (for the stand-alone systems).

110. **Economic benefits include those deriving from avoided economic costs of kerosene, gasoline, dry cell batteries, and diesel, where applicable.** The benefits are based on existing usage patterns of households, MSMEs, and Federal Universities. Additional benefits that have not been captured in the analysis include enhanced quality of energy services for households and MSMEs, such as reliability. Other potential benefits that the project could induce, that are not quantified for the economic analysis, include environmental benefits resulting from reduced kerosene use as well as gasoline or diesel-based self-generation.

111. **An economic analysis based on avoided costs has been carried out to assess the economic viability of the project.** The economic internal rate of return (EIRR) and net present value (NPV) of the

project are calculated using a standard cost-benefit methodology. The economic evaluation is confined to the project activities for which an economic value can be clearly identified and measured.

112. **The economic analysis shows that the project is economically viable even without any consideration of environmental externalities.** The baseline NPV of the proposed project is US\$749 million (at 5 percent discount rate¹⁷) with an economic return of 25 percent (see Table 5).

Table 5. Project EIRR and Composition of NPV

EIRR (excl. CO ₂)	%	25
EIRR (incl. CO ₂)	%	34
NPV (excl. CO ₂)	US\$ million	749
NPV (incl. CO ₂)	US\$ million	989

Table 6. Summary of NPV and EIRR by component (excl. CO₂)

	NPV (US\$ million)	EIRR
Mini Grids	590	26.8%
Stand-Alone Solar Systems	82	46.9%
Energizing Education	76	12.9%

113. **A sensitivity analysis in the form of switching values such as increasing costs and decreasing benefits at various levels has been performed to test the robustness of the economic results to changes in overall costs and benefits.** The results (Table 7) show that the project remains economically viable as long as the total costs do not increase by more than 70 percent. A sensitivity analysis on individual components was also performed to indicate thresholds for each component to remain economically viable (Table 8).

Table 7. Sensitivity Analysis (excl. CO₂)

	NPV (000 US\$)	EIRR
Base Case	749,754	25.0%
Costs Increase 5%	697,438	22.8%
Costs Increase 15%	426,626	18.9%
Benefits Decrease 5%	659,950	22.7%
Benefits Decrease 15%	480,343	18.0%
Costs Increase and Benefits Decrease 15%	323,394	12.8%
Costs increase 70% (EIRR = discount rate)	-	5%

Table 8. Thresholds for economic viability by Component

Component	EIRR = Discount Rate (5%)
Mini Grids	Costs 50% higher than current costs
Stand-Alone Solar Systems	Costs 35% higher than current costs
Energizing Education	Annual demand 30% lower than current demand or costs double

¹⁷ Discount rate applied as per WBG technical guidance note on discount rates



114. **Greenhouse gas (GHG) accounting has been carried out for the project**, which will result in significant GHG emission avoidance by replacing usage of kerosene, gasoline and diesel in households and institutions. Most project activities will not directly emit GHG due to the use of solar technologies, except for mini grids that will be partially fueled by diesel, as well as potentially two gas-fired power stations at universities. For systems such as mini grids, household SHS, community SHS, and hybrid renewable power stations at universities, GHG emissions over 20 years have been analysed. Total baseline emissions are estimated to be 11,510,511 tCO₂, with total gross emission of 1,775,471 tCO₂, whereas the project’s net emissions total -9,735,040 tCO₂.

115. **Financial analysis.** Mini grids are not viable in most cases on a purely commercial basis in Nigeria. Most rural customers would not be able to afford the cost-reflective tariffs that mini grid operators would have to charge. Hence, REA will provide partial grant funding to reduce the CAPEX requirement for mini grid projects to enable operators to charge less than cost-reflective tariffs. Mini grid deployment is also constrained by the significant cost of prospecting for viable sites and carrying out the necessary financial, business and E&S-safeguards due diligence for each of the prioritized sites. The financial modeling was done separately for a 100 kW solar-battery-diesel-generator Mini Grid and a SHS portfolio of 1,000,000 units. The project has the following financial returns in the base case.

Table 9. Financial NPV for Base Case.

	NPV @ 10% discount rate (US\$)¹⁸
Mini Grids	
NPV no debt or grants	(21,000)
NPV with grants	173,000
NPV with grants and debts	202,000
SHS portfolio	
NPV of SHS 1 Million portfolio no debt, no grant	(1,290,815)
NPV with grant	20,307,143
NPV with grant and debt	12,650,645

116. For the mini grid component, a separate analysis was conducted to understand the expected reduction in end user tariffs by providing grants. The results show that without grants and a rate of return on equity of 25 percent, the retail tariff is 77 USc/kWh; with a US\$500 grant per connection this reduces to 51 USc/kWh and with a US\$750 grant per connection the retail tariff is 38 USc/kWh. With a return on equity of 15 percent, the retail tariff is 62 USc/kWh without grant; 42 USc/kWh with a US\$500 grant per connection and 32 USc/kWh with a US\$750 grant per connection.

117. **Sensitivity analysis.** The project returns are sensitive to tariffs and CAPEX. The following switching value analyses were done. The returns for no grants or no debt scenario is given in Table 10 below.

¹⁸ World Bank team estimate based on cost of capital of private firms



Table 10. Switching Values for Financial Returns for No Grants and No Debt Scenario

Key Model input	Equity FIRR @ 10%	Equity FIRR @ 15%
Mini Grids		
Residential Tariff	57 USc/kWh	67 USc/kWh
Commercial Tariff	3 USc/kWh	25 USc/kWh
CAPEX	US\$6,300/kW	US\$7,100/kW
SHS portfolio of 1 Million		
Retail price of SHS	30% higher	
Sales volume over 5 years	500,000	

118. **Rationale for public sector provision/financing.** Achieving universal electrification by 2030 requires substantial public resources to buy down the cost of electricity service from mini grids and stand-alone systems, which typically serve poorer people. Public financing of this project is necessary not only to expand energy access to rural areas, but also to facilitate private investment in mini grids and stand-alone systems.

119. Public resources are thus necessary to crowd in private sector investment from companies currently active in Nigeria and provide further incentives for new market entrants considering expanding into Nigeria. Public resources are also essential for removing some other barriers (e.g. lack of market intelligence) to doing business that have prevented the private sector from entering Nigeria, even though it is one of the largest markets in Africa.

120. **Value added of the World Bank’s support.** The World Bank, with its ability to help design a customized electrification program drawing on decades of global experience and to harness recent technological advancements to provide reliable, affordable, and sustainable energy services to consumers in underserved countries, is well placed to assist Nigeria in designing and implementing this mini grid and off-grid energy access program. The proposed project presents a significant opportunity to bring modern energy services to large numbers of people nationwide in absence of the grid’s capability of fulfilling the same in the near to medium term.

B. Technical

121. The project will maintain high technical standards for equipment in all three components. High quality products and equipment already exist in Nigeria, as do competent developers and product companies, so ensuring that high technical standards are maintained is not foreseen as difficult.

122. The mini grids will be built to Nigeria’s grid code standard in order to allow for future integration with DISCOs when they reach a mini grid site, as specified in the NERC regulations for mini grids. It is expected that most mini grids will use solar generation with battery storage, and diesel back-up generation. Other renewable technologies will be considered on a case by case basis. The mini grids will be required to have (i) prepayment meters to mitigate revenue collection risk; (ii) smart meters to enable better understanding of consumer behavior; and (iii) energy efficient appliances.

123. Under Component 2, the project sets a service floor of Tier 1, equivalent to a pico-solar system with sufficient capacity to provide 1,000 lumen-hours of light and cell phone charging abilities. Therefore, at least this level of service is ensured for all beneficiaries



C. Financial Management

124. **The FM risk for this financing is assessed as *Substantial*.**

125. An FM assessment was carried out to determine whether FGN stakeholders responsible for receiving and disbursing funds are capable of ensuring that (i) funds channeled into the project will be used for the purposes intended in an efficient and economical manner; (ii) the project's financial reports will be prepared accurately, reliably, and on time; and (iii) the project's assets will be safeguarded.

126. The FM assessment was carried out in accordance with the World Bank Directive: FM Manual for World Bank IPF Operations issued on February 4, 2015, and effective from March 1, 2010, and the World Bank Guidance: FM in World Bank IPF Operations issued on and effective from February 24, 2015. The assessment covered the six key FM elements of budgeting, accounting, and internal control including internal auditing, in addition to funds flow, financial reporting, and external auditing arrangements.

127. The responsibility for establishing and maintaining acceptable FM arrangements for the project will be with FPFMD at the Office of Accountant General of the FGN. The Federal Treasury Circular of March 2010 established the FPFMD in the Office of the Accountant General for the Federation (OAGF) to handle the FM responsibilities for funds provided by Donor Partners.

128. The FPFMD is a multi-donor and multi-project FM platform, established at the federal level through the joint efforts of the World Bank and the Government. This platform features robust systems and controls. The FPFMD is presently involved in the implementation of several World Bank-assisted projects. The World Bank's recent review showed that this unit has been performing satisfactorily.

129. To strengthen the FM system in the FPFMD, implementation of some action plans is required as follows. FPFMD will designate from the pool of professional accountants in the Office of Accountant General a project accountant, project internal auditor, and other support accounting technicians that will make for appropriate segregation of duties. The FPFMD will render annual audited financial statements and periodic unaudited interim financial reports (IFR) in the format and frequency that will be agreed, submitting them to the World Bank within agreed timelines. The Government Integrated Financial Management Information System (GIFMIS) will be used and shall be configured in line with the formats of the IFR and the annual financial statements. The project bank account at the Federal level will be opened with the CBN.

D. Procurement

130. REA, through its PMU, will be responsible for procurement in the proposed project. REA has a procurement unit headed by a director who reports to the Managing Director of the Agency. There are eight other procurement officers, four of whom had undergone a two-week procurement training course organized by Bureau of Public Procurement.

131. The procurement in the agency is based on the 2007 Procurement Act of Nigeria. The agency does not have experience in the implementation of World Bank funded projects. The proficiency level of the procurement officers in using the national procurement procedure is assessed as ***Average***.

132. To address the lack of capacity in the implementation of World Bank funded projects, the agency has employed a procurement specialist within the PMU with wide experience in implementing procurement under the World Bank's former Procurement Guidelines.



133. At present, the procurement files and documents management system is not adequate and will require some improvement, particularly to improve REA’s ability to manage procurement of a large number of infrastructure projects, and on the development of bid/auction documents and processes.

134. **Applicable procurement regulations.** Procurement under the project, including the project preparation advance, will be in accordance with the World Bank Procurement Framework as specified in the World Bank’s “Procurement Regulations for IPF Borrowers- Procurement in Investment Projects Financing”, July 2016, revised November 2017; and the Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants (revised as of July 1, 2016). In accordance with Paragraph 5.9 of the “World Bank Procurement Regulations for IPF Borrowers” (July 2016, revised November 2017) (“Procurement Regulations”), the World Bank’s Systematic Tracking and Exchanges in Procurement (STEP) system will be used to prepare, clear and update Procurement Plans and conduct all procurement transactions for the project.

135. A Project Preparation Strategy for Development (PPSD) was prepared. It indicates that the economy is growing gradually since its exit from recession in 2017 and that exchange rates have generally stabilized and the legal and regulatory frameworks have improved in recent years, thus making the environment suitable for private investment. The market analysis shows that there are eight (8) identified Mini Grid Developers and about 14 active SHS-distributors of the Lighting Global quality verified solar lanterns/home systems in Nigeria. Major equipment required for deployment of the mini-grids will be sourced from outside Nigeria. Foreign exchange rate risks are not envisaged due to the relative stability in the market. The PPSD recommends procurement approaches for each component with main packages having open international tender with prior review. For the mini grid minimum subsidy tender initial selection/RFP (simplified) method is recommended. For EEP request for bids (RFB/SPD) method and for consultancies, CQS, QCBS, IND and CDS methods are recommended. The PPSD also indicates that there is no significant professional gap identified, but capacity strengthening through external assistance and training programs may be necessary to further strengthen the capacity as the program expands.

Procurement of Goods and Works and Non-Consulting Services Prior Review Threshold

136. The World Bank’s Standard Procurement Documents shall be used for all contracts subject to international competitive procurement and those contracts as specified in the Procurement Plan tables in STEP.

Table 11. Procurement Methods of Goods and Works and Non-Consulting Services, and Prior Review Thresholds

	Procurement Method	Method Threshold US\$	Prior Review Threshold
1.	ICB (Goods and Non-consulting services)	Above 5,000,000	All
2.	NCB (Goods, information technology and Non-Consulting Services)	Below 5,000,000	1,000,000 and above
3	ICB (Works; including turnkey, supply & installation of plant, and PPP)	Above 20,000,000	All
4.	NCB (Works; including turnkey, supply & installation of plant, and PPP)	Below 20,000,000	10,000,000 and above
5.	Shopping (Goods)	Up to 100,000	None
6.	Shopping (motor vehicles) Quotation from 1st line distributors	Up to 500,000	None
7.	Shopping (Works)	Up to 200,000	None



Table 12. Selection of Consultants Prior Review Threshold

	Selection Method	Prior Review Threshold (US\$)
1.	Competitive Methods (Firms)	500,000
2.	Direct Selection (Firms)	All
3.	Individual	200,000

137. **Approaching the national market.** As agreed in the project preparation advance Procurement Plan, national selection through advertisement in the national media/press may be used when the nature, scope and/or value of the Consulting Services is unlikely to attract foreign competition and there are adequate qualified national Consultants to carry out the assignments. If international Consultants wish to participate in national selection, they may do so. When approaching the national market, the country's own procurement procedures may be used as specified in Paragraphs 5.3 to 5.6 of the Procurement Regulations.

138. **The Procurement risk rating of the Agency is High.** This is because the procurement officers and the procurement consultant in the Agency are not familiar with the World Bank's Procurement Regulations for IPF Borrowers.

139. A detailed Procurement Risk Assessment and Mitigation Action Plan is prepared by REA.

E. Environmental and social (including Safeguards)

140. **E&S risk rating for the project is Substantial.** The proposed project is classified as Environmental Assessment Category B (partial assessment), as E&S risks at the level of individual subprojects are limited in number and magnitude. Land acquisition that may result in involuntary resettlement/economic displacement (including potential issues with voluntary land donation (VLD) practices) and waste management (in particular, used batteries) are the two major risks identified across a large number of small subprojects developed and managed by the private sector. Stakeholder engagement will be key to project's success.

141. **Locations of specific physical infrastructure for the Energizing Education component will not be known before World Bank Board approval.**¹⁹ The locations for the other components are based on market demand, however market intelligence will be provided to reduce the initial overhead to the private sector. In order to ensure sound E&S risk management of the project in line with the national regulations and World Bank Safeguard policies, REA has developed an Environmental and Social Management Framework (ESMF). The ESMF clarifies the roles and responsibilities of REA, private sector mini grid developers and operators, SHS companies and contractors for the university power systems component. A Resettlement Policy Framework (RPF) has also been prepared as a practical tool to guide the preparation of Resettlement Action Plans (RAPs) for subprojects during the implementation, where needed. The ESMF will serve as a basis for integration of E&S risk management into REA's core project management processes, as described below (additional details are provided in Annex 2). The ESMF and RPF for the

¹⁹ For Component 3, while locations of universities are generally known, the decision on which universities will be included in the first batch to be financed under the proposed project will not be finalized prior to consideration of the project by the World Bank Board.



project were disclosed on April 20, 2018 in national newspapers as well as REA and the Federal Ministry of Environment webpages.

142. **REA's approach to integrate E&S into overall project management processes.** REA is expected to effectively manage risks associated with an emerging flow of hundreds of small mini grids, as well as integrate relevant considerations into SHS companies' operations and effectively manage EPC contractors E&S performance for university power systems. An environmental and a social specialist have been recruited by REA. REA's E&S capacity must be further strengthened within the first year of project implementation through formal establishment of an E&S unit and potentially engaging an external firm with E&S expertise to assist with fully integrating E&S risk management processes into operational processes and workflows.

143. **The core principle for the design of E&S risk management approach for the project is expanding and strengthening E&S systems and capacity of the private sector** – through adoption of formal ESMS - that can be relied upon for carrying adequate E&S assessment and risk management for individual mini-grids in Component 1 and SHS installation in Component 2 as described in Annex 2. For Component 3, private sector EPC contractors would also assume the responsibility for carrying out E&S risk management measures as incorporated in the Environmental and Social Management Plans (ESMPs), included in the contracts, and monitored by REA.

144. **To ensure that private sector is adequately equipped to fulfil its role in E&S assessment and risk management for the project,** REA shall provide guidance and support to the private sector in the form of: (i) assistance with developing internal E&S systems and capacity, including training; (ii) required adequate reporting from companies engaged; and (iii) risk-based oversight function that will help allocate REA's resources for review, monitoring, and supervision. REA will ensure that budget is available for these activities.

145. **Grievance Redress Mechanism.** The proposed project will establish a project level grievance redress and beneficiary feedback mechanism. The mechanism will help to provide a forum for resolving grievances and disputes, resolve disputes relatively quickly before they escalate to an unmanageable level, and facilitate effective communication between the project and affected persons as well as win the trust and confidence of project beneficiaries. Arrangements for GRMs at the level of mini grid developers for Component 1, where it is most important, have also been required as part of developers' Environmental and Social Management System (ESMS) design.

146. **Voluntary Land Donation.** Individuals, families, and communities might donate land for mini grids under Component 1 as electricity is an important benefit that may warrant this practice. However, it may be open to abuse and coercion, and as such, it should not be encouraged under the proposed project except in instances where the donation meets the requirements set out in the VLD guidelines in the ESMP, with core principles outlined in Annex 2.

147. **Gender Based Violence (GBV).** As in other jurisdictions, GBV remains a challenge in Nigeria, hence the need for effective prevention and response mechanism on this project. Setting up temporary workers' camps for mini grid installation may result in GBV, sex exploitation, and child abuse. While the types of civil works envisaged in the project are not expected to result in large numbers of workers from outside the communities, the project will be mindful of this risk and take appropriate measures to prevent and address the negative consequences. Even though, the GBV related risks under the project are not expected to be substantial, REA-PMU staff and contractor capacity will be increased through a GBV sensitization and training clinic and other related activities focused on enhancing prevention and response



to violence both at the project and at the institutional level. The focus will be on two aspects: 1) at the project activities level related to energy operations e.g. contractors, beneficiaries and communities and 2) at the client level focused on strengthening institutional aspects e.g. staff capacity, human resource aspects/policies and safe and ethical reporting of GBV. Additionally, REA will identify and partner with key stakeholders e.g. such as UN Women, United Nations Population Fund, etc. to support the prevention and response to GBV. Responsibility for preventing instances of GBV will be included in all construction contracts. The contract for the Owner's Engineer will include responsibility for monitoring and reporting any instances of GBV.

148. **Some of the E&S risks have been identified as systemic and thus requiring a strategic solution that will be developed during project implementation.** These are (i) land acquisition issues and competing land use challenges for mini grids; (ii) waste management, and more specifically, battery storage and recycling; and (iii) need for harmonization of E&S standards among private mini-grid developers, their financiers, as well as Government of Nigeria standards and regulations for mini grid development. Adequate budget has been included in the project's technical assistance component to address these issues.

149. **Gender strategy for the project is as follows:**

- **The National Gender Policy** by the Federal Ministry of Women Affairs and Social Development focuses on female empowerment and a commitment to gender mainstreaming. The draft Energy Policy (2013) states that Nigeria will “disaggregate energy use, supply, and impacts by gender in energy project design and implementation.” In order to gain insights into key gender gaps, an analysis was conducted for the overall energy sector. Based on the findings of the gender gap analysis and other country-level targets, the following key actions are a core part of the operation (additional details are provided in Annex 4):
- **Component 1 - Mini Grids: Given how closely women's gendered responsibilities within the home are connected to their under-recognized role as energy consumers and producers** (as well as energy entrepreneurs), mini grid operators have an incentive to enhance women's participation in mini-grid operations in order to increase sustainability of operations. Depending on the scope of the mini grid, entry points related to the business model will be explored, by REA together with the World Bank and the mini grid operators, including the market analysis that can help collect sex-disaggregated data, the marketing and community outreach activities and training programs that will be delivered at various levels. Actions will also focus on potential win-win interventions that could be adopted, such as the provision of key social services such as lighting at markets or transport stops to increase safety. In the studies related to Component 1, specific focus will be placed on exploring how energy services can reduce the time and labor burden of women and ways to enhance and create income generating opportunities for women e.g. through entrepreneurship or enhanced productivity and agro-processing.
- **Component 2 - Stand-alone Solar Systems: The adoption, use, and scaling up of clean technology solutions are central to the energy access challenge, but women need to be seen and engaged as valuable partners along the entire value chain**—in the design, marketing, sales, and after-sale services. Under the technical assistance activities for the component, solar providers that do not currently integrate gender considerations across



their operations, will be offered the opportunity to access earmarked grants to address gender gaps in job opportunities to both men and women in the areas of marketing, sales and after sales services for solar technologies. The technical assistance will also include analysis of consumer finance issues and the overall supply chain to ensure equitable benefit sharing around decision making, skills and attainment of solar systems at the community level through solar provider's business approaches.

- **Gender data and monitoring and evaluation:** Given the limited sex-disaggregated data available in the sector, attention will be paid to male and female-headed households' and businesses access to electricity by mini-grids and stand-alone solar, especially in the context of rural areas where a gender gap could possibly arise. Actions have been identified as part of the M&E system to track sex-disaggregated data related to the household and business connections.

F. World Bank Grievance Redress

150. Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanisms or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaint to the WB's independent Inspection Panel, which determines whether harm occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit <http://www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service>. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.



VII. RESULTS FRAMEWORK AND MONITORING

Results Framework

Project Development Objective(s)

The development objective is to increase access to electricity services for households, public educational institutions, and underserved micro, small and medium enterprises.

PDO Indicators by Objectives / Outcomes	DLI	CRI	Unit of Measure	Baseline	End Target
Households provided with new electricity services					
Households provided with new electricity services			Number	0.00	500,000.00
of which female headed households			Number	0.00	50,000.00
Micro-, Small- and Medium-Sized Enterprises (MSMEs) provided with new electricity services					
Micro-, Small-, and Medium-Sized Enterprises (MSMEs) with new or improved electricity service			Number	0.00	70,000.00
... of which female headed MSMEs			Number	0.00	7,000.00
Public Educational Institutions provided with new or improved electricity services					
Federal universities and university teaching hospitals with new or improved electricity service			Number	0.00	7.00
People provided with new or improved electricity service					
People provided with new or improved electricity service		Yes	Number	0.00	2,500,000.00



Intermediate Results Indicators by Components	DLI	CRI	Unit of Measure	Baseline	End Target
Solar Hybrid Mini Grids for Rural Economic Development					
Households provided with access to electricity by mini grids			Number	0.00	300,000.00
...of which headed by women			Percentage	0.00	10.00
MSMEs provided with access to electricity by mini grids			Amount(USD)	0.00	30,000.00
...of which headed by women			Percentage	0.00	10.00
Percentage of women of total number of people employed by mini grid and off-grid companies			Percentage	16.00	20.00
Volume of results-based financing channeled to private sector mini grid developers			Amount(USD)	0.00	150,000,000.00
Annual publication of feedback received from citizens reached through the consumer education and citizen engagement program			Yes/No	N	Y
Increased productive uses of electricity for female headed businesses and female famers etc			Percentage	0.00	5.00
New generation capacity of renewable energy (solar) installed			Megawatt	0.00	85.00
Stand-alone Solar Systems for Homes and MSME					
Households provided with access to electricity by stand-alone solar systems			Number	0.00	300,000.00
...of which headed by women			Percentage	0.00	10.00
MSMEs provided with access to electricity by stand-alone systems			Number	0.00	40,000.00
...of which headed by women			Percentage	0.00	10.00



Volume of results-based financing channeled to private sector stand-alone solar system providers		Amount(USD)	0.00	75,000,000.00
New generation capacity of renewable energy (solar) installed		Megawatt	0.00	15.00
Energizing Education				
Federal universities with new or improved electricity service		Number	0.00	7.00
Federal universities with a teaching hospital with new or improved electricity service		Number	0.00	2.00
New capacity of renewable energy (solar) installed		Megawatt	0.00	19.00

Monitoring & Evaluation Plan: PDO Indicators

Indicator Name	Households provided with new electricity services
Definition/Description	The indicator measures the number of households that have received new or improved electricity service through NEP. The indicator includes direct access to electricity, which is measured as the number of households that benefited from new energy services via mini-grids and stand-alone solar systems. Throughout the project, the number of households connected to mini-grids and stand-alone solar systems will be monitored.
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	of which female headed households
Definition/Description	
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU
Indicator Name	Micro-, Small-, and Medium-Sized Enterprises (MSMEs) with new or improved electricity service
Definition/Description	The indicator measures the number of Micro-, Small-, and Medium-Sized Enterprises (MSMEs) that have received new or improved electricity service through NEP. The indicator includes direct access to electricity, which is measured as the number of Micro-, Small-, and Medium-Sized Enterprises (MSMEs) that benefited from new energy services via mini-grids and stand-alone solar systems. Throughout the project, the number of Micro-, Small-, and Medium-Sized Enterprises (MSMEs) connected to mini-grids and stand-alone solar systems will be monitored.
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	... of which female headed MSMEs
Definition/Description	
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU
Indicator Name	Federal universities and university teaching hospitals with new or improved electricity service
Definition/Description	The indicator measures the number of Federal Universities and University Teaching Hospitals that have received new or improved electricity service through NEP. The indicator includes direct access to electricity, which is measured as the number of Federal Universities and University Teaching Hospitals that benefited from new energy services via mini-grids and stand-alone solar systems. Throughout the project, the number of Federal Universities and University Teaching Hospitals connected to mini-grids and stand-alone solar systems will be monitored.
Frequency	Quarterly
Data Source	Participating Universities
Methodology for Data Collection	Quarterly progress reports from participating universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	People provided with new or improved electricity service
Definition/Description	
Frequency	Quarterly
Data Source	The indicator measures the number of people that have received new or improved electricity service through the project. The indicator includes direct access to electricity, which is measured as the number of people that benefited from new off-grid household connections via mini-grids and stand-alone solar systems. Throughout the project, the number of households connected to mini-grids and stand-alone solar systems will be monitored. The indicator shown above will use the average number of people per household in each county (as measured by the MTF survey) multiplied by the number of connections in each county to determine an aggregate value of the number of people that have received new or improved electricity service.
Methodology for Data Collection	
Responsibility for Data Collection	REA



Monitoring & Evaluation Plan: Intermediate Results Indicators

Indicator Name	Households provided with access to electricity by mini grids
Definition/Description	The indicator measures the number of Households that have received new or improved electricity service through NEP. The indicator includes direct access to electricity, which is measured as the number of Households that benefited from new energy services via mini-grids systems. Throughout the project, the number of Households connected to mini-grids will be monitored.
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	...of which headed by women
Definition/Description	The indicator measures the number of Female Headed Households that have received new or improved electricity service through NEP. The indicator includes direct access to electricity, which is measured as the number of Female Headed Households that benefited from new energy services via mini-grids systems. Throughout the project, the number of Female Headed Households connected to mini-grids will be monitored.
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU
Indicator Name	MSMEs provided with access to electricity by mini grids
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA



Indicator Name	...of which headed by women
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA
Indicator Name	Percentage of women of total number of people employed by mini grid and off-grid companies
Definition/Description	Percentage of women of total number of people employed
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	Volume of results-based financing channeled to private sector mini grid developers
Definition/Description	
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU
Indicator Name	Annual publication of feedback received from citizens reached through the consumer education and citizen engagement program
Definition/Description	
Frequency	Annual
Data Source	REA PMU
Methodology for Data Collection	Consumer education and citizen engagement program
Responsibility for Data Collection	REA PMU



Indicator Name	Increased productive uses of electricity for female headed businesses and female famers etc
Definition/Description	
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU
Indicator Name	New generation capacity of renewable energy (solar) installed
Definition/Description	The indicator measures in megawatts (MW) the generation capacity of renewable energy facilities constructed under NEP
Frequency	Quarterly
Data Source	Participating companies and universities, NERC, REA PMU
Methodology for Data Collection	Quarterly progress reports from participating companies and universities under the program
Responsibility for Data Collection	REA PMU



Indicator Name	Households provided with access to electricity by stand-alone solar systems
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA
Indicator Name	...of which headed by women
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA



Indicator Name	MSMEs provided with access to electricity by stand-alone systems
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA
Indicator Name	...of which headed by women
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA



Indicator Name	Volume of results-based financing channeled to private sector stand-alone solar system providers
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA
Indicator Name	New generation capacity of renewable energy (solar) installed
Definition/Description	
Frequency	
Data Source	
Methodology for Data Collection	
Responsibility for Data Collection	



Indicator Name	Federal universities with new or improved electricity service
Definition/Description	
Frequency	Quarterly
Data Source	Participating universities
Methodology for Data Collection	Quarterly progress reports from universities
Responsibility for Data Collection	REA PMU
Indicator Name	Federal universities with a teaching hospital with new or improved electricity service
Definition/Description	
Frequency	Quarterly
Data Source	REA PMU
Methodology for Data Collection	
Responsibility for Data Collection	REA



Indicator Name	New capacity of renewable energy (solar) installed
Definition/Description	
Frequency	
Data Source	
Methodology for Data Collection	
Responsibility for Data Collection	



ANNEX 1: DETAILED PROJECT DESCRIPTION

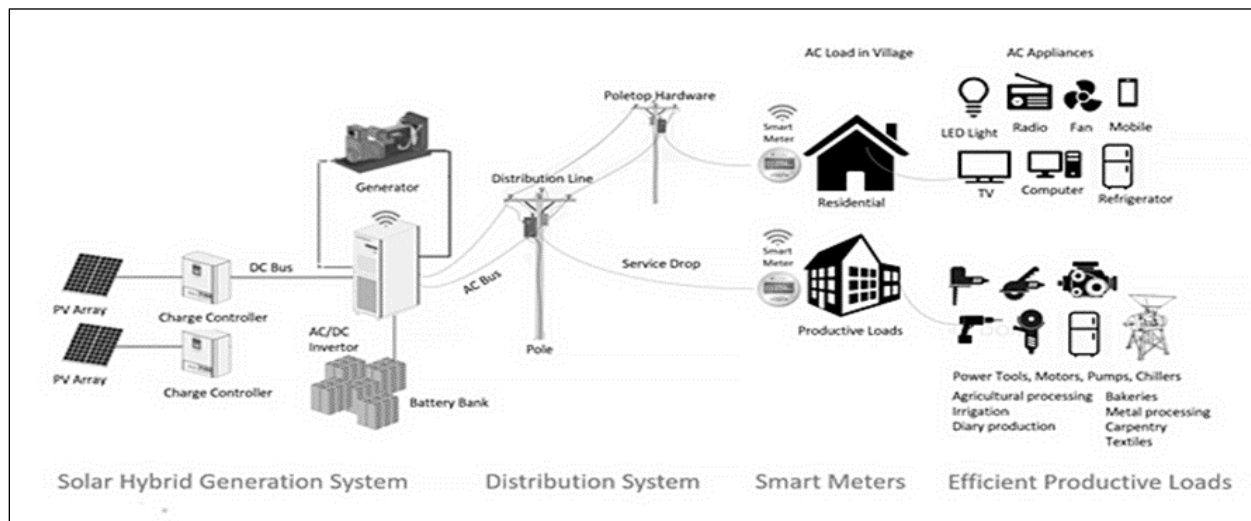
COUNTRY: Nigeria
Nigeria Electrification Project

Component 1. Solar Hybrid Mini Grids for Rural Economic Development (US\$330 million equivalent, of which IDA US\$150 million equivalent and US\$180 million equivalent from private sector funding).

1. Mini grids are the least-cost option for rural electrification, depending on a host of context-specific local conditions, including: a) community size; b) population density; c) distance to existing national grid; e) geographic factors such as topography; and f) general socio-economic factors (energy demand, economic growth potential). Due to their ability to provide reliable electricity, mini grids can be used to power small industrial machinery such as water pumps and mills for farming/agro-processing, tools needed in welding and carpentry workshops, etc., and are consequently expected to have a positive impact on local livelihoods. To assess the potential for mini grids as a rural electrification solution, the FMPWH, with support from GIZ, collected geo-referenced data on population clusters and load centers. This analysis indicates an estimated 8,000 potential load centers that are suitable for mini grids.

2. Mini grids using a combination of solar PV, batteries, and a generator are quickly becoming a long-term solution for providing electricity even in the presence of grid expansion programs (Figure 1.1). Most modern mini grid regulations stipulate co-existence models for mini grids and the main grid, in which mini grids also have the option to continue to operate as small power distributors (SPDs). Nigeria has one of the most comprehensive regulations on the continent.

Figure 1.1. Third generation mini grids with solar hybrid generation, AC-grid-code distribution system, smart meters and efficient consumptive and productive appliances



3. An emergent mini grid sector in Nigeria is poised to grow rapidly if the right financial and regulatory support is available. Indeed, at least eight companies are developing mini grids with a pipeline of over 1,000 projects combined, and large multinational companies have also shown interest in



developing mini grids in Nigeria. Local companies that have large power requirements, such as telecom and agricultural service companies, are an additional set of prospective mini grid developers.

4. Factors such as mini grid-friendly policies and regulations, cost reductions of renewable energy generation technologies, improvements in billing and monitoring equipment like controllers and smart meters, mobile money, and geospatial planning tools to improve site selection are catalyzing industry growth, but nevertheless mini grids still require concessional financing to enable tariffs that are within the willingness and ability to pay of rural customers. Therefore, significant additional investment is needed to scale up deployment of mini grids and extend electricity access.

5. The MTF energy access survey for Nigeria will provide more robust data on household spending on energy and willingness and ability to pay once it is completed in mid 2018. However, a previous survey commissioned by the FMPWH in 2016 estimated household willingness to pay for mini grid electricity at between US\$0.49/kWh and US\$0.62/kWh, depending on customer class, as presented in Table 1.1.

Table 1.1. Average Daily Load Demand by Customer Class and WTP for Each Customer Class (at ₦370 to US\$1)

Consumer Type	Average kWh per day demand per consumer type	WTP Per Month [Naira]	WTP Per Month [US\$]	WTP [NGN/kWh]	WTP [US\$/kWh]
R01 Small Residential	0.275	1,524.6	4.12	182.7	0.49
R11 Small Residential	0.55	3,118.5	8.43	189	0.51
R21 Small Residential	1.1	6,300	17.03	211.05	0.57
R31 Med. Residential	1.65	9,651.6	26.09	195.3	0.53
R41 Med. Residential	2.2	12,700.8	34.33	192.15	0.52
R71 Lrg. Residential	3.85	25,404.75	68.66	220.5	0.60
R82 Lrg. Residential	4.4	30,482.55	82.39	228.95	0.62

Source: EM-ONE Energy Solutions (2016), *Expanding Electricity Access: Solar Mini Grid Design and Operation* (2016).

Regulatory Framework

6. Nigeria has approved a regulatory framework for mini grids. The NERC completed its public consultations for the draft regulation in December 2016 (the World Bank reviewed the draft and provided comments). NERC then revised the regulations based on the public consultation, and its board approved the final regulation for mini grids in March 2017. The regulatory framework aims to accelerate electrification in areas without existing distribution networks (“unserved areas”) and areas with an existing but poorly electrified or non-functional distribution grid (“underserved areas”) by attracting participation of private sector, communities, and non-governmental organizations (NGOs) in achieving nationwide electrification.

7. NERC has approved three windows for grid connected renewable energy projects:
- Net-metering for very small capacities (typically below 1 MW)



- Feed-in tariff for capacities up to
 - 5 MW of solar;
 - 10 MW of wind;
 - 10 MW of biomass; and
 - 30 MW of small hydro.
- Competitive tender for capacities above these thresholds to be procured through NBET.

8. The regulations take several important steps towards creating a more favorable environment for private sector investment in mini grids. They enable mini grid developers to set cost-reflective tariffs, and they set out options for previously isolated mini grids when the main grid arrives, which include selling the distribution assets to the DISCO and converting to an Independent Power Distributor. The regulations also streamline a variety of regulatory processes, including when developers need to apply for a permit (above 100 kW of capacity) and options for “regulation by contract” in which developers enter into bilateral or trilateral agreements directly with communities and local governments. While mini grids above 100 kW must secure a simplified permit, mini grids up to 100 kW can choose to either register as an operator or apply for a simplified permit.

9. Electing to register as a registered operator provides the benefit of minimal regulation in terms of tariff setting and compliance with technical codes and standards, but a permit offers more protection to investors by entitlement to compensation in the case of the arrival of the main grid. However, opting for a permit subjects the developer to the same tariff regulations as larger mini grids. Tariffs for mini grids larger than 100 kW (and for smaller mini grids electing for a permit) are subject to a ceiling calculated by NERC using a model specifically designed for mini grids. Registered mini grids below 100 kW are free to set their tariffs by agreement with the community. These first-generation mini grid regulations may require additional updates as the sector develops, and NERC receives feedback from developers.



Box 1.1. What happens when the main grid is extended to a mini grid site?²⁰

No support provision for registered-only mini grids. Mini grids with generation capacity below 100 kW have an option to register with NERC, without getting a permit from NERC; larger mini grids need a NERC permit. Registered-only mini grids have no rights to compensation or interconnection when the DISCO arrives.

Permitted mini grids can choose to continue to operate. There are three ways in which a permitted mini grid can continue to operate:

- **Mini grid becomes a “small power producer” (SPP).** The mini grid converts to a main grid-connected SPP and sells electricity at wholesale to the grid-connected DISCOs. This requires that all relevant equipment be capable of grid-connected operation.
- **Mini grid becomes a “small power distributor” (SPD).** The mini grid converts to a main grid-connected SPD, with or without back-up generation. The SPD buys all of its electricity at wholesale from the DISCO, and sells its purchased electricity to its customers at retail. The mini grid’s distribution network must be built to main grid standards.
- **Mini grid becomes a “small power producer” and a “small power distributor” (SPP + SPD).** The mini grid (i) sells electricity to its retail customers, with the electricity coming either from own generation or purchased from the DISCO at wholesale rates, and (ii) has the option to sell electricity to the DISCO when a surplus is available.

In these cases, tariffs for electricity sold to or purchased from the DISCO are negotiated between the SPP and the DISCO, and codified in a tri-partite agreement between the mini grid developer, the community and the DISCO.

Permitted mini grid can choose to cease to operate and get compensation from the DISCO. The mini grid goes out of business, and the DISCO assumes ownership and compensates the developer for all assets the isolated mini-grid operator does not want to remove from the Mini-Grid system. The compensation is the depreciated value of the equipment taken over by the DISCOs, plus an amount equal to the last 12 months of the mini grid’s revenues.

Market Context

10. Geo-referenced data on population clusters and load centers collected by the FMPWH with support from GIZ indicates an estimated 8,000 potential load centers that are suitable for mini grids. There is a cohort of private mini grid developers in Nigeria that has already completed initial stages of project development and piloting. With viability gap financing from the public sector, the mini grids commissioned by these developers are charging cost-reflecting tariffs. They are also actively pursuing productive uses of the electricity they generate, as this increases their sales and financial viability.

11. At least eight companies are developing mini grids, with the potential to build more than 1,000 projects combined in Nigeria (See Cost Assumptions section below). Large multinational companies that develop mini grid technologies have also signaled interest in the solicited track of this component. Discussions are also ongoing with commercial entities that have substantial power provisioning needs (e.g., telecom tower operators) to explore their interest and appetite to participate in the program.

12. It is expected that the component will support around 850 projects. The overall estimated investment cost of the component is US\$330 million, of which about US\$150 million will be provided by

²⁰ Source: Nigerian Electricity Regulatory Commission Mini-Grid Regulation, 2016, §9(1)(c)(iii), 19(2), 19(6), and Annex 11 “Tripartite Contract”, Clauses 5.2.1, 10.1, and 10.2



IDA (details provided below). Additional financing will come from the private firms, commercial debt providers, development partners and the Government. REA will be responsible for providing payments to developers toward capital expenditures (CAPEX) through a clear and transparent process.

13. Access to finance remains a critical bottleneck for mini grid developers, with high commercial interest rates (20-30 percent), high collateral requirements and short-term maturity loans (two to three years) making debt financing of project difficult in many cases. Most financial institutions do not know how to conduct credit-risk analysis for renewable energy projects. Many lenders are skeptical that meaningful cash flow can be generated from renewable energy projects or doubt that the cash flow can be relied on to repay loans. Technical assistance to financial institutions to gain familiarity with mini grids and conduct robust appraisals of mini grid projects will encourage lending on more favorable terms to mini grid developers.

14. As local currency debt finance is constrained in Nigeria, the project is designed to collaborate and coordinate with potential lenders to mini grid developers, including commercial banks, private equity funds and other development partners. Other development partners have initiated complementary initiatives that address this barrier and, together with the grant financing proposed through this project, these initiatives are expected to improve the financial viability of mini grid investments in Nigeria. Table 1.2 maps these potential sources of debt and equity financing for mini grid developers in Nigeria. Nigerian firms will be supported through technical assistance to enhance their opportunity of participation under the program, provided they meet the eligibility criteria for participating companies²¹.

Table 1.2. Debt and Equity Co-financing for Mini Grids and Solar Companies in Nigeria

Project/Facility	Organization	Description
Facility for Energy Inclusion	AfDB	Pan-African debt facility for SHS companies, small IPPs and mini grid developers. US\$100 million already mobilized; seeking to raise an additional US\$400 million. US\$200 million is proposed for parallel financing to NEP.
Nigeria Energy Access Fund (NEAF)	AfDB/All On	Equity fund targeting SHS companies, IPPs and mini grid developers in Nigeria. US\$15 million committed; target capitalization of US\$100 million with US\$40 million first close by Q2 2018.
Sustainable Use of Natural Resources and Energy Finance in Nigeria (SUNREF)	<i>Agence Francaise de Developpement</i> (French Development Agency - AFD)	US\$90 million credit facility for RE and EE in Nigeria along with \$8-9 million grant and some TA. Approved by AFD Board in December 2017. Participating financial institutions (PFIs) will on-lend to mini grid developers for eligible investments in either local currency or US\$.
Access to Renewable Energy (AtRE)	(UNDP)/BoI	A blend of US\$1.4 million in debt and US\$0.6 million in grant offered to mini grid developers through the current phase. Favorable terms of 7 percent interest and 15-year tenor have been accessed by developers, and due to positive experience, BoI interested in expanding mini grid portfolio.
TBD	European	EIB is keen to expand its financial operations in Nigeria and

²¹ Any private enterprise, NGO or community duly registered as a legal entity in Nigeria and having the capacity to enter into a contract under the laws of the Federal Republic of Nigeria is eligible, subject to REA assessment of technical, FM, procurement and environmental and social capacity to implement the proposed subproject according to the Implementation Manual. Further details are provided in the Project Implementation Manual.



Project/Facility	Organization	Description
	Investment Bank (EIB)	might be interested in contributing to a working capital facility that could be used by private firms participating in this project.

15. The CBN launched the *MSME Development Fund* in August 2013 with share capital of Naira 220 billion (close to US\$600 million at the current market exchange rate of Naira 370 to US\$1). The broad objective of the Fund is to channel low interest funds to the MSME sub-sector of the Nigerian economy through PFIs, recognizing the significant contributions of the MSMEs to the economy and the financing gap that they face. Ten percent of the Fund is reserved for developmental objectives such as grants, capacity building and administrative costs, while ninety percent is for lending to PFIs at 2 percent for on-lending to MSMEs at a maximum interest rate of 9 percent per annum. Eligible activities to be financed include renewable energy/energy efficient products and technologies. SMEs may qualify for loans of up to Naira 50 million (approximately US\$135,000) with a repayment period of up to three years. However, but uptake has been slow due to limited interest and appetite from the financial institutions²².

16. The Bol and the UNDP are currently implementing the second phase of their AtRE project, which provides long-term financing for the installation of mini grid and stand-alone solar solutions, following up on a pilot phase in one community in each of the six geo-political zones. This second phase is financed through a blend of US\$1.4 million in debt from Bol and US\$600,000 in grant from UNDP. UNDP’s grant contribution is used to reduce the cost of the mini grids and thus enhance viability, and the loan from Bol is offered at an interest rate of 7 percent and tenure of 15 years, which is lower than their typical interest rate of 10 percent with three to five year tenor. Bol has had a successful experience with mini grid developers through this program, and has expanded its portfolio from an initial two mini grid developers to 10. Discussions indicate that Bol is receptive to expanding its lending to mini grid developers should credible projects and credible developers be identified.

17. The AFD board approved in December 2017 the SUNREF project, which includes a US\$90 million concessional credit, and guarantees if required, to PFIs to on-lend to renewable energy and energy efficiency projects. Mini grids are specifically included as eligible investments, and the facility intends to enable PFIs to make loans available at affordable interest rates and extended maturity.

18. The AfDB has created a pan-African fund called the Facility for Energy Inclusion that seeks to increase access to clean energy across Africa by providing debt capital to SHS companies, small independent power producers and mini grid developers. The AfDB Board approved a US\$50 million equity investment and US\$50 million convertible debt investment to the Facility in December 2016, and the Facility is seeking to raise another US\$400 million from investors. It offers both senior and subordinated loans to mini grid developers with a tenor of 10-15 years that fits project economics. The grant manager has been selected, and the Facility will offer both US\$ and local currency loans, ranging from US\$2 million to US\$20 million.

19. Another fund, the NEAF, is being jointly developed by AfDB and All On. Like the Facility for Energy Inclusion, this Fund also targets SHS companies, independent power producers and mini grid developers. NEAF is an equity fund, anchored by US\$10 million in equity from AfDB, US\$5 million from All On, along with additional capital from other local investors and potential support from the Green Climate Fund private sector facility. NEAF aims to mobilize US\$100 million, with a US\$40 million first close by Q2 2018,

²² The reference to CBN’s development finance schemes is illustrative only in the context of mapping exercise and is not an endorsement of central bank’s quasi fiscal activities.



and expects to provide loans in both US\$ and local currency, depending on the financing needs of the borrower.

Component Description

20. The component will be implemented under a market based approach whereby the private sector develops mini grids to deliver electricity services on a build-own-operate basis, with financial support offered through two investment funding windows: 1) minimum subsidy tender; and 2) performance-based grant.

21. A Technical Review Committee, consisting of a Technical Specialist, Commercial Specialist, Procurement Specialist, FM Specialist, Environmental Specialist, Social Specialist (all members of the PMU), as well as an external specialist will be tasked with the responsibility of evaluating proposals under both funding windows and providing technical and financial due diligence on the proposals/applications under consideration. Their recommendation will be provided to the Investment Committee, consisting of the Managing Director of REA, the Project Coordinator of the PMU, and a rotating observer from one of the donor agencies active in the sector, which will make the funding decision.

22. The technical focus will be on solar hybrid systems, i.e., solar generation with battery storage, and diesel back-up; other renewable technologies may also be considered on a case by case basis. The mini grids will be built to Nigeria's grid code standard in order to allow for integration with DISCOs grid when the latter are extended to reach a mini grid's site (as specified in the approved NERC regulations for mini grids). These hybrid mini grids can be rolled out quickly because the physical generation and distribution infrastructure components, as well as the skills to install them, are already available in Nigeria. Prepaid metering and smart meter systems will be required to mitigate revenue collection risk and enhance the bankability of the mini grid sub-projects.

23. The presence of productive loads is important for the commercial operation and long-term sustainability of mini grids. Therefore, the proposed project seeks to identify synergies with World Bank assisted agricultural programs, such as the Agro-Processing, Productivity Enhancement and Livelihood Improvement Support Project and the Fadama III Project, in order to identify agricultural load centers²³. Mapping of these loads will enhance the quality of the bid packages for the solicited program and may increase the feasibility of the associated sites for mini grid development. Incorporation of data on SME distribution across the country from the World Bank's Private Sector Development team is expected to do the same and will be merged with the geospatial data that has already been collected to identify viable mini grid locations for the solicited track.

24. Existing geospatial data for rural electrification in Nigeria will be augmented with additional geo-referenced data. REA has obtained location data as well as other pertinent information, such as on energy demand profile and fuel provisioning arrangements, on telecom towers that may serve as anchor loads for mini grids from the tower company IHS and incorporated it into the existing database. The World Bank project team has commissioned geo-spatial assessments in a few key states to complement ongoing efforts, and these outputs are being utilized by REA in the preparation of the sites for the minimum subsidy tender. The World Bank sponsored MTF surveys, scheduled to be completed for Nigeria in mid 2018, are

²³ FADAMA and REA have started mapping the electricity demand of farmers who have machinery, such as those for milling and for water pumping, that is currently idle due to lack of power. These loads are incorporated in the database that is an input to the market intelligence packages.



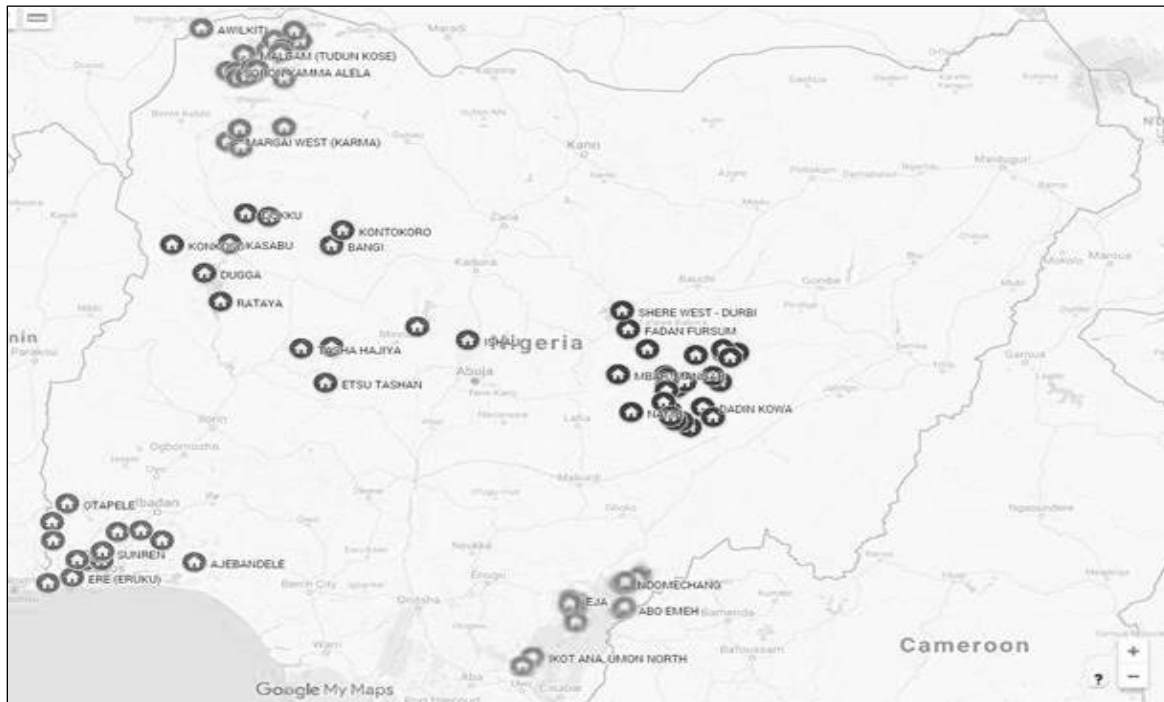
expected to yield further insights relevant to the screening and selection of sites for mini grid development.

Component 1.1: Minimum Subsidy Tender for Mini-Grids (IDA US\$70 million equivalent)

25. Given the scale of the energy access challenge in Nigeria and the limited number of private developers that are already active prospecting for potential mini grid sub-projects, in order to catalyze mini grid deployment at scale and kick-start the market, this component includes a minimum subsidy tender. 250 rural load centers will be divided into lots to encourage economies of scale in procurement and efficiency in O&M. A large number of sites in a geographic cluster could comprise such a lot and will be tendered on the basis of minimum subsidy requirement. By increasing the deal size, this window aims to attract some of the international private developers to enter the mini grid market in Nigeria.

26. **Geographical areas with private sector interest.** From the initial list of 8,000 potential mini grid sites, REA has identified about 600 candidate sites with high potential for mini grid electrification, based on geo-referenced data on population clusters and load centers, including population density, number and type of productive end-uses, and the presence of community infrastructure such as schools, water pumps and health facilities. Geo-referenced data on telecom towers, agro-processing and other agricultural activities and their associated electricity demand has also been collected. After conducting field surveys to validate the geo-referenced data, close to 100 of these off-grid sites have been prioritized to be tendered out, based on the population, productive loads and estimated load profiles, as part of this minimum subsidy tender. Additional sites will be prioritized using the same methodology to bring the total number of sites to be tendered to 250.

Figure 1.2. Candidate sites for minimum subsidy tender in five states



Source: REA.



27. REA is preparing market intelligence for the portfolio of 250 projects in five states based on geo-spatial assessments combined with on-the-ground validation by REA survey teams. The georeferenced database includes 16,000 telecom towers, agricultural loads and rural enterprises that could function as anchor loads. The longlist of sites is prioritized based on economic parameters. A full analysis has been completed for 97 sites and, for each site, feasibility level information is available²⁴. The World Bank ESMAP sponsored MTF surveys, scheduled to be completed for Nigeria in September 2018, are expected to yield further insights relevant to the screening and selection of sites for mini grid development.

28. Bid packages will give significant commercial choice to the bidders, including specifying the tariff, subject to a tariff ceiling based on commercial tariffs from existing mini grid operators; selecting the technology, subject to minimum technical specifications; client selection, subject to a minimum population that will need to be connected; and promotional sales campaigns, subject to a minimum adoption of productive use appliances. In addition, the mini grid sites contained in the bid packages have been selected based on economic parameters and are the “low-hanging fruit” with significant populations, high population densities, available productive uses to support daytime demand for electricity and no major E&S issues. The combination of flexibility and attractive economic fundamentals has already garnered interest from private sector developers.

29. Each load center/village in each lot to be bid out will be matched with one of five economically optimized scalable and modular system designs based on hybrid PV-storage-diesel systems. These five standardized mini grid configurations have been dimensioned with different peak power capacities to meet the demand of a range of load centers. Each standard system can be configured and equipped with a range of different PV and battery sizes, which makes it configurable for all recipient villages. A village is assigned to a certain standard size, based upon its peak power demand and then the standard size is configured according to the village’s daily energy consumption to deliver the least costly system that matches the village’s needs. Bidders will have the discretion to propose minor modifications to the standard configuration indicated for each mini grid but will have to comply with the major parameters in order to allow comparison and evaluation of bids.

30. For each lot, bidders will therefore compete to demand the lowest amount of subsidy to build, own and operate a portfolio of mini grids that serve the load centers with the standardized design configuration that best fits the demand profile. The lots will also include a requirement to make available (on a lease to own basis) a certain number of productive use and household appliances that will be specified in the bid documents. Leasing of appliances on commercial terms will be permitted, but the deployment of the appliances will be required and will be subject to verification by REA as part of post-commissioning verification.

31. To reduce collection risk, the mini grids will be required to include pre-paid metering systems and smart meters to enable effective load management. Given that NERC regulations permit cost-reflective tariffs with NERC approval, the bidders’ financial proposals will be assessed on the basis of minimum subsidy requirement provided that technical specifications comply with the parameters defined in the bid documents.

²⁴ Specific milestones for the minimum subsidy tender include: completion of data collection and surveys for all 250 candidate sites; design of the bid instruments, documents and processes (June 2018); and, updating Project Implementation Manual. The full tender package is expected to be ready by July 2018.



32. The minimum subsidy tender will use an innovative online platform Odyssey²⁵ to disseminate market intelligence to prospective bidders and to generate standardized submissions for evaluation. It is expected that the minimum subsidy tender will extend access to 110,000 new mini grid customers through these 250 mini grids.

33. **Electrification in high-risk environments:** Implementation of mini grids in the conflict-affected areas in the Northeast of Nigeria (excluding Borno) in partnership with an established international organization in the area is under consideration.

Component 1.2: Performance-Based Grant Program (IDA US\$80 million equivalent).

34. Performance-based grants will be provided to mini grid projects on the basis of new customer connections (US\$/end user) to (i) bridge the affordability gap faced by mini grid sub-projects; and (ii) make the service affordable to the communities. Developers will be encouraged to submit a business plan for grant-based support to grow their mini grid portfolio that they themselves have identified, screened and prepared. After establishing eligibility to participate in the program, qualifying developers may apply for performance-based grants from REA.

35. The proposed project must be technically viable in its design and may use conventional sources of energy provided that the renewable energy supply part is more than half of the installed capacity. While the focus of the program is on solar or solar-diesel hybrid systems, other renewable energy technologies may also be accepted by REA on a case by case basis. However, if a site dependent technology such as wind or mini hydropower is proposed, resource availability must be demonstrated through a detailed energy resource assessment.²⁶ If a biomass or biogas based project is proposed, a supply chain analysis to establish resource availability will be required. Furthermore, the proposed project must use equipment that has been certified by Standards Organization of Nigeria or any other locally or internationally recognized body/initiative, and all distribution networks must be built in compliance with Nigeria's distribution code.

36. Taking as a benchmark the US\$500-600 per new connection subsidy provided by GIZ for a series of pilot mini grids as part of its NESP, the grant is proposed to be initially set at US\$350 per new connection taking into account the decline in component prices, improved macroeconomic conditions in Nigeria, especially in terms of currency stability and forex availability, and the assertion from developers during market sounding exercises about their ability to implement mini grids at significantly lower cost today. Price discovery from the minimum subsidy tender is expected to provide a better understanding of prevailing market fundamentals, and the performance-based grant may be adjusted accordingly. The grant will be provided in US\$ and shall not exceed 50 percent of the total capital cost of the project.

37. The project developer must first submit a business plan to establish their eligibility to receive the performance-based grants. The business plans will be assessed by the PMU against defined eligibility criteria to ensure that the developer is credible and has a sustainable business model. Once their eligibility has been established, the developer may submit applications for performance-based grants for each mini grid sub-project it will build and operate.

²⁵ Odyssey Energy Solutions is a secure web-based platform that facilitates mini grid bidding.
<https://www.odysseyenergysolutions.com/>

²⁶ Only very small hydro systems, if any, would be considered. The PIM will contain further information on eligibility criteria and requirements associated with mini hydropower.



38. Applications will be assessed on a rolling, first come first served basis. Grant Agreements will be signed between REA and the project developer for approved projects, and the performance-based grant will be disbursed against pre-defined milestones: 1) verification of technical design; 2) verified delivery of equipment to the project site; and 3) verification of customer connections. Verification will be done by REA. Projects must be commissioned within six months of the signature of the Grant Agreement, having fulfilled the milestones specified in the Grant Agreement. REA-PMU oversees the verification of the completion of these milestones.

39. It is expected that performance-based grants will benefit around 580 mini grids/load-centers; at least eight companies; and more than 230,000 end users.

Cost Assumptions

40. It is projected that the component will support 850 projects and 85-MW of new mini grid capacity. The overall estimated cost of the component is US\$330 million, of which US\$150 million is proposed to be provided by IDA and the remainder to be mobilized by the private sector through a combination of debt, equity and other sources of grant funding.

41. Under the minimum subsidy tender, REA will invite proposals for minimum subsidies for 250 rural load centers. Based on geo-referenced data collected with support from GIZ, 100 kW is taken to be the typical size of the mini grids to be constructed, and the total capacity to be installed through these 250 mini grids is therefore projected to be 20 MW (subject to revision once the sites are identified and pre-feasibility assessments completed). Average CAPEX of US\$4,400 per kW of installed capacity, inclusive of distribution costs, as quoted by the local developer Green Village Electricity (GVE), is conservatively assumed for these mini grids, although the large-scale procurement entailed by the minimum subsidy tender, the standardized design configurations proposed, and the expected involvement of larger international developers may deliver lower costs. The total cost of electrifying these 250 rural load centers with mini grids is estimated at about US\$88 million.

42. GIZ's NESP provided CAPEX grants of approximately US\$500-600 per new user connection to the pilot mini grids it supported. This co-financing requirement may have been appropriate for these first few pilots, but the minimum subsidy tender can reasonably be expected to apply downward pressure on the subsidy requirement. Analysis of the costing of the GIZ pilots indicates that the current subsidy requirement may be about US\$300-350 per new user connected for mini grids to be operationally sustainable while offering tariffs within beneficiary communities' willingness to pay. The competitive tendering process may yield bids to implement mini grids at a lower level of subsidy. An analysis of the subsidy requirement was conducted against several rates of returns with specific risk profiles. This resulted in US\$350 to US\$640 per new user connected to estimate the subsidy requirement of up to US\$70 million for the implementation of 250 mini grids under the minimum subsidy tender. This would lead to mini grid electrification of 110,000 households and businesses. The balance of US\$75 million is expected to be mobilized by the private sector.

43. Estimation of the demand for performance-based grants from the project is based on market sounding carried out during project preparation, which suggests growth in the number of projects implemented by eight developers active in the mini grid space as described in the table below. Projections for seven of the developers have been made according to the growth strategy and project pipeline proposed of GVE, an established developer with a successful track record that is scaling up its operations. According to this projection, up to 1,167 mini grid projects may seek co-financing from performance-based grants.



Table 1.3. Mini Grids - Size of Project/Portfolio (#)

Company	2018	2019	2020	2021	2022	2023	Total
GVE	48	75	100	135	150	167	675
Nayo	4	6	8	11	13	14	56
CESEL	10	16	21	28	31	35	141
Rubitec	2	3	4	6	6	7	28
GoSolar	12	19	25	34	38	42	169
GreenElec	3	5	6	8	9	10	42
Powerhive	2	3	4	6	6	7	28
Arnergy	2	3	4	6	6	7	28
Total							1,167

44. The installed capacity associated with the project pipeline displayed in the preceding table is calculated in the table below using the typical size of the mini grids each company is currently developing or operating. This project pipeline is expected to yield a total installed capacity of about 87 MW. Using the US\$4,400 per kW cost guide again, the estimated total cost of this mini grids pipeline is about US\$380 million.

Table 1.4. Mini Grids - Size of Project/Portfolio (MW)

Company	2018	2019	2020	2021	2022	2023	Total
GVE	2.0	3.1	4.1	5.5	6.1	6.8	27.6
Nayo	0.4	0.6	0.8	1.1	1.3	1.4	5.6
CESEL	2.0	3.1	4.2	5.6	6.3	6.9	28.1
Rubitec	0.2	0.3	0.4	0.5	0.5	0.6	2.4
GoSolar	1.1	1.7	2.3	3.0	3.4	3.8	15.2
GreenElec	0.3	0.5	0.6	0.8	0.9	1.0	4.2
Powerhive	0.0	0.3	0.4	0.6	0.6	0.7	2.7
Arnergy	0.1	0.1	0.2	0.2	0.3	0.3	1.1
Total							86.9

45. Estimation of the number of new connections (encompassing both households, commercial users and productive loads) is carried out using an allocation of 250 W per end user for six of the eight companies; actual allocation per user from GVE and CESEL-Renewvia is used to calculate the number of new connections for these two companies. The 250 W allocation is higher than the average Watts per user found in GVE mini grids but lower than that specified by CESEL-Renewvia in its projects under development. The slightly higher value than generally accounted for in rural electrification is warranted by the focus of this project on productive loads. The number of new connections realized if the entire pipeline of 1,167 mini grids amounting to about 87 MW of installed capacity were to be funded is thus estimated at 342,423.



Table 1.5. Mini Grids - Size of Project/Portfolio (# of New Connections)

Company	2018	2019	2020	2021	2022	2023	Total
GVE	11,000	18,000	24,000	32,400	36,000	40,065	161,465
Nayo	1,600	2,500	3,333	4,500	5,000	5,556	22,489
CESEL	4,000	6,250	8,333	11,250	12,500	13,889	56,222
Rubitec	680	1,063	1,417	1,913	2,125	2,361	9,558
GoSolar	4,320	6,750	9,000	12,150	13,500	15,000	60,720
GreenElec	1,200	1,875	2,500	3,375	3,750	4,167	16,867
Powerhive	160	1,250	1,667	2,250	2,500	2,778	10,604
Arnergy	320	500	667	900	1,000	1,111	4,498
Total							342,423

46. The budget required to provide a performance-based grant of US\$350 per connection, which has been estimated by GIZ as sufficient to bring down the tariffs of mini grids in Nigeria to levels within the prevailing ability to pay of rural populations, is calculated to be around US\$120 million for 342,423 new connections, with the balance of US\$260.5 million expected to be mobilized by the private sector.

47. However, since the mini grid sector in Nigeria is still at a nascent stage, it is proposed that this component take a much more conservative estimate of the growth potential of the sector when allocating the budget for performance-based grants and calculating the outcomes in terms of installed capacity and number of new connections served. Therefore, the performance-based grant sub-component has a more modest expectation of supporting the development of 585 mini grids, amounting to 58.5 MW in installed capacity. Applying the same assumptions on power allocation per user, cost per kW, and level of the performance-based grant, these 580 mini grids are expected to serve more than 230,000 customers and require CAPEX of about US\$257 million. With a performance-based grants of US\$350 per new connection, the budget requirement of this sub-component amounts to about US\$80 million. An additional US\$175.5 million would need to be mobilized by private developers in the form of equity, debt or grants from other sources in order to implement these sub-projects.

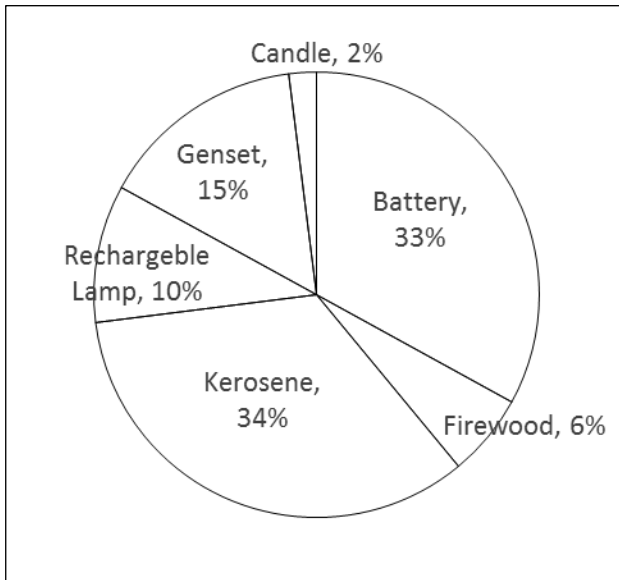
Component 2. Stand-alone Solar Systems for Homes and MSMEs (US\$305 million equivalent, of which IDA US\$75 million equivalent and US\$230 million from private sector funding).

48. Most Nigerians lack access to reliable electricity. Instead, most people rely upon petrol generators, kerosene lanterns, and disposable batteries, and often pay to recharge mobile phones. In most cases, there is a reliable, high quality, solar system that would deliver brighter light and clean energy at a lower cost.

49. This combination of lower cost and better service means that latent demand for solar tends to be high. The gap is one of supply and awareness: the presence of capable providers of solar and/or consumer finance within reach of Nigerian consumers. The focus for accelerating the market therefore is to encourage those capable providers to enter, invest, and reach consumers.



Figure 1.3. Main sources of lighting in households not connected to the grid Source: NBS, GHPS, 2013 and 2015



50. However, the Nigerian market for SHS remains nascent. In 2015, existing solar providers and prospective new entrants were optimistic and buoyant. But, the market was undermined from late 2015 until early 2017 by a variety of factors. The Nigerian currency depreciated sharply, its value remained uncertain, and for long periods it was not possible for importers to access foreign currency at any price. Some providers exited the market, and some potential entrants terminated their market entry plans. Some investors remained in the market only on the back of matching grants.

51. During June 2015 to June 2017, around 350,000 solar lighting and home power systems were sold in Nigeria, the majority of which were single solar lights.



52. The Nigerian SHS sales are currently running at an average of 13,000 units per

month. Today, there are good signs that this rate is now recovering from the macro-economic shocks of 2016 and could rise rapidly especially with increasing utilization of PAYG models. Leading solar providers in the market are confident of substantial growth, and are investing to deliver it.










53. A number of companies with proven capability to drive the market are already operating in Nigeria. International donors have been active to help them begin, and early commercial and impact investors have recently become more active. However, the market is still considered nascent.

54. Nigeria currently has 14 active SHS distributors of Lighting Global quality verified solar products. However, the market is dominated (in both revenue and number of units) by four established providers: Total, D.light, Lumos, and LAPO (Nigeria's largest micro finance bank), who combined account for more than 90 percent of the 350,000 unit sales over the past two years. New entrants and prospective new entrants and start-ups with the capability and ambition to increase the market size by orders of magnitude include: Green Light Planet (world number two in pico solar now moving into PAYG SHS), Rensource (strong Nigerian start-up offering large SHS on pure rental basis), PAS Bboxx (PAYG SHS business), and Arnergy (a growing Nigeria SHS startup).

Figure 1.4. Current and potential solar firms in Nigeria.

Solar Company	Profile
	Lumos - Strong PAYG offer for larger SHS. Partner with MTN (mobile telephone operator). 50 Work Peak (Wp) system. US\$90 m debt facility from OPIC – world’s largest in PAYG solar. 40,000 systems installed to date.
	d.light - World market leader in pico solar with more than 10 million units sold. Well established in Nigeria. Well supported by parent company, but rate of investment constrained by concerns about country risk.



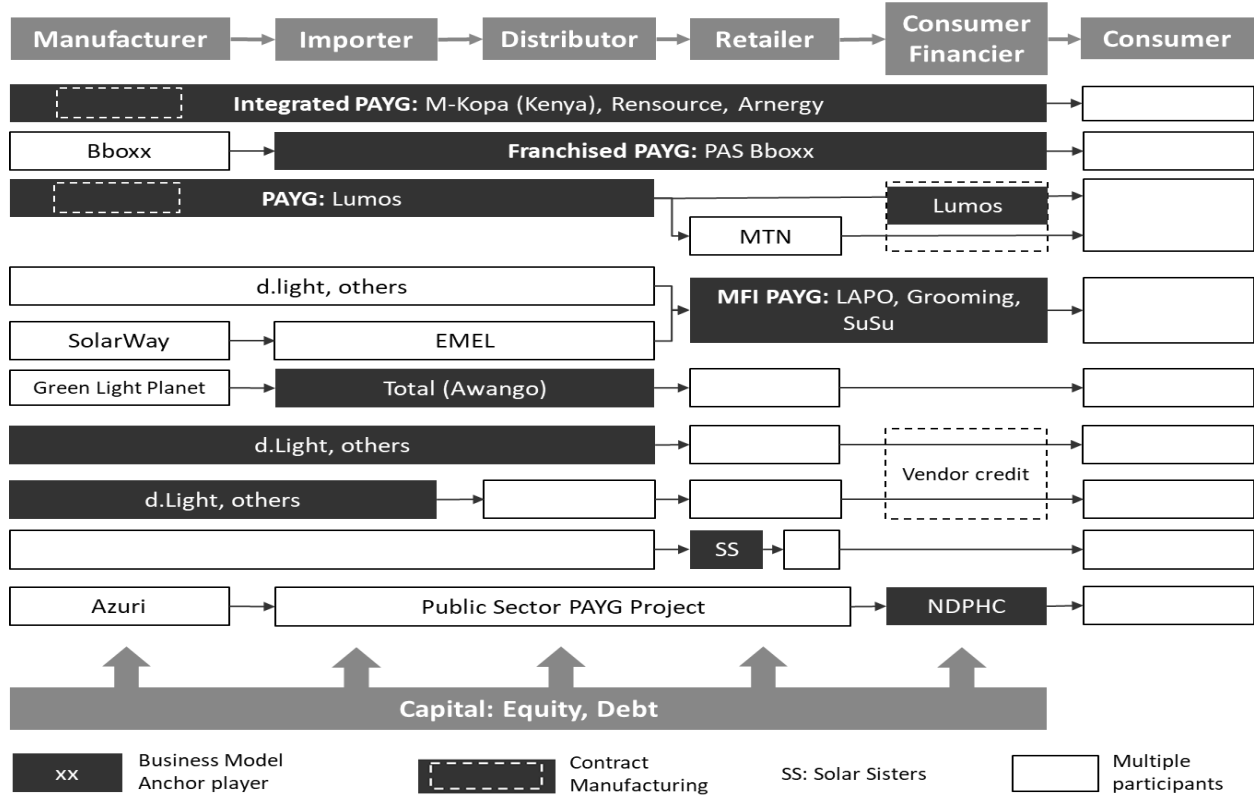
Solar Company	Profile
	Total – a market leader globally and in Nigeria selling pico solar on cash via petrol station dealers. Proven scale for pico solar on cash.
	Bboxx - is an international specialist in SHS PAYG. The franchised PAS Bboxx launched in Kano state in 2017, owned by Pan Africa Solar and a portion of Bboxx equity.
	Azuri - is an international specialist in SHS PAYG. Implementing a government funded 20,000 10 Wp SHS project.
	Green Light Planet - A world leader in pico solar. Commenced Nigerian pilots in 2017 for pico solar and SHS PAYG. Currently raising funding for up-scaling.
	Arnergy - Strong Nigerian start-up with products ranging 30-200 Wp SHS PAYG. Can operate PAYG beyond mobile phone coverage range.
	Renresource - Highly capable local start-up. PAYG for larger home systems and enterprises. Early investors poised to support growth. Recently gained highly competitive participation in XL Africa – Scaling Up Digital Innovation program.
	Lapo - Nigeria’s largest micro finance bank. Has provided finance for more SHS than have been provided via PAYG to date.
	Solar Sister - International specialist in taking pico solar to remote villages. Launched in Nigeria 2015.
	Barefoot Power - International specialist in pico solar. Distributing to Nigeria.

Variety of Business Models

55. SHS companies in Nigeria operate an array of business models. A map of structures across the value chain for the main players is shown below. M-Kopa, while not yet operating in Nigeria, is shown as a reference. For simplicity, the market map does not include elements such as how cash is collected from consumers (leaves out Mobile Money actors).



Figure 1.5. Stand-alone Systems- Business Models



Market Forecast

56. Initial indicative estimations show that with project support, during the five-year implementation period, about 1.5 million households and small enterprises would benefit from full SHSs. Another one million are likely to benefit from small single lamp solar devices, which include a port for charging mobile phones.

57. Market forecasts are built upon estimates of the level of service for which various consumers are likely to be willing to pay²⁷. Experience suggests that even where PAYG finance is available to access the higher levels of service provided by solar, few consumers are willing to pay more per week (or month) initially than they pay now for their basic energy needs (from kerosene, dry cell batteries, or gasoline generator). However, the financial value proposition is quite strong given the payback period and the cost savings from foregoing purchase of costly fuels.

58. Kerosene and gasoline are the principal fuels used for lighting and for power generation, respectively (small household level 0.5 kVA generators. The actual financial cost of the fuels is much higher than what the official government subsidized price indicates. This is due to black market activities and illegal diversions to other sectors resulting in massive mark-ups depending on supply and demand dynamics in different parts of Nigeria. For example, while the official price of kerosene is Naira 83 (around

²⁷ Since the data from MTF surveys has not yet been processed, data from the National Bureau of Statistics General Household Panel Survey 2013 and 2015 were used.

US\$0.25) per liter, the average price paid by consumers in last six months across Nigeria is around Naira 290 (or US\$0.8) per liter.

59. The preliminary five-year forecast includes:

- About 1.5 million homes would select a SHS.
 - A little over half of these would be up to 10 Wp (three lights but including larger single lights that also charge mobile phones).
 - Nearly a third would access a mid-range SHS (enough power for fan and TV and multiple lights).
 - Around 10 percent would be larger home power systems.
- About 1 million homes would select a single solar lamp.
 - Such early adoption of single lamps has proved important in other markets as a step towards higher levels of access. It helps build awareness and confidence in the solar light and power products.

60. It is expected that approximately US\$230 million would be leveraged as private investment in the five years period.²⁸

61. Customer uptake of SHS is very sensitive to price (either cash or PAYG), which is linked to system size. The levels draw upon those described by SEforALL but are adapted for this purpose.²⁹

Table 1.6. Levels of SHS Service:

Product Tiers		Level 1	Level 2	Level 3	Level 4	Level 5	Level 6		
Minimum Capacity	Power (Min Wp)	0.3-<3	3	6	15	50	200	800	2000
	and Daily Capacity (Min Wh)		12	24	60	200	1000	3400	8200
	or Services		Lighting of 1,000 lumens hours per day, phone charging	Min 3 lamps, possible 2,000 lumen hours per day, phone charging	min 3 lamps, phone charging, air circulation possible	Electrical, lighting, air circulation, television, and phone charging are possible			
Minimum Duration	Hours per day(min)	4	4	4	4	4	8	16	23

²⁸ Considering the objective is to support market growth, the SHS sales and thus the private sector leverage is expected to be even higher following the project end date. For a 10-year period (to 2028) it is estimated that the funds leveraged by the private sector may reach over US\$400 million.

²⁹ Only Lighting Global certified products will be eligible for participation under the program. However, for SHS > 350 Wp for which there are no Lighting Global standards yet, there will be verifications that all SHS components meet the relevant international component standards. There will be an assessment of the technical capability of the solar company to not only design and install to adequate standards, but to manage and oversee those standards wherever they operate. Verification may involve some desktop review, evaluation of company team and in-field technical audit by an engineering expert.



Product Tiers		Level 1	Level 2	Level 3	Level 4	Level 5	Level 6		
	Hours per evening (min)	1	1	2	2	2	3	4	4
Retail Price	Min US\$	6	30	80	125	250	800	3200	8000

Sector Challenges and Risks

62. Discussions were held with key partners and private sector companies active in the Nigerian solar market to assess what financial and non-financial barriers exist, which if eased, would enable them to scale quickly and more effectively. Some of the key challenges that solar companies in Nigeria are facing include:

- **Capital – both upfront and working capital – is needed:** To reach and serve large numbers of homes PAYG companies need large amounts of upfront and working capital to fund the portfolio of SHS assets. The key issue is that the companies need (i) working capital to purchase systems in large quantities, and then in addition (ii) the PAYG companies need funding to lease the systems to households – they do not recoup the cost of the system until one-three years later. If companies do not have access to working capital, it is difficult for the market to accelerate.
- **Expansion costs:** To make use of finance for PAYG portfolios or stock in the supply chain, both PAYG and cash sellers must invest very large amounts in building up their ‘soft infrastructure’ to reach and serve customers. Recruitment and training of people, advertising, establishing and fitting out branches/sales points, develop processes and systems to run the business, providing customer service, etc.

63. Additional barriers and risks related to the enabling environment identified include:

- *Import duties* - There is often inconsistency in applying the rates across different product categories in different entry ports. Product cost increases making it harder for consumers to afford.
- *Product standards* - counterfeit and low quality SHS inundating more mature markets that failed to establish enforcement early on has begun in Nigeria. Emerging international standards for SHS are not adopted or enforced in Nigeria. Increased risk that the market is spoiled by poor quality product and capable companies with high standards deterred from investing in Nigeria.
- *Country risk* - Higher perceived risk than other SHS markets in Africa. Key SHS providers and their investors may prefer to invest in other countries, which would significantly slow the development of the Nigerian market.
- *Currency devaluation risk* - the Nigerian currency halved in value between late 2015 and mid-2017 negatively affecting operations of SHS actors, who in turn suffered financial losses. Rates have become more stable although a range of different windows and rates remains.



- *Access to forex* - During parts of 2016, SHS actors were unable to exchange local Naira for US\$ at any price. This meant that US\$ investors or creditors could not be serviced or be certain about future servicing.
- *Collateral* - Nigerian banks have shown a lack of willingness to accept commercial risk with SMEs and are often unwilling to recognize any collateral value in solar assets.
- *High interest rates* - Nigeria is still facing a high interest rate environment. MSME solar providers have been offered (nominal) rates recently between 21 percent and 28 percent, and requiring heavy collateral thus inhibiting access to finance. Much of this has to do with structural issues such as inflation that is running at around 15 percent, exacerbating the problem.
- *Market insights* - Nigeria lacks an in depth, national, and comprehensive description and assessment of the market issues relevant for capable SHS companies to make business decisions.

Financing Instruments and Investment Allocation

- (a) **Performance-based window:** providing fixed incentive payment per system installed
- (b) **Market Scale-Up Challenge window:** providing lump sum grants against strong business plans and other investor co-funding
- (c) **Technical Assistance** – to address financial and non-financial barriers including working with partners on assessing financing options and associated risk mitigation.

Investment Allocation

Table 1.7. Stand-alone Systems: Investment Allocation

Investment	US\$ million	US\$ million
Financing	75	
2.1. Market Scale-up Challenge grants		15
2.2. Performance-based grants		60
Technical Assistance	5	
Total	80	

Component 2.1: Market Scale-up Challenge Grants (IDA US\$15 million equivalent)

64. *The purpose of the Market Scale-up Challenge Grants:* the instrument will offer up-front grants to the strongest and most capable providers, against robust business plans and other co-funding. The main purpose of this instrument will be to reduce the risk to investors and to commit larger investments needed to drive faster reach to consumers and accelerate their capacity to reach and serve Nigerian households and MSMEs at scale. Grant funds can also be used directly by grantees to provide additional direct working capital to enable faster investment in the activity and inventory needed to move quickly.

65. *Rationale:* SHS scale rapidly when very capable private companies and their investors commit and invest. Nigeria presents additional barriers to such companies compared with other places they can invest: local debt is limited and very high cost, forex access remains a risk, and upfront capital investments are significant especially for PAYG business models with capacity of expanding faster who will need to lock



down significant amount of capital upfront. In this setting, lump sum grants can act to secure their investment into scaling the Nigeria market.

66. *Robust evaluation process.* In addition to the pre-qualification criteria applied to the Performance-based grants, access to the Challenge fund will require strong evidence that the applicant possesses all of the capabilities necessary to scale massively and rapidly. Solar companies that bid for the grants will have to show that they have been able to /are in the process of leveraging equity or debt financing to support their growth in their core market. Additional criteria will emphasize business plan that is investment worthy and of international standard; senior management team that is deep and capable across all key disciplines including consumer marketing, consumer finance, IT, logistics, FM, business process management; commitment to high sales targets; credible pathway to mobilizing the substantial capital required to grow.

67. *Phased disbursement against milestones:* Provision of lump sum grants will likely be provided released over several quarters as the grantees meet their commitments per their business proposal.

68. Potential complementary financing efforts under development by partners are being considered AfDB has established a US\$100 million regional financing facility for off grid energy a considerable amount of which is expected to benefit companies operating or planning to enter Nigeria (US\$25 million). Agencies such as All-On (an impact investment vehicle created by Shell Foundation) including with partners are currently at inception for a concessional finance facility given the prohibitively high interest rates and need for debt offering SHS securitization. The engagement of multiple partners in the sector at this time is mutually reassuring as it aims to provide adequate forms of financing for firms at different stages of growth and with different financial constraints. However, a gap in access to finance for working capital in form of local debt remains a key barrier for company growth.

69. The task team will coordinate closely with the complementary Regional Off Grid Electrification Project for West Africa, which will be focusing on a set of West African countries and will look into risk mitigation for access to finance for solar companies and may establish a regional credit facility to address some of the key barriers mentioned above. This regional project's funds for Nigeria are constrained by the fact that it will support 18 countries. To this end, the regional project will not invest IDA funds in Nigeria to avoid overlap with investments in the proposed NEP. Hence, the proposed project's funds will complement the regional project.

Component 2.2: Performance-based Grants (IDA US\$60 million equivalent)

70. *The purpose of these grants* is to enable capable solar providers to reach and serve larger numbers of customers more rapidly.

71. *Rationale:* Expanding reach is costly; it requires significant investment in soft infrastructure: people, training, advertising, increased working capital, processes, logistics, etc. Underpinning a portion of those costs enables capable solar providers to more rapidly reach and serve larger numbers of customers. The qualification criteria will place less emphasis than the Market Scale-up Challenge grants on evidence that the applicant has the ability to scale. This enables strong new entrants and capable Nigerian start-ups to begin slowly with little risk some of which may then become large and capable of scaling up.



72. Providing the grant against each system after installation also means that the Grants Administrator and REA in its oversight role are able to better account for the support provided as well as track, and automatically direct the grant proportionally towards those solar providers that are proving most successful in serving more customers as well as those that provide a higher level of service, which is one of REA's strategic goals.

73. Due to FGN's and REA's strategic goal in providing a large number of consumers with higher level of service that go beyond single lamp solar devices, the investment is directed towards supporting access to SHSs (>3 Wp), with some incidental support to smaller single solar lamps (< 3 Wp). It is recognized that single solar lamps still have a very significant value proposition, and are an important stepping stone to climbing toward higher forms of access.

74. *Pre-qualification of eligible providers:* The aim of the pre-qualification for Performance-based Grants is that the applicant has all of the capabilities needed to deliver quality equipment, service and after sales service to customers and will have the internal integrity and rigor to cope with the reporting and audit requirements attached to the grant. The Pre-qualification will focus on technical standards of the solar PV products, business integrity, competence in financial administration, legal compliance, technical delivery, warranty and its delivery, etc.

75. *Performance-based level of support:* Performance-based Grants will be paid for each system installed as a pre-defined amount per system (likely ranging from 15-20 percent of the nominal retail price). SHS will be categorized into several Tiers based on capacity and service. Within each Tier of SHS, a single unit rate of Performance-based Grant will be set to be paid against all systems. The grant amount per system (Unit Rate) will vary across several categories of solar product. The support paid per system will reduce over the life of the program, to a nominal level during the final period of the program and the support level reviewed progressively.

76. *Business model neutral:* All business models are eligible. The Performance-based Grant amount is the same whether the SHS is provided to the customer as a cash sale, loan from a bank or micro-bank, integrated PAYG, pure PPA or operating lease, or some other variant of these basic models.

77. *No subsidy on end-user price:* Solar providers would decide how best to use the grant funds received. The Performance-based Grants will form just a small portion of the revenues and expenditures: however, customers will still be required to pay commercial prices and solar providers will invest this portion of the gross margin on business growth (accelerate the expansion of their sales, logistics and after sales capability, increase advertising, pricing strategies, etc.,) Verification will ensure that if there is application of grants to reduce price then support levels may be reviewed down.

78. *Verification.* A risk based approach to verification with escalating levels of verification - to balance cost with benefits - will be designed. Integrated PAYG operators expected to have very high data integrity and some non-importer solar providers with close ties to consumers such as microfinance banks can be expected to have good customer evidence. Others that mostly focus on cash sales in areas with poor communication coverage will be through field verification by the verifying agency.

Implementation Arrangements

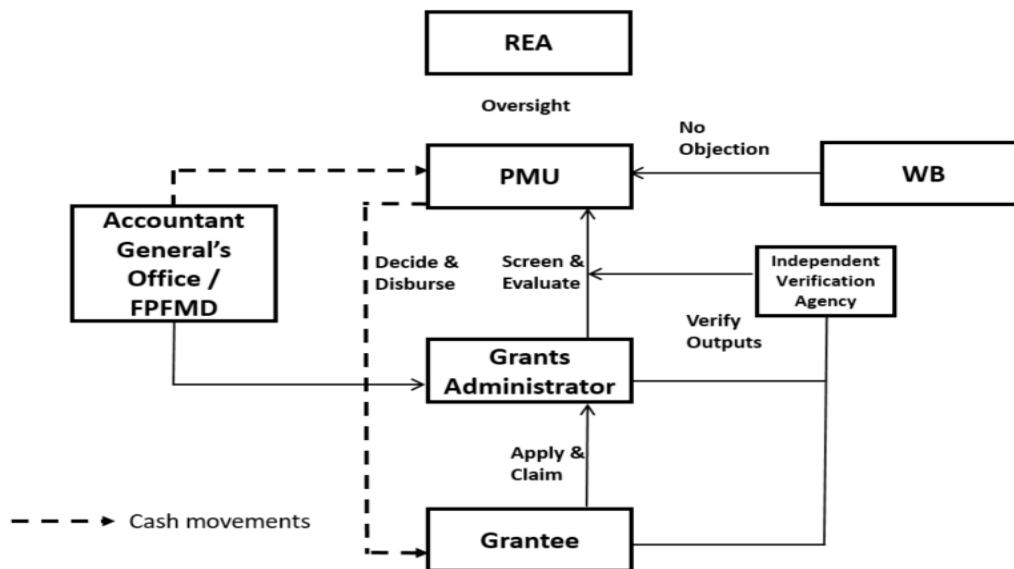
79. The implementation arrangements for this component will entail competitive selection of a Grants Administrator firm to manage the day to day operations of the financial support aspects of the component with REA remaining in the oversight role. The benefits of an expert third party for managing the operational elements of this component are:



- deep technical expertise in evaluating and appraising solar business models can be highly complex and time consuming,
- adequate bandwidth and capacity is required to minimize any delays with disbursement considering the cash flow needs and the dynamic nature of the solar companies,
- having the operations be managed by a dedicated entity may send a positive signal to the private sector companies and increase confidence in participation, and
- the Grants Administrator may have the capacity to integrate and manage the monitoring and verification process.

80. Initially, the contract will be combined to reduce overhead with the firm carrying out the monitoring and verification of the systems for the performance-based support and to ensure compliance with the grant terms. With the volume of sales increasing, this is expected to be separated into two contracts. The Grants Administrator will report to REA and submit regular progress reports. REA will continue to supervise the activities under the Component, including hiring of the Grants Administrator. The Technical evaluation of systems and companies for the systems larger than 350 Wp will be conducted by a third party international expert. The detailed guidelines for the component will be codified in the Project Implementation Manual.

Figure 1.6. Flow of Funds



Component 3. Energizing Education (US\$105 million equivalent from IDA).

81. The component is expected to provide new or improved service to seven universities and teaching hospitals, serving approximately 120,000 people. This is Phase 2 of the Energizing Education Program (EEP). Phase 1 of the EE program is currently being implemented by REA with exclusively FGN funds. The aim of the EEP is to provide reliable, affordable and sustainable power to Federal Universities and Teaching Hospitals.

82. For the purposes of the EEP, reliability, affordability, and sustainability will be defined as follows:



- From a design perspective, **reliability** parameters will be agreed in terms of percentage of load served over a year. This may vary for high priority loads (e.g. water supply) and interruptible loads (e.g. dormitories during daytime hours). For example, the design for high priority loads may use a 99 percent reliability factor, while service to other loads may be designed for a 95 percent reliability factor.
- **Affordability** will be considered attained if the operational expenditure (fuel plus O&M) is less than or equal to the available budget of the users of the electricity.
- Prospects for **Sustainability** will be assessed based on a satisfactory appraisal of:
 - engineering design
 - budgeting approach
 - operation and maintenance arrangements
 - system administration (REA and University roles)

83. Universities and teaching hospitals selected for Phase 1 are listed in Table 1.8. Initial estimates for both the power system type (solar hybrid or gas-fired reciprocating engines) as well as system peak capacity are also provided. These estimates are based on REA’s scoping of 40 Federal Universities, nine Teaching Hospitals, and eight city campuses.

Table 1.8. Energizing Education - Phase 1 Institutions – Financed by FGN Exclusively.

#	University	State	Region	Power Type	Capacity (MW)
1	Federal University of Agriculture Makurdi	Benue	North Central	Solar Hybrid	3.5
2	Abubakar Tafawa Balewa University	Bauchi	North East	Solar Hybrid	0.5
3	Usuman Danfodio University	Sokoto	North West	Solar Hybrid	2.0
4	Bayero University	Kano	Kano North West	Solar Hybrid	3.0
5	Federal University Ndufu-Alike	Ikwo	Ebonyi South East	Solar Hybrid	1.0
6	Nnamdi Azikwe University	Awka	Anambra South East	Solar Hybrid	2.0
7	Federal University of Petroleum Effurun	Delta South	South	Solar Hybrid	0.5
8	Obafemi Awolowo University	Osun	South West	Gas	8.0
9	University of Lagos	Lagos	South West	Gas	8.0

84. **Phase 2.** World Bank funds will finance Phase 2 of the EEP. As with the other components, this component will also be implemented by REA, which will lead the design, installation, operation, and maintenance of the systems.

85. On behalf of FGN, REA will take ownership of the systems and assume responsibility for EPC and O&M contract oversight. REA will sign a Memorandum of Understanding with each of the recipient universities, which clearly lays out the roles, and responsibilities of each party (see details below). Payment for the capital expenses will be through this project. Operating expenditures, including the O&M contract for each site as well as fuel, will initially be financed through the project budget.



86. Arrangements for extending the O&M financing after the project period will be finalized prior to Phase 2 implementation. Several options are under consideration, including: universities paying directly from their own budgets; establishing a federal budget line item expressly for this cost; transferring the assets to universities for their operation; or, covering remaining costs in a follow-on Bank-supported project. All of these solutions have serious complicating factors, and this issue is clearly the highest risk element of the component.

87. The FGN is actively moving to address the over-arching issues currently affecting the power sector's ability to deliver high quality service to customers. The World Bank is supporting this effort through a suite of ongoing and proposed operations. In view of the serious and long-standing nature of these issues, it is difficult to predict the pace at which the current efforts will result in improved service to the universities included in the EE Program.

88. Following the initial installation of the dedicated power systems under this NEP, the evolution of the EEP power systems at each campus will depend in part on the progress with the broader power sector reform effort. If reforms move swiftly, and high quality service is available through the DISCOs, the EEP power systems would be converted to Independent Power Producers feeding power into the DISCO grid. Under a scenario of slower sector reform progress, the EEP power systems could potentially be used to serve the surrounding community under a mini grid model similar to Component 1.

89. **EPC and O&M contracts.** REA will contract with competitively selected EPC contractors to build, operate and maintain the power plants at each site and also build and equip the training center. The procurement will allow bidders to bid on one or several sites. Each bidder will also be requested to include a five year O&M contract for the power station.

90. The activities related to building and operating the power systems will cover two distinct contractual phases: The EPC phase and the O&M phase. REA will be the FGN signatory for both. Under the EPC contract, the developer is responsible for building the power system, street lighting (see below), and constructing and equipping a training center. Upgrading of the existing campus distribution system may also be included depending on the system condition on each campus. The scope of the O&M contract includes five years of operation and maintenance of the generation facilities³⁰. O&M contracts will be offered to EPC contractors upon satisfactory work progress, but may also be offered to other companies, since the EPC contract does not bind REA to the EPC contractor for the O&M contract. The sustainability of this arrangement and the viability of alternate arrangements will be explored further during project preparation, especially in light of Phase 1 experience.

91. **Power station.** The program will install dedicated power stations at each of the university sites that will serve the campus independently from the DISCO system. The physical DISCO connection will be maintained, although electrically disconnected. Existing university-owned generators (mostly diesel) will be evaluated by the bidders during pre-bid site visits for potential inclusion in the dedicated power station. However, REA's initial inspection of university generation plants suggests that many are nearing the end of their useful life and would not be suitable for the new power station. Therefore, most EPC contracts are expected to include installation of a full capacity power station, including the diesel or gas-fired portion as appropriate.

³⁰ Maintenance of the campus distribution system will remain the responsibility of the university's facility staff.



92. Solar hybrid systems will be strongly favored, with gas-fired reciprocating engines as the preferred backup option³¹. The system would feature a modular design with the initial investment sized to serve the current electricity demand. REA staff have undertaken an initial assessment of the electricity demand, physical aspects of the university, and other factors for each of the EEP university campuses. They are now in the process of implementing extended (i.e. one-to-two-week) demand assessments which will be the basis for the conceptual design to be included in the tender documents. The design will be informed by E&S impact/mitigation studies, also commissioned and overseen by REA.

93. **Existing equipment.** During the detailed assessment phase, undertaken during the first year of the project, REA staff will review the campus' electricity distribution system to assess the need for repairs/upgrades. They will also perform a first-level energy efficiency audit to identify major energy savings opportunities. Necessary distribution system repairs/upgrades and the energy savings opportunities, as well as the prepayment meters will be included under the Bank-financed program. These may be included in the EPC contract (e.g. distribution repairs/upgrades) or may be financed under a separate contract (e.g. energy efficiency).

94. **Street lighting.** A street lighting system will be included to improve quality of campus life, particularly safety. This system will be designed in parallel with the power system design. The design will require a high level of reliability, given the high priority accorded to street lighting. In many cases, this is likely to result in autonomous or semi-autonomous solar street lights. However, systems powered by the main power system will also be considered. Street lighting was included in the EPC contracts under Phase 1. This approach will also be included for Phase 2. Final decisions will be based on each campus' unique characteristics.

95. **Training facilities.** The EEP includes a focus on power system training with an emphasis on renewable energy. To this end, the EPC contract will include the erection and equipping of a training facility. The aim of this facility is to provide practical vocational level training to improve job prospects. Certificate programs will be the focus, aimed at high value staffing needs of the Nigerian power sector and high quality training programs offered by leading international firms will be considered. REA will seek inputs from private firms on their employment needs, and coordinate with the National University Commission as well as universities on the curriculum to be offered.

96. **University role.** Universities would be required to provide suitable land for the power station, and provide access, security, etc. for the EPC and O&M contractor during and after the contract period. Universities will also be responsible for maintaining the campus electricity distribution system, as well as sustainable use of the power system. In view of the fixed capacity of the power station, system usage will require allocation of the available capacity and energy among the various users on campus. For this purpose, prepayment metering systems will be installed throughout the campuses. These will serve to limit both the peak and energy consumption in-line with allocations for each building or department. Smart, prepayment meters will be financed under the World Bank-supported project.

97. REA will sign a Memorandum of Understanding with each university clearly laying out the roles and responsibilities of the parties. These will be prepared and negotiated in the first year of project execution. Under the terms of the MOU, the university will be responsible for operation of the prepayment metering system for allocation and usage of the power on campus. Universities will be

³¹ Compressed natural gas (CNG) is available for delivery in southern Nigeria. In the central and northern regions, Liquefied natural gas (LNG) would be needed to cost effectively transport the fuel. The Nigerian LNG market remains nascent, which may preclude this option for sites in this region.



encouraged to convene an oversight committee with representation from students, faculty, administration, alumnus, etc., to advise on allocation practices, hear grievances, etc.

98. **The investment cost** for this component is estimated at US\$105 million. This is based on the current REA designs (solar or gas) as well as sizing for the university power systems, and conservative estimates for the system costs. All of these factors are subject to change. System design and sizing will be refined based on a more detailed assessment of each university campus (see Readiness and timeline below).

99. **Investment pipeline and portfolio.** The proposed World Bank-supported project will focus on the selected universities and teaching hospitals that comprise Phase 2 of the EEP. Sites will be selected to represent each of the six geopolitical zones. Depending on the implementation timeline and results of Phase 2, and on the available budget, additional universities could be financed under the proposed project.

100. **Readiness and timeline.** REA has drafted a detailed timeline to guide preparation and implementation of EEP Phase 2. Completion of the conceptual design and tender package are the key critical path items. Perhaps the most critical on this path is monitoring the electricity demand at each university over a representative period. REA is in the process of procuring the needed equipment (primarily data loggers and diesel fuel for the two-week testing period) to be financed under the project preparation advance. This is fundamental to starting the design process.

Figure 1.7. Energizing Education Portfolio of Sites



101. Other important inputs to the design and tender package include:

- **Site information**, including the physical layout of the campus; single-line diagram of the campus electrical system; proposed location for the project investments.



- **Environmental and social assessment**, which is needed to finalize locations for physical investments (power station, solar field, training center, etc.) and to identify any mitigation requirements, which must be included in the EPC and/or O&M contract.
- **Legal and contractual arrangements**, including the draft EPC and O&M contracts which must be included in the tender package; MoU/inter-agency agreements between REA and each of the universities defining the roles and responsibilities of the parties (REA, University, EPC and O&M contractor)
- **Energy efficiency assessment (energy audit)**, identifying major efficiency improvement opportunities, including estimated costs and payback, and proposed funding and implementation approach.
- **Assessment of existing generation and distribution equipment**, including location, maintenance history, serviceability in new power system; need for repair/refurbishment/replacement, etc.
- **Potential for phasing of the new power system**, including consideration of sites separate from the main campus; need and potential for modular additions, etc.
- **Definition of the training program**, will need to be determined at least to the extent that the nature of the program affects the design of the facility to be built and equipped by the EPC contractor. If the contractor will be involved in the training program itself, this also will need to be decided and included in the tender document.

102. **Bid documents and Project Implementation Manual.** REA has completed an initial assessment of all the planned Energizing Education sites (40 universities and nine teaching hospitals). Building on this information as well as Phase 1 experience to date, Phase 2 will include: i) more detailed design and engineering specifications, based on a more thorough demand assessment; ii) strong emphasis on solar hybrid systems, including for sites initially earmarked by REA for gas-fired generation; iii) emphasis on both supply and demand-side energy efficiency; iv) a more comprehensive agreement on roles and responsibilities among the parties (universities, REA, contractors); and v) full compliance with World Bank procurement procedures.

Component 4. Technical Assistance (US\$25 million equivalent, of which US\$20 million equivalent from IDA and US\$5 million equivalent from counterpart funding).

103. This component will support project implementation and broad capacity building in FMPWH and REA that will be useful beyond this project. This component will finance project implementation as well as help build a framework for rural electrification.

Component 4.1: Strengthening Implementation Capabilities (IDA US\$4.0 million equivalent)

104. This support will fund REA's PMU, REA's technical, management, financial and administrative staff in Abuja and staff in the six regional offices, and the Grants Administrator. Support for institutional strengthening related to energy access will also be provided to key stakeholders including FMPWH, mini grid developers, solar companies and universities. It will also support a variety of REA activities, including engineering design and project management for Energizing Education (Component 3), and the Minimum Subsidy tender of Component 1.



105. In addition, the technical assistance will help build the capacity of local banks to lend to mini grid and stand-alone solar projects, in coordination with the IFC and the World Bank's finance experts. This activity will improve the local financial institutions' understanding of mini-grid costs, revenues and risks and allow them to better appraise loan applications from mini-grid project developers. The CBN has made low cost funds available to PFIs to on-lend at maximum interest rate of 9 percent, and mini-grid developers are eligible for these loans, but uptake has been negligible due to limited interest and appetite from the financial institutions³². Grant funding from this project will ideally need to be complemented by commercial debt financing, and there is therefore an urgent need to sensitive and develop the capacity of local financial institutions to appraise mini-grid projects. Eligible activities may include training delivered by mini-grid experts and financial analysts familiar with mini-grid economics as well as study visits to countries with significant numbers of mini-grids deployed to consult with the financial institutions that have lent to such projects and learn from their experience.

106. This activity will also build capacity of existing mini-grid developers and other private companies interested in entering the mini-grid market to identify sites viable for mini-grid development, mobilize community engagement, establish business relationships with reputable vendors, develop bankable business plans with realistic load models and revenue forecasts, and ensure implementation of E&S safeguards.

Component 4.2: Strategy and Pipeline Development (IDA US\$3.0 million equivalent)

107. This will be a vehicle for developing a pipeline of investments (including, but also beyond, those identified during project preparation) in mini grids and stand-alone solar systems. It will finance the development of an electrification strategy and a least-cost geospatial electricity mini grid and off-grid rollout plan in a participatory manner, bringing together FMPWH, development agencies, private sector (including developers and financiers), and communities. This will include, but not be limited to, energy demand studies, surveys and community identification for developing solar mini grids and individual solar systems.

108. To identify sites feasible for mini-grid deployment and help developers determine financial viability, this activity will support nation-wide geospatial analysis and survey data collection. Specifically, this activity will finance determination of electrification status using satellite imagery and customized algorithms, manual building mapping of residential and non-residential structures in unelectrified communities, and surveys to collect socio-economic data and record consumption behavior in order to build customized load profiles and develop preliminary financial analyses. These outputs may be used to provide market intelligence to prospective developers prospecting for candidate mini-grid sites or serve as the basis for additional mini-grid tenders to be issued by REA.

Component 4.3: Analytical Work on Finance Constraints (IDA US\$1.0 million equivalent)

109. During the first year of the project, a detailed assessment will be conducted aimed at determining financing constraints for private sector enterprises engaged in delivery of solar products. The assessment will provide recommendations regarding the potential design of novel and sustainable financing instruments, including the possibility of establishing a credit line for this purpose. This assessment will be conducted in conjunction with the World Bank's Finance, Competitiveness and Innovation Global Practice. Potential interventions resulting from this assessment will be designed in alignment with ongoing financial

³² The reference to CBN's development finance schemes is illustrative only and is not an endorsement of central bank's quasi fiscal activities.



sector policy dialogue and projects and World Bank's IPF Policy – financial intermediary financing - which consists of the four focus areas described below.

110. As local currency debt finance is constrained in Nigeria, collaboration is established with potential lenders to mini grid developers, including the World Bank supported MSME fund, commercial banks, private equity funds and other development partners. Other development partners have initiated complementary initiatives that address this barrier and, together with the grant financing proposed through this project, these initiatives are expected to close the viability gap for mini grid investments. Table 2 lists these potential sources of debt and equity financing for mini grid developers in Nigeria.

111. Private solar firms have been constrained by limited access to affordable credit from local financial institutions and market intelligence. Many companies are struggling to secure equity investment from impact investors. Solar firms will need donor funding to leadoff their investments. Sales to lower income households are constrained by the lack of resources to expand reach to these segments. This is particularly the case for geographical areas with low population densities, where the costs of delivery are significantly higher.

Component 4.4: Evolving Regulatory Environment (IDA US\$1.5 million equivalent)

112. The NERC Regulations for Mini-grids take important first steps towards creating an enabling environment for private sector development of mini grids. This activity will assist NERC in operationalizing the new regulations. Furthermore, as deployment of mini-grids is scaled up in the country, these first-generation regulations may need to be updated and strengthened with feedback from private sector developers and based on experience on the ground. The activity will also include a review of the implementation of the first-generation NERC regulations, its impact on mini-grid development, and guidance on improving the regulations.

Component 4.5: Mini Grid Pre-Investment Activities (IDA US\$2.5 million equivalent)

113. These are part of the ongoing support. REA will procure a firm to establish a pre-investment support program to mini grid developers to mitigate the risk involved in the early stages of project development. These grants may be used to finance feasibility studies, and preparation of business plans and E&S safeguards assessments.

Component 4.6: Stand-alone Solar Systems Technical Assistance (IDA US\$5.0 million equivalent)

114. Technical assistance will help mitigate the market and regulatory barriers, to make the financing support to the private sector go further and help the sector grow and mature. Several TA support pieces were identified during the preparation mission to address the market and regulatory barriers:

- An extensive national **market study** to identify the needs and market opportunities at the household level through establishing energy demand for different levels of service and market segmentation. The study is likely to build on the MTF household survey scheduled to be carried out in the next few months. The study would provide insights that will help companies to decide where to target their services.
- Targeted **sensitization campaign** focusing on consumer awareness and sales promotion to support all eligible providers (currently supported by Lighting Africa Nigeria).
- **Value chain integration** for importers and distributors to establish new partnerships and further expand their networks (also currently supported by Lighting Africa Nigeria).



- **Incubation and technical advice** to new entrant solar companies to help them develop missing capacities, refine and develop business strategy, and support them in engaging with and attracting investors.
- Adoption of Lighting Global **standards** for solar products in Nigeria will require testing and enforcement capability. Lighting Africa with Standards Organization of Nigeria and ECOWAS are presently leading this effort, which will require further support.

Component 4.7: E&S Safeguards (IDA US\$2.5 million equivalent)

115. This will cover:

- (a) **Citizen engagement**, which will support the education and awareness under the project’s key delivery areas namely households, small businesses, universities. The initiative will equally prioritize men and women as a prime target audience. It is in project’s interest to reach women who will be the end users of the proposed solar solutions. The initiative is proposed to address the following:
 - (i) initial reservation in the adoption of a new technology for communities and households (for both solar mini-grids and SHS);
 - (ii) buyer inability to make informed purchasing decisions and decipher quality in the market;
 - (iii) importance and advantages of conserving energy; and
 - (iv) E&S awareness for solar technologies, such as recycling/ proper disposal of batteries.
- (b) **Developing strategic solutions for E&S risk management for the off-grid solar market.** This will support developing programmatic approaches to address key strategic challenges identified, which are
 - (i) land issues and competing land use challenges for mini-grids; and
 - (ii) waste management, and more specifically, battery storage and recycling; and need for harmonization of E&S standards among private mini-grid developers and their financiers.

Table 1.9. Estimated E&S budget

Environmental & Social Activities	US\$
1. Strengthening REA’s E&S capacity	600,000
2. Design and implementation of a GRM	400,000
3. Training and support to mini grid developers for ESMS development and implementation	200,000
4. Developing strategic solutions for E&S risk management for the off-grid solar market	700,000
<i>4a. Battery recycling</i>	<i>300,000</i>
<i>4b. Land acquisition and resettlement</i>	<i>250,000</i>
<i>4c. Policy/ standards harmonization</i>	<i>150,000</i>
5. Community engagement and sensitization campaigns	400,000
6. Gender actions implementation	400,000



Environmental & Social Activities	US\$
<i>6a. Enhancing gender aspects of mini-grids and increasing productive uses of energy for female farmers and businesses</i>	<i>200,000</i>
<i>6b. Earmarked grants to address gender gaps in off-grid value chain</i>	<i>150,000</i>
<i>6c. GBV prevention and response</i>	<i>50,000</i>
Total	2,500,000

Component 4.8: Support for Local Supply Chain Development (IDA US\$0.5 million equivalent)

116. While most major electro-mechanical components for mini-grid projects are imported today, given the scale of the Nigerian market, there may be scope for local assembly and, possibly, manufacturing. This consultancy assignment will map the supply chain for mini-grid components in Nigeria, assess the potential for local assembly and/or manufacturing, and provide concrete recommendations on the type and scale of support necessary to catalyse development of such industries in Nigeria.



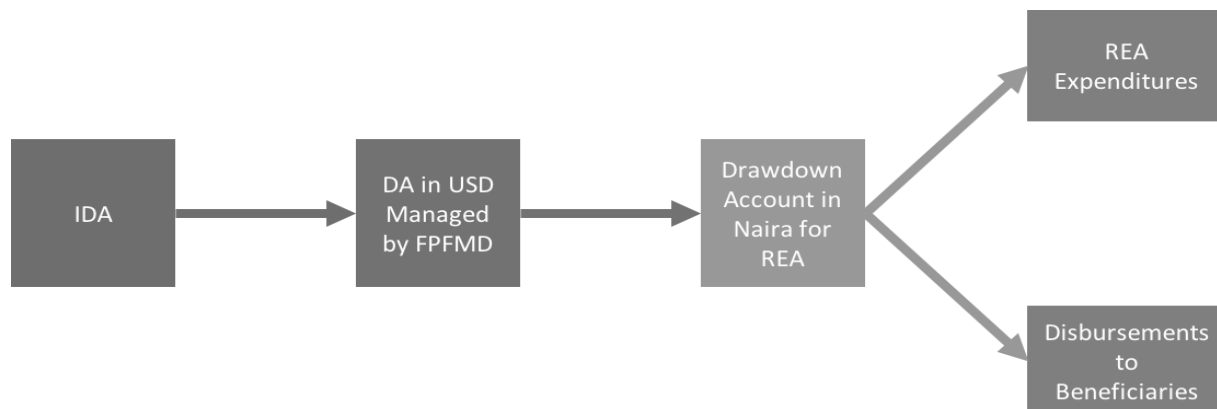
ANNEX 2: IMPLEMENTATION ARRANGEMENTS

COUNTRY: Nigeria Nigeria Electrification Project

Financial Management

1. The responsibility for establishing and maintaining acceptable FM arrangements for the project will be handled by the PPFMD at the Office of Accountant General of the FGB. The Federal Treasury Circular of March 2010 established the PPFMD in the OAGF to handle the FM responsibilities for funds provided to MDAs by Donor Partners. The PPFMD is a multi-donor and multi-project FM platform, established at the federal level through the joint efforts of the World Bank and the government.
2. A summary of the FM issues according to the six FM elements of budgeting, funds flow, accounting, internal control, financial reporting, and audit are as explained below.
3. **Budgeting.** The project funds will be factored into the national annual budget under the Federal Ministry of Finance and captured in GIFMIS. REA will also capture the project activities in its annual budget.
4. **Funds Flow Arrangements.** There would be one designated account (DA) established in US Dollars at the CBN for the IDA credit for this proposed project. This account would be managed by the PPFMD. Funds from the DA would be transferred to a Transactions Account, opened in the CBN in accordance with FGN's Single Treasury Account policy, to meet eligible expenditures in local currency, provided that transactions and balances in these accounts are included in all project financial reports.
5. The PMU at REA would draw funds from the Transaction Account and then disburse directly to mini grid developers (Component 1), and EPC and O&M contractors of the power plants at the designated universities (Component 3). An arrangement has been discussed for the Grant Administrator to receive periodic advances from the PMU to support directly the stand-alone solar system providers when the program reaches significant scale (thousands of transactions per month) to allow for timely processing of the requests. The necessity of this will be reviewed during project implementation as well as be part of the mid-term evaluation (Component 2). The PMU would also draw from this account to fund the project support and technical assistance activities under Component 4.

Figure 2.1. Project Flow of Funds Diagram





6. Statement of Expenditures (SoE) disbursement method would be used as the basis for the withdrawal of IDA funds. The project provides for the use of advances, reimbursements and direct payments as acceptable disbursement methods, and these would be specified in the disbursement letters. Supporting documentation would be retained by the REA for review by the World Bank and external auditors.
7. **Accounting Arrangements.** The FPFMD, which oversees the FM of the project, will designate from the pool of professional accountants in the Office of Accountant General a project accountant, project internal auditor, and other support accounting technicians that will make for appropriate segregation of duties. The FPFMD will render annual audited financial statements and periodic unaudited IFRs in the format and frequency, which will be agreed, submitting them to the World Bank within agreed timelines. The GIFMIS will be used and shall be configured in line with the formats of the IFR and the annual financial statements. The project bank account at the Federal level will be opened with the CBN.
8. For its part, REA maintains accounting practices and software that meet the Financial Reporting Council of Nigeria's (FRCN) accounting standards. The Project Accountant assigned by FPFMD as part of this project will ensure that the accounting practices and subsequent reports not only meet FRCN's standards but also are also acceptable to the World Bank.
9. **Internal Controls.** The FPFMD features robust systems and controls. The FPFMD is presently involved in the implementation of several World Bank-assisted projects. The World Bank's recent review showed that this unit has been performing satisfactorily. REA's internal controls for FM have been assessed as requiring further capacity development, hence the assignment of a Project Accountant by FPFMD to the PMU.
10. **Financial Reporting.** FPFMD has adequate capacity to meet the World Bank's financial reporting requirements, as evidenced by their prior work in other World Bank-supported projects. REA already conducts financial reporting through the course of its normal business, and further capacity development on financial reporting will be provided as needed through the proposed project's capacity building activities.
11. REA will submit quarterly reports to the World Bank within 45 days after the end of each calendar quarter and also to the FPFMD by the 15th day of the following month. The annual financial statements will be submitted to the World Bank and FPFMD by not later than September 30, being three months after the end of the fiscal year. The format of the financial reports will remain the same as that being used for other World Bank-financed projects involving FPFMD.
12. **Audit Arrangements.** Annual audits would be conducted at the end of each fiscal year by independent and qualified auditors, acceptable to the World Bank. The auditors would be selected on a competitive basis in accordance with the World Bank's procurement guidelines. The terms of reference (ToR) of the auditors would be cleared by the World Bank. The project would select the auditor within four months of the start of project implementation. The project financial statements including movements in the DA would be audited in accordance with International Standards on Auditing (ISA) and a single opinion would be issued to cover the project financial statements in accordance with the World Bank's audit policy. The auditors' report and opinion in respect to the financial statements, including the management letter, would be furnished to the World Bank within six months after the end of each fiscal year.



13. **FM Risk Assessment and Mitigation Strategies.** The overall FM risk for the project is assessed as Substantial at the preparation phase. This is mainly because of the inherent risks and issues of developing a large number of small, disparate, electrification projects nationwide, not due to the control risks associated with the basic elements of the project FM arrangement. However, these inherent risks are well mitigated by the use of the FPFMD, which features robust controls (internal and external).

14. With the mitigation measures, the **residual FM risk is Substantial.** The mitigation measures include use of computerized accounting systems, professionally qualified and experienced FM staff, and independent and effective internal audit that will adopt risk-based internal audit methodology involving risk mapping and other best practices. The Financial Procedures Manual for the proposed project will detail adequate internal controls, which will include an enhanced accountability framework over soft expenditures (travel, study tours, workshops, training, etc.) that will be incurred during the project implementation. Regular reporting arrangements and supervision plans will also ensure that the implementation of the project is closely monitored and that appropriate remedial actions are taken expeditiously. The FM risks will be reviewed during project implementation and updated as appropriate.

15. **Financial Management Action Plan.** The plan in Table 2.1 indicates the actions to be taken for the project to strengthen its FM system and the completion dates.

Table 2.1. FM Action Plan

	Action	Due Date
1.	Opening of a DA and communicating the details of the bank account and signatories to IDA	Immediately on signing of the Financial Agreement
2.	Training project FM staff on World Bank FM and Disbursement Guidelines	Annually
3.	Internal audit review by FPFMD	Annually
4.	External audit review by third party auditors	Annually

16. **Conclusion.** The results of the assessment indicate that the overall FM arrangements satisfy the World Bank’s minimum requirements under OP/BP 10.02 and are therefore adequate to provide, with reasonable assurance, accurate and timely information on the status of the project as required by the World Bank. The FM residual risk for the project is Substantial.

Disbursements

17. A flexible ceiling will be applicable to the DA and Transaction Account. The ceiling will be derived from approved work plan and budget, and will be equivalent to six months expenditure forecast. The ceiling will be reviewed annually and revised based on expenditure forecasts. Details of the disbursement arrangement will be included in the Disbursement Letter.

18. **Disbursement Categories.** The table below sets out the expenditure components and percentages to be financed out of the IDA funds:



Table 2.2. Allocation of IDA Proceeds

Category	Amount of IDA Proceeds Allocated (US\$)	Percentage of Expenditures to be Financed by IDA Proceeds (Inclusive of Taxes)
Goods, works, non-consulting services, consultants’ services, training and operating costs for project Component 1 (Mini Grids)	150,000,000	100%
Goods, works, non-consulting services, consultants’ services, training and operating costs for project Component 2 (Stand-Alone Solar Systems)	75,000,000	100%
Goods, works, non-consulting services, consultants’ services, training and operating costs for project Component 3 (Energizing Education)	105,000,000	100%
Goods, non-consulting services, consultants’ services, training and operating costs for Project Component 4 (Technical Assistance)	20,000,000	100%
TOTAL AMOUNT	350,000,000	
Refund of project preparation advance	6,000,000	100%

Procurement

19. **World Bank Regulations.** Procurement for the project will be carried out in accordance with the “World Bank Procurement Regulations for Borrowers under IPF,” dated July 1, 2016, hereafter referred to as “Procurement Regulations.” The project will be subject to the World Bank’s Anticorruption Guidelines, dated July 1, 2016. In addition, the World Bank’s STEP system will be used to prepare, clear and update Procurement Plans, and conduct all procurement transactions for the Project.

20. **Nigeria Regulations.** Considerable progress has been made in procurement reforms in Nigeria since the Procurement Act was passed in 2007. Among the results are procurement training courses for government employees, and development and deployment of the national Standard Bidding Documents (SBDs). The national SBDs have been cleared for use for national competitive bidding in World Bank-funded projects in Nigeria. Procurement activities are carried out at the procuring entity level, and the Federal Executive Council must approve contract awards at a pre-determined threshold.

21. **Procurement Arrangements.** REA, through the PMU, will have full responsibility for project-level procurement activities, and to ensure they conform to both Nigerian and World Bank regulations. REA has a procurement unit headed by a director who reports directly to the Managing Director of the Agency.

22. The categories of procurement to be implemented under the procurement are: (i) Minimum Tender Subsidy for Mini Grids; (ii) Performance-based Grant for Mini Grids; (iii) Performance-based Grant for Stand-alone Solar Systems; (iv) Market Scale-up Challenge Grants for Stand-alone Solar Systems; and (v) EEP. There will also be procurement for technical assistance, which will consist of mainly consulting services.

23. Under the **minimum tender subsidy for mini grids**, the sites will be grouped into lots that will be attractive to international private developers to enter into the mini grid market. Request for proposals will be issued to firms to develop the sites after an initial selection of qualified companies. For the



performance-based grants for mini grids, a performance-based payment system will be used for participating companies.

24. The procurement **for stand-alone solar systems** will also follow a performance-based approach after the firms eligible for the grants have been selected. For the **market scale-up challenge grants**, firms will be requested to submit proposals for initial selection to benefit from the grant. The **EEP** will be bid out as procurement of design, supply and installation of plant and equipment with operation and maintenance packages.

25. The technical assistance will include the selection of a Grant Administrator, the third party independent verification agency, support to NERC on mini grid regulatory environment, market study for stand-alone SHSs, and safeguard studies. The appropriate selection method for each of the above contracts is established in the Procurement Plan.

26. **Preliminary Procurement Risk Assessment.** The procurement risk rating for REA at the project preparation stage is *High*. There are eight procurement officers, four of whom have undergone the two-week procurement training course organized by Bureau of Public Procurement, but none is familiar with World Bank procurement guidelines or processes. In addition, the procurement files and documents management system is not adequate and will require some improvement, particularly to improve REA's ability to manage procurement of a large number of infrastructure projects, and on the development of bid documents and processes. Due to the significant amount of procurement activities expected during implementation of the proposed project that will exceed REA's prior procurement experience, REA has hired an experienced procurement consultant with proficiency in the World Bank's former procurement guidelines to provide procurement support. The consultant will build the capacity of REA's procurement officers and other project staff that have low procurement capacity or no experience with World Bank-financed project procurement rules and guidelines. A detailed Procurement Risk Assessment and Mitigation Action Plan, included in the Procurement Appraisal Document, is prepared for the implementation of the procurement under the main project.

27. **Procurement Plan.** REA with World Bank support developed a procurement plan consisting of the procurement methods or consultant selection methods, the need for pre-qualification, and prior review requirements (see tables below). This plan was reviewed and approved by the World Bank in August 2017. It is available in the project's database and in the World Bank's external website. The procurement plan will be updated regularly – at least annually – in accordance with STEP to reflect the actual project implementation needs and improvements in institutional capacity.

Table 2.3. Prior Review Thresholds for Procurement of Goods, Works and Non-Consulting Services

	Category	Procurement Method	Method Threshold US\$	Prior Review Threshold US\$
1.	Goods and Non-consulting services	ICB	Above 5,000,000	All
2.	Goods, information technology and Non-Consulting Services	NCB	Below 5,000,000	1,000,000 and above
3.	Goods, information technology and Non-Consulting Services	Shopping	Up to 100,000	None
4.	Works; including turnkey, supply & installation of plant, and PPP	ICB	Above 20,000,000	All
5.	Works; including turnkey, supply & installation of plant, and PPP	NCB	Below 20,000,000	10,000,000 and above
6.	Works; including turnkey, supply & installation of plant, and PPP	Shopping	Up to 200,000	None
7.	Motor vehicles	Shopping	Up to 500,000	None

Table 2.4. Prior Review Thresholds for Selection of Consultants

	Category	Selection Methods	Prior Review Threshold US\$
1.	Firms	Competitive Methods	500,000
2.	Firms	Direct Selection	All
3.	Individual	Individual	200,000

28. **Procurement of Goods and Works Including Supply and Installation.** Procurement competition of mini grids under the minimum subsidy tender in Component 1 and of power plants for universities under Component 3 will be based on a variety of factors including design, supply, installation, distribution network construction and connection services, with the Component 1 contracts bidding for least subsidy required to operate commercially and the Component 3 contracts bidding for one-time contract price. The bidders will be requested to quote for the different services spelled out in the Bid Documents and award will be made to most advantageous bid to the client. Details will be set in the bidding documents to be issued.

29. **Approaching the National and International Markets.** Procurements approaching the international market will be done using the World Bank's Standard Procurement Documents. As agreed in the Procurement Plan, national selection through advertisement in the national media/press may be used when the nature, scope and/or value of the activity is unlikely to attract foreign competition and there are adequate qualified national entities to carry out the assignments. If international entities wish to participate in national selection, they may do so. When approaching the national market, the country's own procurement procedures may be used as specified in Paragraphs 5.3 to 5.6 of the Procurement Regulations.

30. **Procurement of Consultancy Services.** Consulting services to be procured under the project include hiring of firms to manage activities and carry out studies, assessments, designs, supervision of works, and related activities for all four components of the project. Hiring of individual consultants will likely be limited to international consultants required for project implementation.



31. **Operating Costs.** These items will be procured using REA's national procurement and administrative procedures acceptable to the World Bank including selection of project implementation support personnel. REA will also pay for costs associated with any resettlement, land acquisition, compensation, and relocation of services.
32. **Record Keeping.** All records pertaining to award of tenders, including bid notification, sale and receipt of bids, bid opening minutes, bid evaluation reports and all correspondence pertaining to bid evaluation, communication sent to/with the World Bank in the process, bid securities, and approval of invitation/evaluation of bids will be retained by REA and the World Bank and also uploaded in STEP.
33. **Disclosure of Procurement Information.** The following documents shall be disclosed on REA's website: (a) a Procurement Plan and updates; (b) invitation for bids for goods and works for all contracts; (c) Request for Expression of Interest for selection/hiring of consulting services; (d) contract awards of goods, works, and non-consulting and consulting services; (g) financial and physical progress reports of all contracts; and (h) any action taken on the complaints received.
34. **Fiduciary Oversight by the World Bank.** The World Bank shall undertake a prior review of contracts according to prior review thresholds set in the PPSD/Procurement Plan. All contracts not covered under prior review by the World Bank shall be subject to post review during implementation support missions and/or special post review missions, including missions by consultants hired by the World Bank. To avoid doubts, the World Bank may conduct, at any time, independent procurement reviews of all the contracts financed under the Project.
35. **Contract Management.** High-risk and high-value procurements will be identified for increased contract management support and indicated in the Procurement Plan. REA will develop key performance indicators for such identified contracts, and the key performance indicators will be monitored during actual execution of contracts. The World Bank team will provide additional due diligence and independent review of the contract performance of such identified procurements. REA's PMU will be responsible for overall project/contract management.

Environmental and Social (including safeguards)

Key Environmental and Social Risks and Mitigation

36. **E&S Risk Rating for the project is *Substantial*.** Key E&S risks vary by project component and are presented in Table 2.5.



Table 2.5. Key Environmental and Social Risks by Project Component

Component/ risk issue	1. Solar Hybrid Mini grids for Rural Economic Development	2. Stand-alone Solar Systems for Homes, Enterprises and Farms	3. Power Systems for Public Universities and Teaching Hospitals
1. Land acquisition/ resettlement	<p>Land will be acquired for mini grid sites from individuals, families, or communities. Involuntary resettlement is not expected to be frequent or large-scale. Economic displacement is possible (e.g. cutting of economic trees).</p> <p>VLD³³ practices are expected to be frequent and may be abused by developers. VLD by communities to mini-grid developers will not be encouraged except (a) it meets the criteria set out in the VLD guidelines and (b) the process is verified and approved by the REA prior to finalization of the donation.</p>	Not expected for this component.	Major risk is expected to be encroachment on land that may be used for mini-grids that is allocated to universities and traditionally used by communities. As the universities are expected to provide land for the project, the main concern would be REA’s capacity for conducting stakeholder engagement and preparing RAPs and/ or LRPs, where needed.
2. Waste management	<p>Risks associated with disposal of lead-acid batteries and lithium batteries used in mini-grids will present a challenge for the project’s long-term sustainability.^{34 35}</p> <p>Disposal of used solar panels may also present a risk in the longer term.</p>	Long-term implications of the increased number of the energy storage units (containing batteries). This impact requires a strategic solution and REA will be requested to put in place a program for battery disposal/recycling, in which SHS distributors will play a role.	Same as Component 1.

³³ Voluntary land donation is strictly defined in international practice as the ceding of a property by an owner who is: a) fully informed; and b) can exercise free will, i.e., can refuse to sell or to donate. “Fully informed” means that the owner has complete information regarding the proposed activity and its impacts, its land requirements and its alternate activity sites, as well as his or her rights to compensation. The owner has also been provided with sufficient time to consider his or her disposition of the property, and the owner has knowingly rejected the right to renege on his or her initial decision. “Free will” means that the owner can reject the possibility of giving up his or her land.

³⁴ This will be an issue once batteries reach their recycling age. It has been estimated that should Nigeria reach its target of installing 30,000 MW of solar PV by 2030, about 280 million used batteries will end up needing disposal/ recycling (assuming average battery life of 3 years).

This will present



Component/ risk issue	1. Solar Hybrid Mini grids for Rural Economic Development	2. Stand-alone Solar Systems for Homes, Enterprises and Farms	3. Power Systems for Public Universities and Teaching Hospitals
3. Labor and working conditions	Risk of poor occupational health and safety (OHS) practices among developers exists, although not expected to be high among international developers working in Nigeria.	Labor and working conditions practices are generally adequate and shall be maintained. Weak labor practices (e.g. use of child labor) may be possible but not expected to be frequent or severe.	There is risk of poor OHS practices among EPC contractors. It must be ensured that labor conditions comply with Nigerian regulation and international good practice.
4. Community health and safety issues	General construction impacts, as well as moderate labor influx, can be expected and may be associated with security and GBV concerns.	Installation of SHS generally has low risk of community health and safety concerns.	Same as Component 1.
5. Biodiversity impacts	Bird mortality is noted as a possible risk due to perception of solar panels as water bodies (collisions). Due to small size of mini grids, this risk is not expected to be high. Impacts on sensitive natural habitats are possible where mini grids are constructed in such areas. Initial screening done through electricity demand surveys indicates this is not to be a frequent case.	Not expected.	Bird mortality is noted as a possible risk due to perception of solar panels as water bodies (collisions).
6. Resource consumption (water)	Stress on local water use and supply is possible due to the need to wash solar panels frequently.	Not expected.	Same as Component 1.

37. **Electricity demand surveys carried out during project preparation integrated a number of questions regarding potential E&S risks.** Outcomes of the survey will be shared with developers who will bid on the minimum subsidy tender subcomponent so that they are better informed of the potential risks when selecting the actual sites for mini grids within the communities included in the tender. The survey indicated a few potential communities that are located in proximity to sensitive habitats and protected areas or living in flood-prone zones. The survey also collected data on land ownership models in communities. This is the first World Bank project for off-grid electricity that incorporated E&S in demand surveys, and lessons learned from this innovative approach will be shared broadly.

38. **As a basic measure to reduce the risks upfront at the initial screening stages** and before further E&S impact assessments are done, two sets of Exclusion Criteria are incorporated in the Project Implementation Manual for components and the ESMF:



- (a) *Exclusion Criteria for Mini-Grid and Power Generation Sites* (applicable to Component 1 and 3), addressing such issues as resettlement with no compensation and forced evictions, impacts on sensitive natural habitats and cultural heritage.
- (b) *Exclusion Criteria for Mini-Grid Developers, SHS Companies, and Contractors* (applicable to all components), addressing things like clean track record with no environmental fines, compliance with provisos of Basel Convention (for hazardous waste management issues), and prohibition of child and forced labor.

39. **Core E&S issues that will be given priority attention and specific measures to integrate them in project design** are as follows:

- (a) *Effective stakeholder engagement has been identified as central to project success.* For Component 1 involving mini-grids, REA will not only exercise reasonable efforts to engage with communities during electricity demand identification process but also require and support private developers in building their own effective community engagement plans. Developers will also be required to have a stakeholder engagement plan and a grievance mechanism to identify, mitigate, or prevent adverse impacts on communities and produce appropriate corrective actions. REA will also put in place a GRM at its level and a Citizen Engagement Strategy. For Component 3, universities will be expected to engage with their students and staff regarding the construction and operation of their power station, and nearby communities will also be engaged in the event the university power supply is extended to also supply the community.
- (b) *With regard to used battery disposal and recycling,* lead-acid batteries used in mini-grids will present a major challenge once the project goes to scale. The number of used batteries in Nigeria is expected to grow quickly in the next few years, with mini-grids being one of the major contributors. Currently, the battery recycling market in Nigeria is mostly informal and is known for its substandard practices that pose risks to health and safety for workers and communities. REA will explore strategic solutions for this issue and develop a battery recycling policy, drawing on existing good practices in other countries. While regulation by NESREA would be a long-term solution, a shorter-term practical approach such as creating a pool of approved safe recycling facilities may be needed. There is some work that has been done in Nigeria and can be built upon. For example, work done in the past two years by the Recycling and Economic Development Initiative of Nigeria in collaboration with Heinrich Poell Foundation (Germany) and the Institute of Development Studies (UK) has identified possible solutions involving private sector recyclers. ESMF will include a roadmap for REA to develop a solution. With regard to lithium ion batteries used on mini grid and SHSs, companies will be requested to articulate their current policies in that regard as a first step, followed by a strategic solution to be developed by REA in the course of project implementation.
- (c) *Land acquisition, resettlement in the private sector context and across a large number of small subprojects.* Where resettlement may be required, mini grid developers will be requested to categorize these subprojects as high risk and prepare a RAP and a Livelihood Restoration Plan (where needed). These will need to be reviewed by the World Bank and disclosed by the Federal Ministry of Environment. In some cases, inconsistencies have been identified between the amount of land requested by developers – which is especially



relevant for cases of VLD - and the proposed generation capacity. To mitigate this issue, REA will consistently check whether the required amount of land take corresponds to the generation capacity proposed by developers using the following formula: $ha \text{ (generation capacity / panel capacity} \times \text{panel surface area)}$. The standard that will be used to determine the land requirements is 15 m² per kW of generation capacity. Developers would be required to justify land take that is greater than this estimate.

- (d) *Voluntary Land Donation*. Experience from other projects suggest that this is open to abuse and coercion. VLD should only be authorized if they (a) have affected people as direct beneficiaries; (b) clearly document Informed Consent; (c) clearly document Power of Choice (option of refusal or to sell at prevailing market rate); and (d) meet the VLD guidelines of the project. The guidelines have been put into place to ensure that donations are indeed voluntary, that the donor is the legitimate owner of such lands, and that the donor is fully informed of the purpose of the donation and of the implications of donating the property³⁶. If the land is donated on a conditional basis, the terms and conditions for the temporary use of the property must be clearly documented.

40. The following principles should be complied with when VLD is carried out:

- The land required to meet technical project criteria must be identified by the affected community through a participatory approach and not by the developer, line agencies or project authorities (nonetheless, technical authorities can help ensure that the land is appropriate for project purposes and that the project will produce no health or environmental safety hazards); mini-grids can be sited in any location within a community so long the location meets the technical criteria for the investment;
- The proportion of land that may be donated cannot exceed 15 m² per kW of the proposed generation capacity plus an additional 7.5 m² per kW for future generation capacity expansion;
- Land donation for a single mini-grid or power generation system shall not exceed 10 percent of the land donor's holdings in cases where land ownership is individual or family;
- Land required above 1,500 m², whether for initial construction or future generation capacity expansion, can be either leased using leasehold agreement (using ground rent scale set by each state in Nigeria) or bought on willing-buyer-willing-seller basis at current local market price in the community;
- Donated land can only be used for power plant construction and future expansion and be fenced off accordingly; and
- Shall the donated land not be used for power plant construction within three years, the unused land shall be returned to the donor.

³⁶ Voluntary land donation is strictly defined in international practice as the ceding of a property by an owner who is: a) fully informed; and b) can exercise free will, i.e., can refuse to sell or to donate. "Fully informed" means that the owner has complete information regarding the proposed activity and its impacts, its land requirements and its alternate activity sites, as well as his or her rights to compensation. The owner has also been provided with sufficient time to consider his or her disposition of the property, and the owner has knowingly rejected the right to renege on his or her initial decision. "Free will" means that the owner can reject the possibility of giving up his or her land.



Design of an Integrated Environmental and Social Risk Management Approach

41. **REA will be responsible for overall project implementation.** In order to ensure sound E&S risk management of the project in line with the national regulations and World Bank Safeguard policies, REA has prepared an ESMF, as well as RPF, although key provisions to manage resettlement risks are also integrated into the ESMF given the need for a fully integrated approach due to private sector involvement and complex project design. ESMF would cover step-by-step processes for assessing and managing E&S risks and impacts for each component.

42. **It is essential for REA to put in place an integrated process for E&S due diligence fully linked to the key operational documents and processes for each component and the overall project.** One of the key challenges in this project is expected to be dealing with an emerging market space with hundreds of small mini grid subprojects and SHS companies' operations. In this scenario, it is important to design and implement an integrated E&S system that is fully tied to REA's overall business management processes. The approach for each project component is described below. The ESMF will serve as a basis for integration of E&S risk management into the overall project management and REA's core business processes as follows:

- (a) *For Component 1*, private sector mini grid developers will assume primary responsibility for assessment and management of E&S risks and impacts of mini-grids designed, constructed and operated by them. In order for REA to exercise efficient and effective oversight of this process, developers will be asked to prepare and submit an institutional Environmental and Social Management System (ESMS) to REA as part of qualification criteria for minimum subsidy tender and subsequently for performance-based grants. The ESMS will spell out developers' E&S policy, approach to risk identification and analysis, internal structure and capacity for coherent implementation of risk mitigation measures, approach to managing land issues (including RAPs, Livelihood Restoration Plan LRPs, and VLD protocols), stakeholder engagement strategy, design of a grievance mechanism, and reporting. Additionally, developers will be asked to demonstrate clean track record with regard to E&S issues (e.g. absence of environmental fines related to their current operations within the past three years). As part of legal agreements for the grants, mini grid developers will have E&S conditions, namely to implement their ESMS, apply Exclusion Criteria for Mini-Grid and Power Generation Sites, categorize mini grid subprojects according to risk levels, conduct necessary E&S screening and assessment studies as commensurate with the level of risk for individual mini-grids, prepare and implement ESMPs, provide consolidated reporting to REA on implementation, and immediately notify REA of any significant incidents or accidents. REA will provide oversight, conduct regular monitoring and supervision checks, and ensure consistent reporting from developers.
- (b) *For Component 2*, SHS companies would also be required to prepare an ESMS to qualify for the program. This ESMS would focus on key E&S risks identified for this component, and in particular include adequate HR policy, OHS guidelines, and a feasible approach to battery disposal/ recycling. SHS companies will be asked to submit documents attesting to them having such systems in place with their application for the program. Specific prohibition of forced and child labor will also be applied to these companies.
- (c) *For Component 3*, Environmental and Social Impact Assessments (ESIAs)/ ESMPs and, if necessary, RAPs would be prepared by REA, cleared by the World Bank and disclosed by the



Federal Ministry of Environment, as appropriate. Risk mitigation measures will be included in the bidding documents and contract for the EPC contractors that will construct and operate the solar power system for the universities. REA, with active participation from universities, will also execute the RAPs, including proper stakeholder engagement process with regard to possible land-related issues. Another risk is the approach of the universities to e-waste management strategies and engagement will be conducted on this issue with them during project implementation.³⁷

43. **Resettlement.** REA has prepared a RPF in accordance with the World Bank Safeguard policy on Involuntary Resettlement (OP/BP 4.12). The RPF provides practical tools to guide the preparation of RAPs for subprojects during the implementation of the NEP. The RPF will set out principles, likely categories of affected people, eligibility criteria and categories, compensation rates, methods of valuing affected assets, community participation and information dissemination, GRM and effective M&E. These arrangements shall also ensure that there is a systematic process for the different stages of the implementation of a framework that assures participation of affected persons, involvement of relevant institutions and stakeholders, adherence to both World Bank and Government procedures and requirements, and outline approaches for compensation for affected persons. RPF will ensure that the processes described therein are fully aligned with the overall design of the E&S risk management approach for each component as described above.

44. **Grievance Redress and Feedback Mechanism.** REA will set up a project-specific Grievance Redress and Feedback Mechanism for people to report concerns or complaints, if they feel unfairly treated or are affected by any of the subprojects. The mechanism will amongst other things: (a) provide information about project implementation; (b) provide a forum for resolving grievances and disputes at the lowest level; (c) resolve disputes relatively quickly before they escalate to an unmanageable level; (d) facilitate effective communication between the project and affected persons; and (e) win the trust and confidence of project beneficiaries and stakeholders and create productive relationships between the parties. The mechanism is envisaged to be at multiple levels (REA, mini-grid developers) and will address such complaints, including logging, tracking, and resolving grievances promptly during and after the implementation of the project.

45. **Citizen Engagement and Social Sustainability Programs.** There is the need to utilize social development approaches (such as inclusive and continuous stakeholder participation in project implementation) as key accelerators to achieving results. The social sustainability program will support but also test what citizens can do to keep the Government's investments through the project operating properly and yielding benefits to the citizenry as intended. REA will coordinate citizen engagement activities by (a) setting up effective grievance redress and beneficiary feedback mechanism; (b) ensuring an intensive program of engagement with project stakeholders; (c) deploying of effective strategic communications and public education; (d) deepening the consultation process, which began during project preparation; and (e) monitoring social impact through annual stakeholder surveys. Specific budget has been allocated under the TA component for these activities.

Capacity of Key Implementing Parties for E&S Risk Management

46. **Success of E&S risk management during project implementation will depend on REA's ability to adopt an approach that fully integrates it into REA's overall project management processes.** Through

³⁷ These include auctioning used equipment to private bidders in lots. It is unclear how these private bidders approach disposal of the equipment that can no longer be used and forms part of the lots.



this approach, REA is expected to be able to effectively manage risks associated with an emerging flow of hundreds of small mini grids, as well as integrate relevant considerations into SHS companies' operations and effectively manage EPC contractors E&S performance for university power systems. REA will be responsible for overall project implementation but currently has no experience in handling safeguards aspects of energy infrastructure projects that apply World Bank safeguard policies. REA's institutional capacity has been enhanced with an environmental and a social specialist. REA's E&S capacity must be further strengthened within the first year of project implementation through formal establishment of an E&S unit and potentially engaging an external firm with E&S expertise to assist with fully integrating E&S risk management processes into operational processes and workflows.

47. **To enable the above model to function well, to processes and capacity of key private sector stakeholders for E&S risk management must be analyzed and enhanced.** This includes:

- (a) *Component 1:* Mini-grid developers are at varying levels of capacity and E&S standards that they are applying to preparing their projects. International companies, especially those that receive funding from development institutions (e.g. GIZ) and foundations, are at a higher level and more advanced and proactive in their approach as a result of the E&S requirements that come with the funding. However, domestic mini grid developers are relatively unaware of such requirements and will need major effort in building their capacity to comply with the World Bank conditions that REA will need to implement as part of the project. Major differences have been identified in how developers approach site selection and interactions with communities to ensure that communities can consistently benefit from electricity provision in an inclusive and sustainable manner. These range from full engagement, securing broad community support, reaching agreements with communities on VLD, and proactively conducting ESIA's as part of project design to full reliance on the government processes for land expropriation and no E&S studies or exploring alternative site locations to reduce potential E&S risks and impacts (however, these cases are rare). ESMS that developers will be asked to prepare and implement is expected to be an instrument to enable harmonization of practices and increase clarity on requirements. Developers would additionally need systematic support and training from REA to enhance their systems and capacity.
- (b) *Component 2:* While SHS companies would be requested to articulate their current strategy with regard to used energy storage units (containing batteries) that need to be recycled or safely disposed of, their capacity to manage this issue on their own is likely to be limited. REA will be required to develop a practical solution and engage with SHS companies to implement it. SHS companies are expected to have adequate capacity to manage labor and OHS issues.
- (c) *Component 3:* REA would be expected to take the lead and be responsible for managing E&S risks and impacts during design, construction, and operation of power systems. Universities would play in this process, but it is recognized that World Bank requirements would need to be met and capacity and budgets available at universities are generally low. At the same time, REA shall build capacity of the universities to continue engaging with communities after mini grid construction is completed. Universities will also be encouraged to prepare e-waste management plans that account for safe end-of-life disposal of equipment from solar installations.



Harmonization of E&S Standards among Mini Grid Developers, Financiers, and Government

48. **Mini grid developers will need consistency, uniformity, and clarity on E&S requirements to ensure fair market competition.** While the private sector participation in the expansion of the mini grid market – both rural and urban – is still conditioned on commercial viability, it is expected that the World Bank-supported program will eventually lead to a stable and sustainable growth in this sector in Nigeria. Already at this stage, the market is starting to enjoy the entry of some of the domestic and international companies, as well as various international financiers. In this scenario, this market growth will be accompanied by a variety of E&S standards that developers will be asked to use depending on source of funding. Additionally, it is expected that the FGN will not initially have an efficient risk-based approach to environmental clearance processes for individual mini grid projects, leading to long approval times and escalated costs, thus presenting a hurdle to market development. A solution that will make the government processes more efficient without compromising long-term E&S sustainability of the market is needed. The TA component includes budget for engagement with FGN on this issue as part of the Ease of Doing Business initiative.

49. **It is proposed for REA to set up a platform that would bring together international companies, financiers, key development institutions working in the solar sector in Nigeria, and government entities** to develop strategies for harmonization of E&S standards in the market to make it easier for developers by providing a level playing field and aligning the approach with the evolving Nigerian regulations for the sector.



ANNEX 3: ECONOMIC AND FINANCIAL ANALYSIS

COUNTRY: Nigeria Nigeria Electrification Project

1. **Rationale for Public Sector Provision/Financing.** Achieving universal electrification by 2030 requires substantial scale-up of resources in the off-grid space in the underserved counties. Public financing of this project is necessary not only to expand energy access to rural areas, but also to leverage private sector financing and support considerably de-risked opportunities for the private sector. Grid connectivity in many rural areas is not economically feasible especially in the current power sector climate where reforms will take years before the DISCOs will be able to make any marked difference in new connections and improving the reliability of existing ones. Due to high initial CAPEX, mini grid developers will require partial early support to roll out mini grids at a faster pace in off grid areas, which public resources can help accomplish.

2. Public resources are thus necessary to crowd in private sector investment from companies currently active in Nigeria and provide further incentives for new market entrants considering expanding into Nigeria. Public resources are also essential for removing some of the softer but crucial barriers to doing business that have prevented the private sector from entering in what otherwise is known as one of the largest markets in Africa. Further, public support and financing for solar technologies are also necessary to reduce the financial costs of solar power and to enable it to be competitive with diesel and gasoline generation.

3. **Value Added of the World Bank's Support.** The World Bank, with its ability to support the design of a customized electrification program drawing on decades of global experience and to harness recent technological advancements to provide reliable, affordable, and sustainable energy services to consumers in underserved countries, is well placed to assist Nigeria in designing and implementing this off-grid energy access program. The proposed project presents a significant opportunity to bring modern energy services to large numbers of people nationwide in absence of the grid's capability of fulfilling the same in the near to medium term.

EEP (Component 3).

4. The program is expected to have a broad positive impact on the universities and hospitals served. This includes academics and research as well as ancillary university functions and overall campus quality of life. The EEP is expected to have much further reaching impacts as well. Box 3.1 provides a list of the benefits, some of which will be monitored in this project.



Box 3.1. EEP Benefit Indicators.

The EEP is expected to create impacts beyond the formal project indicators.

Improved academic/research outcomes

- Increase in number of lecture hours (monthly)
- Increase in research output (number of academic papers in peer reviewed journals annually)
- Reduction of number of incidents of equipment breakage due to power quality

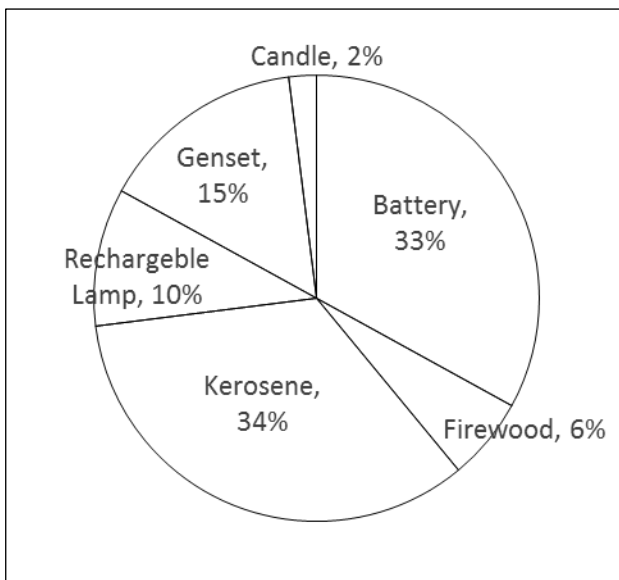
Improved health outcomes:

- Improved health impacts
 - incidence of malaria and/or other diseases
- Increase in number of procedures
- Reduction in mortality

Additional benefits for campus community:

- Increase in community safety and security
 - Reduction in number of security incidents on university property,
 - Increase in perception of security (based on survey)
- Increase in social events (number per year)
- Improved water supply (cubic meters per year)

Figure 3.1. Main sources of lighting in households not connected to the grid



5. **Baseline energy use at the household level.** While current consumer demand data is under development as part of the implementation of the MTF in Nigeria, preliminary review of the data from the National Bureau of Statistics shows that more than 55 percent of the households in Nigeria still rely on fuel-based lighting options including kerosene, dry cell batteries, gasoline gensets, and to a lesser extent candles and other fuels. For those without connection to the grid, the main alternative for lighting are kerosene (34 percent of those without electricity), followed by battery/dry cell (33 percent), and followed by gasoline household-level generators (15 percent).

6. Annualized economic costs for the key baseline fuels used in Nigeria shows the relatively high cost per unit compared to the annualized cost for SHSs and PV lanterns,

without considering the additional benefits such as enhanced level of service, reliability, and overall quality. The economic value is demonstrated in the economic analysis further below.

Table 3.1. Cost of baseline Fuels Used for Lighting in Nigerians Households

	Dry cell batteries	Kerosene Lamp	HH level genset
Consumption	1 lamp per year	1 lamp every year	1 genset every 4 years
	6-8 batteries per month	4 liters per month	45 liters of gasoline per month
Light output (lumens)	61	45	580
Daily usage (hours)	4	5	3-4
Annual service provided (Lumens/year)	89,060	82,125	740,950
Initial Costs (US\$/unit)	US\$5 for lamp US\$1 each batt	US\$5 for lamp every year; US\$0.33 per liter	US\$59 for genset; US\$0.4 per liter
Annualized Cost (US\$)	72.00	20.84	200 – 258.46

7. **Methodology and assumptions.** The project will invest in off-grid electricity solutions in those areas in Nigeria where the provision of grid electricity services is not economically or technically feasible in the medium term. The solutions include:

- The development of around 85 MW of installed mini grid capacity or around 850 solar hybrid mini grids at an average nominal capacity of 100 kW (plus 24 kW diesel generation) as well as distribution lines and household connections for an average village of 420 households, 70 commercial customers and about 10 productive users depending on the load demand. The actual size of mini grids may vary from the model, but these key assumptions would generally still apply;
- The distribution of 1.5 million stand-alone solar products. These include SHSs ranging in size from 3 W to 50 W or above including their installation and maintenance service (such as battery replacement);
- The provision of independently generated reliable power to seven universities and teaching hospitals for a total installed capacity of about 19 MW through a combination of solar hybrid systems and gas-fired generation replacing a large number of diesel generators across campuses.

8. The economic viability of the proposed project was assessed using a standard cost-benefit methodology. Net benefits for the project were calculated by comparing total system costs and benefits for the “with project” and “without project” scenario. Economic costs were estimated based on the preparatory studies developed for the project and adjusted to remove duties and taxes while economic benefits were based on a conservative approach using an avoided cost methodology derived mainly from survey results and first-hand interviews.

9. The proposed project is also expected to have a number of additional benefits which are either uncertain or difficult to quantify such as (i) employment generation; (ii) health benefits derived from the displacement of some sources of energy for lighting, like kerosene or wood; (iii) improvements in the



provision of education and health services; and (iv) range of E&S externalities. As such, the results of the economic analysis can be considered a conservative estimation of the total economic benefits for society.

Table 3.2. Modeling Assumptions

Indicator	Value	Comments/sources:
Exchange rate	370 (NGN/US\$)	FX Window exchange rate ³⁸
US Inflation	n/a	Modeled in real US\$
Diesel price (economic)	250 NGN/liter	Country sources
Gasoline Price (economic)	148 NGN/liter	NBS's monthly price survey (avg)
Kerosene Price (economic)	120 NGN/liter	NBS's monthly price survey (avg) ³⁹
Gas price (economic)	133.2 NGN/m ³	Country sources
Crude oil price (base year)	US\$53/b	Commodity prices
Economic Discount Rate	5%	Derived using the WBG technical guidance note on discount rates

10. The overall economic capital cost is around US\$748 million the five-year project period. The costs for each of the components are included in the table below.

Table 3.3. CAPEX and Opex by Component

		Mini grids	SHSs	Energizing Education
Description		100 kW solar hybrid mini grid (with 24 kW diesel generator)	15-50 Wp SHS (average)	1.5 – 6 MW range solar hybrid and gas fired systems
Total capacity:		85 MW***	22 MW	19 MW
CAPEX (total)	Per unit (US\$)	US\$477,762 initially then US\$429,079 in equipment replacement for 20 years plus US\$16,000 (avg) annually for O&M	US\$125-US\$285 (retail price)	US\$4 /W installed (solar hybrid) US\$2/W installed (gas-fired)
	# of units	850	1,000,000	7
	Total CAPEX (US\$, millions)	US\$406 (initial costs) US\$771 (lifetime costs) *	US\$194.8**	US\$64.4**
OPEX (annual)	(US\$/year avg)	US\$11,487,000	US\$6,400,000	US\$8,189,000

* Includes replacement costs of battery, inverter, prepaid meters and other equipment during the 20-year period.

** Includes replacement costs of battery

*** 85MW without diesel back-up system. If including diesel back up then 105MW

³⁸ Nigeria has recently introduced a new FX window rate to identify a market rate based on dealers entering FX hedges in order to control the multiple exchange rates that were prevalent in the recent years (the official one after the abandonment of the peg to US\$ and the black market rate).

³⁹ The actual financial cost of the fuels is much higher than what the official government subsidized price indicates. This is due to black market activities and illegal diversions to other sectors resulting in massive mark-ups depending on supply and demand dynamics in different parts of Nigeria. The official price of kerosene is Naira 83 (around US\$0.25) per liter, the average price paid by consumers in last six months across Nigeria is around Naira 290 (or US\$0.8) per liter. The price chosen here is a best guess between the government subsidized price and the marked-up rate that most Nigerians are paying.



11. **Mini Grids.** The key data used for the analysis for the mini grids component was gathered from private mini grid developers in the country. This included (i) the cost data, which was disaggregated by cost component and any subsequent investment such as battery, inverter, meter replacements; and (ii) demand per customer and number and types of customer based. An avoided cost analysis was then carried out to estimate the total benefits based on the assumption that mini grid will on average be replacing the costs of gasoline generators the costs for which were estimated separately based on usage patterns gathered from household surveys and developer gathered data. The costs of diesel were assumed would increase year on year based on a correlation factor with crude oil prices and projections on changes in those prices.

12. **Stand-Alone Solar Systems.** Energy use data on sources of energy for lighting in Nigeria was first synthesized from the GHPS surveys carried out by National Bureau of Statistics (2013 and 2015), which serves as the primary basis that for those households not connected to the grid or with unreliable grid supply. The proposed intervention solutions were then analyzed vis-à-vis the annualized cost for kerosene, batteries and gasoline gensets. The analysis was then done on two levels: (i) at the pico/lantern level where a nominal 3 Wp solar lantern was assumed as displacing the costs of kerosene and (ii) at the solar system level where two nominal sizes of 15 Wp and 50 Wp were chosen as displacement for kerosene and batteries (15 Wp) and gasoline gensets (50 Wp). It was assumed that for the 3 Wp lanterns the economic benefits accrue for three years for products supported under the project five year period while for the SHS, the economic benefits would accrue over a seven year period from the year the household signs up for the service⁴⁰. The economic costs of the solar products were estimated based on the detailed costing data provided by private companies operating in Nigeria, less duties and other taxes.

13. For the gasoline generator households – two levels of generator use were modeled: one based on 3 hours running of a generator and another one four hours, giving two different calculations for avoided costs. The genset cost assumptions are captured in the table below.

Table 3.4. Generation Costs

Category	Unit	
Genset Purchase (annualized cost)	Avg US\$/pa (4 years lifespan)	US\$15
Av Liters per hour	Lph	0.40
Gasoline Fuel Cost	US\$/pa	US\$175
General Maintenance cost	Avg US\$/pa	US\$10
Total Costs pa in US\$ (HH level 1 – 3 hours/day)	US\$ pa	US\$200
Total Costs pa in US\$ (HH level 2 – 4 hours/day)	US\$ pa	US\$258

14. **Energizing Education.** The baseline energy use was modeled after the University of Abuja system, which is one of the universities participating in the EEP. The data was obtained from the REA Energy Consumption Surveys and Power Demand Forecast completed for this university, which included details

⁴⁰ The period was chosen based on real data provided by current PAYG providers in Nigeria. At year 7, the electronics in the control system, battery, inverter, etc. will no longer be functional and will need to be replaced, which would be the equivalent of signing up for a new SHS service.



on university’s expenditures on self-generation, daily energy consumption, and estimated demand growth.

Economic Analysis

15. An economic analysis based on avoided costs was carried out to assess the economic viability of the project. The EIRR and NPV of the project are calculated using a standard cost-benefit methodology. The economic evaluation is confined to the project activities that generate quantifiable benefits for which an economic value can be clearly identified and measured. The economic analysis shows that the project is economically viable even without any consideration of environmental externalities.

Table 3.5. Economic Internal Rate of Returns

EIRR (excl. CO ₂)	%	25
EIRR (incl. CO ₂)	%	34
Composition of NPV		
NPV (excl. CO ₂)	US\$, millions	749
NPV (incl. CO ₂)	US\$, millions	989

Figure 3.2. Summary of Benefits

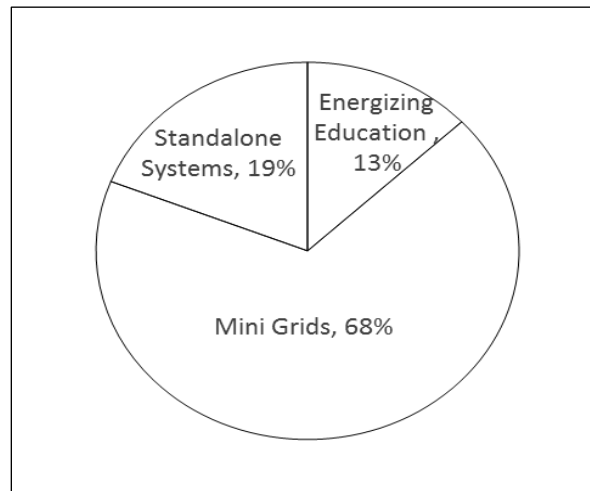
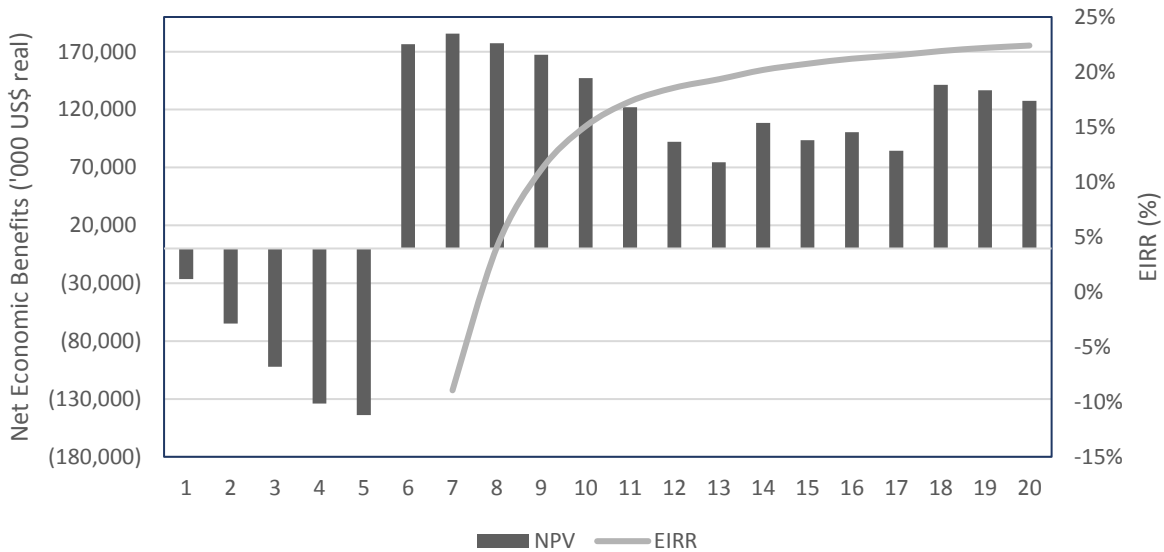




Figure 3.3. Net Benefits vs EIRR Excluding CO2



16. The economic benefits are attributable to the replacement of the relatively more expensive baseline fuels such as gasoline, kerosene, and solutions such as dry cell batteries using conservative assumptions about the daily usage of power or fuel for lighting and fuel quantity during the period analyzed.

Table 3.6. Summary of NPV and EIRR by Component

	NPV (US\$, millions)	EIRR
Mini Grids	970	26.8%
Stand-Alone Solar Systems	82	46.9%
Energizing Education	76	12.9%

Economic Sensitivity Analysis

17. A sensitivity analysis in the form of switching values such as increasing costs and decreasing benefits at different levels has been performed to test the robustness of the economic results to changes in overall costs and benefits. The results show that the project remains economically viable as long as the total costs do not increase by more than 70 percent. A sensitivity analysis on individual components was also performed indicating that the economic viability of each of the components is strong.

Table 3.7. Scenario Analysis

Sensitivity Analysis (excl. CO2)	NPV ('000 US\$)	EIRR
Base Case	749,754	25.0%
Costs Increase 5%	697,438	22.8%
Costs Increase 15%	426,626	18.9%
Benefits Decrease 5%	659,950	22.7%
Benefits Decrease 15%	480,343	18.0%



Sensitivity Analysis (excl. CO2)	NPV ('000 US\$)	EIRR
Costs Increase and Benefits Decrease 15%	323,394	12.8%
Costs increase 70% (EIRR = discount rate)	-	5%

Table 3.8. Scenario Analysis by Component

Component	EIRR = Discount Rate (5%)
Mini Grids	Annual avoided costs 50% higher than current costs
Stand-alone Systems ⁴¹	Annual avoided costs 35% higher than current costs
Energizing Education	Annual demand 30% lower than current demand or costs double

18. **Greenhouse gas (GHG) accounting has been carried out for the project**, which will result in significant GHG emission avoidance by replacing usage of kerosene, gasoline and diesel in households and institutions. Most project activities will not directly emit GHG due to the use of solar technologies, except for mini grids that will be partially fueled by diesel, as well as two gas-fired power stations at universities. For systems such as mini grids, household SHS, community SHS, and hybrid renewable power stations at universities, GHG emissions over 20 years have been analyzed. Total baseline emissions are estimated to be 11,510,511 tCO₂, with total gross emission of 1,775,471 tCO₂, whereas the project net emissions total -9,735,040 tCO₂.

Financial Analysis

19. **Financial Model Assumptions.** The financial modeling is done separately for a 100 kWp solar-DG Mini-grid and a SHS portfolio of 1,000,000 units. The following assumptions were made for the financial analysis.

20. The system configuration and overall costs for Mini-grids and SHS are provided in Table 3.9

Table 3.9. Mini Grid and SHS Assumptions for Financial Analysis

Mini Grid		SHS Portfolio	
System PV size	100 kWp per site	Portfolio size	1 million units
Diesel size	24 kW	15 W SHS CAPEX	US\$125 + duties
Diesel running hours	3 hours per day	15 W SHS annual rev.	US\$80 for 3 years
Battery backup	5 hours	50 W SHS CAPEX	US\$285 + duties
CAPEX cost	US\$5,360/kW	50 W SHS annual rev	US\$200 for 3 years
Diesel running cost	46 US cents/kWh;		

21. For mini-grids, following additional inputs were assumed based on inputs from first set of mini-grid candidates:

- (a) Replacement CAPEX schedule has been assumed:
 - (i) 24 percent of CAPEX in year nine and year 17 for battery replacement

⁴¹ Given the highly variable costs of kerosene across the different regions, additional sensitivity analysis using the price of kerosene revealed that even at the official subsidized cost of 83 NGN/liter the EIRR is 15 percent for 3 Wp solar lanterns as a substitute product. The average kerosene price paid by consumers nationally according to NBS is around 267.5 NGN/liter (due to black market activities) which would yield an EIRR of 347 percent.



- (ii) 10 percent of CAPEX in year 11 for inverter and charge controller replacement
 - (iii) 30 percent of CAPEX in year 13 for diesel generator, mechanical supports major maintenance and meters
 - (b) On Demand side, a mini-grid on average is expected to have 500 connections of which 80 percent is residential, 2 percent productive use and rest commercial uses. The average demand per month based on initial sites input is expected to be around 20-25 kWh/ month, 30 kWh / month and 150 kWh / month for residential, commercial and productive uses respectively. Demand growth is assumed at nominal 1 percent each year for all segments.
 - (c) Demand is ramped up over three years with residential, commercial and productive users ramping up (35 percent, 75 percent, 100 percent), (30 percent,60 percent,100 percent) and (50 percent,80 percent,100 percent) in years 1, 2 and 3 respectively.
 - (d) For simplicity and given high local inflation, tariffs are assumed to be in constant US\$, with annual adjustments in local currency based on exchange rate. The initial tariffs for residential customers is taken as US\$0.75/kWh and US\$0.45/kWh for commercial users and productive load. Operating costs are also assumed to be remain fixed in US\$ terms.
22. For SHS, following additional assumptions were included for financial analysis;
- (a) Duties and VAT of 20 percent and 5 percent respectively on retail values of the systems. And a Corporate income tax of 30 percent.
 - (b) A result based funding of 20 percent of retail value as additional income on year of sale coming from the project.
 - (c) Operating costs of approximately US\$1.5 million in first year, which then grows at 2x annually in years 2 and 3 and then doubles in year 4 and 5 reaching a maximum operating burn of US\$7.5 million in year 5.
 - (i) Local debt market likely will be difficult to tap for mini-grids and SHS firms initially due to industry barriers accessing credit from commercial banks. But this can likely be catalyzed over time by capacity building and sector development by the World Bank. Debt is likely to play an important part for working capital – some firms are likely to access debt from foreign sources as well. For the SHS, we have assumed a 50 percent debt with two years, while for mini grids a 60 percent debt leverage for 5-year tenors. Local interest rates are about 5-10 percent higher than local inflation, so a real interest rate of 8 percent in US\$ (to match dollar tariff assumptions) is assumed. Moreover, a default rate of 12 percent for the overall portfolio has been assumed for SHS PAYG.
 - (ii) The base case equity returns are fairly low at less than 10 percent IRR in base case as discussed below. These projects will likely need grants to attract commercial investors to get commensurate returns for the inherent risks in this market. The initial proposal is to have grants as connection based performance grants based on project design at US\$350 per connection (same amount for all type of connections including productive use). The connection grants are paid 50 percent at beginning (during signature of contract) and 50 percent after installation and verification.



Results of Financial Analysis

23. With the above assumptions and inputs, the project has following financial returns in the base case. An average 100 kW mini-grid is expected to cost US\$580,000 per site, with equity investment of US\$144,000 upfront after grants and with debt.

Table 3.10. NPV for Base Case.

	NPV @ 10% discount rate (US\$)
Mini Grids	
NPV no debt or grants	(21,000)
NPV IRR with grants	173,000
NPV with grants and debts	202,000
SHS portfolio	
NPV of SHS 1 million portfolio no debt, no grant	(1,290,815)
NPV with grant	20,307,143
NPV with grant and debt	12,650,645

Sensitivity Analysis

24. The project returns are sensitive to tariffs and CAPEX. Following switching values analysis were done. The returns for no grants or no debt scenario is given in Table 3.11 below.

Table 3.11. Switching Values for Financial Returns for No Grants and No Debt Scenario

Key Model input	Equity FIRR @ 10%	Equity FIRR @ 15%
Mini Grids		
Residential Tariff	57 USc/kWh	67 USc/kWh
Commercial Tariff	3 USc/kWh	25 USc/kWh
CAPEX	US\$6,300/kW	US\$7,100/kW
SHS portfolio of 1 million	Eq. IRR @ 10%	
Retail value of SHS	30% higher	
Sales volume over 5 years	500,000	



ANNEX 4: ADDRESSING GENDER GAPS TO ENHANCE DEVELOPMENT OUTCOMES AND ACTION PLAN

COUNTRY: Nigeria Nigeria Electrification Project

- 1. Enhancing gender equality in energy delivery contributes towards Nigeria’s growth and poverty reduction strategies.** The National Gender Policy by the Federal Ministry of Women Affairs and Social Development focuses on female empowerment and a commitment to gender mainstreaming. In addition, a Gender Focal Point has been established in the FMPWH, located within the Sustainable Development, Climate Change, Gender and Human Rights Unit, which ensures compliance with various measures, e.g., the National Gender Policy.
- 2.** Other initiatives, such as the Federal Ministry of Finance’s Girls and Women’s Initiative of Nigeria, have partnered with the Rural Women Energy Security Initiative, in recognition of the fact that providing households, social institutions, and productive enterprises with new energy access and improved energy services has the potential to promote gender equality, create employment and business opportunities for women, and improve development outcomes.
- 3. The draft Energy Policy (2013) states that Nigeria will “disaggregate energy use, supply, and impacts by gender in energy project design and implementation.”** The implementation of this policy will include the development of “reliable gender responsive statistical data” and “monitoring and evaluating the impacts of rural energy projects on poverty alleviation and gender.” Lack of gender disaggregated data and analysis makes these objectives difficult to achieve.
- 4. In order to gain insights into key gender gaps, an analysis was conducted for the overall energy sector.** The aim was to summarize gender gaps in the energy sector across multiple data sources available for Nigeria and investigates the existence of a link between key gender gaps and the energy sector:
 - **Literacy:** Men are more literate than women: 76 percent of young male and 61 percent of adult males are literate versus 58 percent young female and 41 percent adult females. More male heads of households attain secondary education (30 percent) than female heads of households (24 percent).
 - **Labor:** According to International Labor Organization data from 2017, women in Nigeria make up 43 percent of the total labor force. Of the total female population ages 15+, 49 percent participate in the labor market. For the same category for males, the labor force participation rate is 64 percent. DHS calculations show that men have higher rates of employment in skilled manual labor (men 23 percent, women 14 percent), unskilled manual labor (men 5 percent, women 0.1 percent), and in professional, technical and managerial (men 11 percent, women 7 percent). Women on the other hand have higher rates of employment in the sales and services area (men 25 percent, women 61 percent); and the numbers in clerical jobs was similar for both, at 1 percent. There were also differences in the employment rates of married men (99 percent) versus married women (71 percent). Low levels of women in research are observed with only 23 percent of women in research positions versus 77 percent of men.
 - **GBV:** Women face physical violence not only by all types of perpetrators (28 percent) but also by intimate partners (14 percent). The same holds for sexual violence against women



where 7 percent is committed by all perpetrators and 5 percent by intimate partners. Eleven percent of Nigerian women were subject to physical and/or sexual violence in the last 12 months.⁴²

- **Connections-varied gender gaps exist in connection rates with wealth being one proxy for access rates:** Overall 63 percent of female-headed households versus 54 percent of male-headed households have an electricity account (45 percent of rural female-headed households have electricity versus 32 percent of rural male-headed household and **79 percent of urban female-headed households have electricity versus 85 percent of urban male-headed households**) and 40 percent of those with electricity are concentrated in the highest wealth quintile. On average rural households are poorer than urban households, and **urban female-headed households are poorer than urban male-headed households** (however in rural areas female-headed households are less poor than male-headed households). This points to a need to pay attention to varied gender gaps that may develop in urban areas and as poorer households are targeted for household connections e.g. through densification.
- **Firewood and water collector dynamics:** The main source of energy for cooking is wood, which is highly concentrated in rural areas. The second most utilized energy for cooking is kerosene, mainly in urban areas. Charcoal and natural gas are also utilized but at a much lower rate. Women spent more time (minutes per day) collecting fuel or water, and also undertaking unpaid work than men:
 - *Time spent collecting fuel or water:* women 80 min/day, men 64 min/day.
 - *Time spent on unpaid work:* women 509 min/day, men 393 min/day.
 - *Women's work time is distributed into:* collecting water/fuel 80 min/day, housework 205 min/day, care of children 256 min/day, and care of adults 47 min/day.
- **Agriculture productivity gaps between male and female farmers:** The gender productivity gap in agriculture in Nigeria is 18.6 percent. Main reasons include female managers and farmers cultivate smaller land, have less access to inputs, advisory and extension services, display a lower rate of modern inputs application than their male counterparts, and suffer from discriminatory land laws. Gender productivity gaps are more pronounced for certain crops (cassava, yam and maize) while it is mild in other crops (guinea corn, bean, millet).
- **Entrepreneurship:** The Enterprise Survey 2014 collected data on 2,676 firms from the manufacture and service industries that can be disaggregated by owner/managers gender. In Nigeria, 16 percent of firms have female participation in firm ownership, and 14 of firms have females in top management positions.

5. **Gender Actions:** Based on the findings of the gender gap analysis and other country-level targets, the following key actions are a core part of the operation:

Component 1 Mini Grids

6. Given how closely women's gendered responsibilities within the home are connected to their under-recognized role as energy consumers and producers (as well as energy entrepreneurs), mini grid

⁴² Data Source: United Nations Statistics Division Report 'The World's Women 2015: Trends and Statistics'.



operators have an incentive to enhance women’s participation in mini-grid operations in order to increase sustainability of operations. Depending on the scope of the mini grid, entry points related to the business model will be explored, by REA together with the World Bank and the mini-grid operators, including the market analysis, which can help, collect sex-disaggregated data, the marketing and community outreach activities and training programs that will be delivered at various levels. Actions will also focus on potential win-win interventions that could be adopted, such as the provision of key social services such as lighting at markets or at transport stops to increase safety.

7. Given the gender gaps identified in agro-processing activities (outlined above), which is found particularly in sub-Saharan Africa, attention will be paid to enhancing the productive uses of energy. Beyond the national level gender gap on productivity, no site-specific data is currently available (sites still to be selected) and will be determined for selected sites to establish a baseline and track the closure of the identified gender gap. Applications of electricity in rural areas such as milling, grinding, carpentry, food processing, phone charging and tailoring help save the time and labor burden of men and women. However, women’s access to resources and community participation are usually more restricted and limited, and their agricultural contributions often go largely unrecognized. In the studies related to component 1, specific focus will be placed on exploring how energy services can reduce the time and labor burden of women and ways to enhance and create income generating opportunities for women e.g. through entrepreneurship or enhanced productivity and agro-processing.

Component 2- Stand-alone Solar Systems:

8. The adoption, use, and scaling of clean technology solutions are central to the energy access challenge, but women need to be seen and engaged as valuable partners along the entire value chain—in the design, marketing, sales, and after-sale services. Evidence from Kenya shows that when women entrepreneurs are engaged in the energy value chain, they outsell men by almost 3:1⁴³. Consultations held with off-grid companies⁴⁴ in Nigeria by the project team revealed a low representation of women as technical staff and managers in the sector, with roughly 16 percent of all staff being female. Under the technical assistance activities for the component, solar providers that do not currently integrate gender considerations across their operations, will be offered the opportunity to access earmarked grants to address gender gaps in job opportunities to both men and women in the areas of marketing, sales and after sales services for solar technologies. The technical assistance will also include studies of consumer finance issues and the overall supply chain to ensure equitable benefit sharing around decision making, skills and attainment of solar systems at the community level through solar provider’s business approaches.

GBV Prevention and Response:

9. The GBV related risks under the project are not expected to be substantial but REA PMU staff and contractor capacity will be increased through a GBV clinic and other related activities focused on enhancing prevention and response to violence both at the project and at the institutional level. The focus will be concentrated on two aspects: 1) at the project activities level related to energy operations e.g. contractors, beneficiaries and communities; and 2) at the client level focused on strengthening institutional aspects e.g. staff capacity, HR aspects/policies and safe and ethical reporting of GBV.

⁴³ Johns Hopkins Bloomberg School of Public Health

⁴⁴ E.g. Nayo Tropical Technologies



Additionally, emphasis will be placed on identifying and partnering with key stakeholders e.g. such as UN Women and UNFPA to support the prevention and response to GBV.

Gender Data and Monitoring and Evaluation:

10. Given the limited sex-disaggregated data available in the sector⁴⁵, attention will be paid to male and female-headed households' and businesses access to electricity by mini-grids and stand-alone solar, especially in the context of rural areas where a gender gap could possibly arise. The following actions have been identified to track sex-disaggregated data related to the household and business connections:

- (a) **Application Form:** Application form for connecting to the grid and off-grid energy services should require applicants to identify whether they are a male- or female-headed household or businesses/ enterprise.
- (b) **Pre-Electrification:** Ensure that pre-feasibility studies for electrification conducted should gather and present information about the target population by the gender of the head of household and business.
- (c) **Post-Electrification:** Validate if the final profile of the connections made by the selected contractor, reflects the gender of the household head/business head prevalent in the community as recorded in the completed feasibility studies. The task will also involve collecting, monitoring, and reporting sex-disaggregated data regarding beneficiaries for the project indicators.
- (d) **Communication and Consultation:** As part of connection awareness activities, additional consultative meetings should be held with women and female-headed households/businesses to explain electrification procedures and safety practices and answer specific questions, which are unlikely to be raised in a larger, mixed group. Standard ToR for feasibility studies for electrification must require the consultant to gather and present information about the target population by the gender of the head of household and business.

⁴⁵ General Household Survey Panel Wave 3 conducted in 2015-16. 45 percent of rural female-headed households have electricity versus 32 percent of rural male-headed household and 79 percent of urban female-headed households have electricity versus 85 percent of urban male-headed households.

ANNEX 5: DEVELOPMENT PARTNERS SUPPORT IN THE MINI GRID AND OFF-GRID AREA IN NIGERIA

COUNTRY: Nigeria
Nigeria Electrification Project

Support Programme	Summary	Development Partner
Solar Nigeria (implemented by ASI; 2014-2020)	The Solar Nigeria Programme (SNP) is designed to demonstrate viability of off-grid solar for clean, reliable, sustainable and affordable electricity in Nigeria by scaling up public and private markets. Grant components: (i) social: ~45 PHCs and 172 schools, 5-125 kW/each; (ii) Consumer (16 grants of max. US\$200,000 each to solar companies and MFIs); (iii) Commercial (30 percent grant). Upcoming project might focus in North East, and in consumer finance schemes. 5 MW installed in Lagos, 1.5 MW in Kaduna, 1.1 MW Kano	DFID
Power Africa (USAID; 2014-2018)	Power Africa is the US Government's energy program that seeks the development of a strong energy sector in Africa. Through these measures, Power Africa is working to mobilize affordable and long-term financing to support capital and operational expenditure requirements for successor generation and DISCOs to accelerate electricity market development.	USAID
Renewable Energy and Energy Efficiency Program (REEEP) (implemented by Winrock; 2014-2018)	Commercially oriented program that provides: a) TA to Companies (mainly mini grids) to develop bankable projects and raise capital; b) Technical Assistance to Banks to increase renewable energy lending across the off-grid value chain (including support to CBN SME Fund to enable access to solar companies, and to Ecobank to use the DCA guarantee); c) Training standards promotion (with NESP program).	USAID
Scaling Off-Grid Energy (SOGE; 2016-2018)	1) In Nigeria, the SOGE team has already invested US\$1,250,000 for GLP to achieve up to 20,000 projected new connections and is planning additional direct awards to companies operating in Nigeria. 2) Spurring Demand through Innovations: Through a partnership with Global LEAP and US DOE, SOGE supported a US\$600,000 innovation prize for new technologies like off-grid refrigerators that can help build demand for off-grid solutions. SOGE is also supporting GSMA's Mobiles for Development Innovation Fund to spur new solutions to the mobile payments barriers in Nigeria. 3) Strengthening the marketplace: SOGE is partnering with Power For All, the WBG CIC, and Shell Foundation.	USAID
USTDA (2000-tbc)	Grants for feasibility studies for infrastructure projects to US entities collaborating with local companies for projects of around US\$10 million CAPEX threshold. (Quaint for 50 MW IPP, ~US\$750,000 grant to CESEL (Community Energy Enterprises Limited (CESEL) with Renewia for 25 micro-grids in 25 rural communities.	USAID



Support Programme	Summary	Development Partner
NESP; 2013-2018; upcoming NESP II	The NESP is supporting the Nigerian FMPWH and other public and private partners to improve access to sustainable energy. Co-funded by EU and German Gov't and implemented in partnership with USAID's REEEP. a) Piloting 5 mini grids with Community Research and Development Center, Nayo Tropical Techs, Rubitec, GVE, GoSolar Africa (US\$200,000 grant subsidy for each); b) regulatory support to develop PPP regulations for mini-grids; c) GIS-based study on mini-grid and SHS potential; d) competency standards and training for training institutions (partnered with ~13 training institutions). Goal: 5,000 connections. Upcoming NESP II for 100,000 connections.	GIZ
SUNREF (Under preparation)	Promote RE and EE investments through a financial facility that provides credit lines for banks to on-lend to selected projects under softer terms. For projects <10 MW, and max US\$15 million/grant (lower averages expected). Partnered with MAN to select potential customers	ADF
All On (2016)	Independent, not for profit company limited by guarantee established by Shell International to act as a catalyst in the growth of Nigeria's market for sustainable off grid energy solutions. Will provide (i) impact investing (including grants, high risk equity and debt, RBF); (ii) innovation hub to accelerate companies; (iii) collaboration platform	SHELL Corporate
Access to RE Project (2016)	The BoI has established a lending facility that provides concessional loans (7 percent interest) to renewable energy companies. Phase 1 completed for 6 projects (~US\$300,000 each) for GVE and Arnergy to deploy three pilot projects each: two mini grids and one SHS based. Phase 2 launched in 2017 (Solar Energy Fund): 25 communities more (not clear if support to companies, MSME customers or communities). Topstep was awarded a grant in second phase.	UNDP/BoI
SME Facility (2016)	The Government of Nigeria has setup a Naira 500 billion SME facility to incentive local banks to lend to local SMEs. Provides concessional loan terms of 9 percent and 5-year tenures, and amounts up to Naira 50 MM.	CBN

ANNEX 6: IMPLEMENTATION SUPPORT PLAN

COUNTRY: Nigeria Nigeria Electrification Project

1. The innovative design of the proposed project will require a substantial level of implementation support particularly in the early years. Technical specialists and consultants from the World Bank will continue to be involved in the design of the project and provide implementation support. At least three full team missions and continuous involvement is anticipated in the initial couple of years.

Table 6.1. Implementation Support Plan

Time	Focus	Skills Needed
Years 1-2	Launch of first mini grid tender and implementation Launch of performance grant program including NERC mini grid cell Selection of Grants Administrator for Solar component and support during take-off of bid for challenge fund as well as performance grant program Demand assessment and preparation of bid documents for Energizing Education component Review financial sector for debt availability and support implementation of recommendations Implementation of ESMF, RPF and ESMS Supporting well-functioning PMU	Engineering, solar technology, regulatory issues, communications, FM, procurement, E&S
Years 3-5	Supervision of mini grid tender for 250 sites Supervision of solar companies under challenge funds Supporting entry of new participating businesses for solar and mini grids on a rolling basis as well as supporting supervision of implementation of plans Support arrangement for debt and equity provision to private sector Implementation of ESMF, RPF and ESMS Supporting well-functioning PMU	Engineering, solar technology, regulatory issues, communications, FM, procurement, E&S

Table 6.2. Overview of frequency of desk reviews, on-site visits and capacity building

Activity	Frequency
Desk reviews	
IFRs review	Quarterly
Audit report review	Annually
Review of other relevant information such as internal audit reports	Quarterly



Activity	Frequency
On-site visits	
Review of overall operation of the FM system	Annually during implementation support missions
Monitoring of actions taken on issues highlighted in audit reports, auditors' Management Letters, and internal audit and other reports	Continuous
In depth transaction reviews	As required
Capacity building	
FM Training	Before project start and thereafter annually
Technical Assistance	Continuous

2. **Frequency of procurement supervision.** Three missions a year, at an interval of four months, are envisaged for procurement supervision of the proposed project.
3. **Frequency of FM supervision.** The World Bank FM supervision review will be conducted at least once every year based on the risk assessment of the project. The mission's objectives will include ensuring that strong FM systems are maintained for the project throughout its life. Reviews will be carried out regularly to ensure that expenditures incurred by the project remain eligible for IDA funding.
4. Additional breakdown of task team skills mix and implementation support see Table 6.3 below.

Table 6.3. Task Team Skills Mix Required for Implementation Support

Skills Needed	Number of Staff Weeks per Year	Number of Trips per year	Comments
Project management (task team lead)	10	3	HQ based
Project management (co-team lead)	10	3	Field based
Technical Specialist Mini Grids and Distributed Power	8	2	HQ based
Technical Specialist Individual Solar Systems and Private Sector Development	8	2	HQ based
Agriculture Specialist	4	2	Field based
Procurement issues	5	3	Field based
FM issues	5	3	Field based
Environmental issues	4	2	HQ based and field based
Social issues	5	3	Field based
Gender issues	2	2	HQ based
Administrative support	10	-	HQ and field based