



**RURAL ELECTRIFICATION AGENCY**

ENERGY ≡ EMPOWERMENT ≡ EFFICIENCY

# Unlocking Barriers to Large Scale Deployment of Mini-Grids in Nigeria

Upscaling Mini grid for least cost and timely access to electricity  
**Action Learning Event**

Abuja 4<sup>th</sup> - 8<sup>th</sup> December

# INTRODUCTION



---

# ACHIEVING THE RURAL ELECTRIFICATION AGENCY (REA) MANDATE IS CRITICAL TO OVERCOMING CURRENT CHALLENGES

## Tackling electrification challenges in Nigeria...

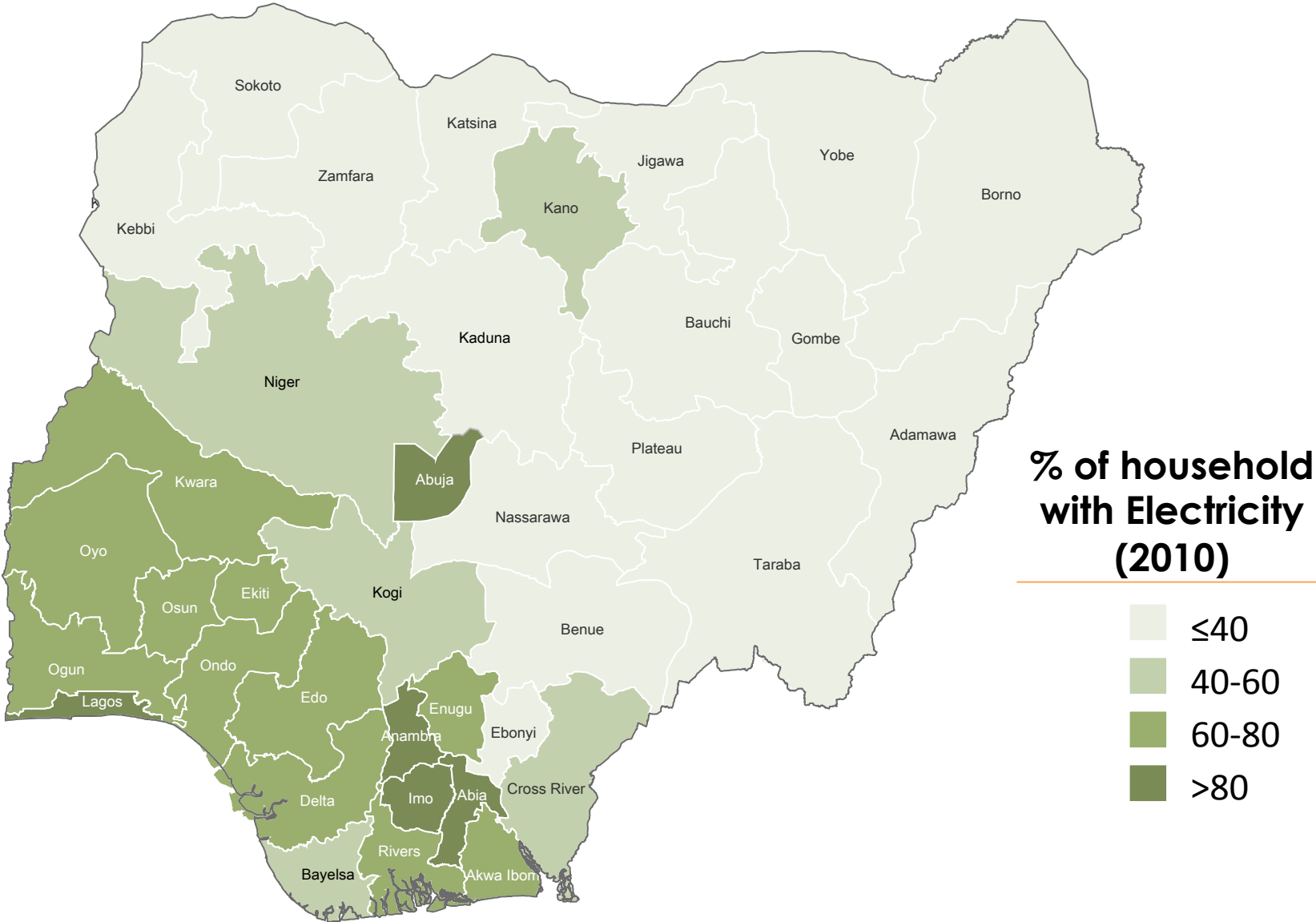
- It is estimated that only **36% of the rural population have access to electricity** and **85 million** Nigerians do not have access to electricity.

## ...are core part of the REA mission/mandate

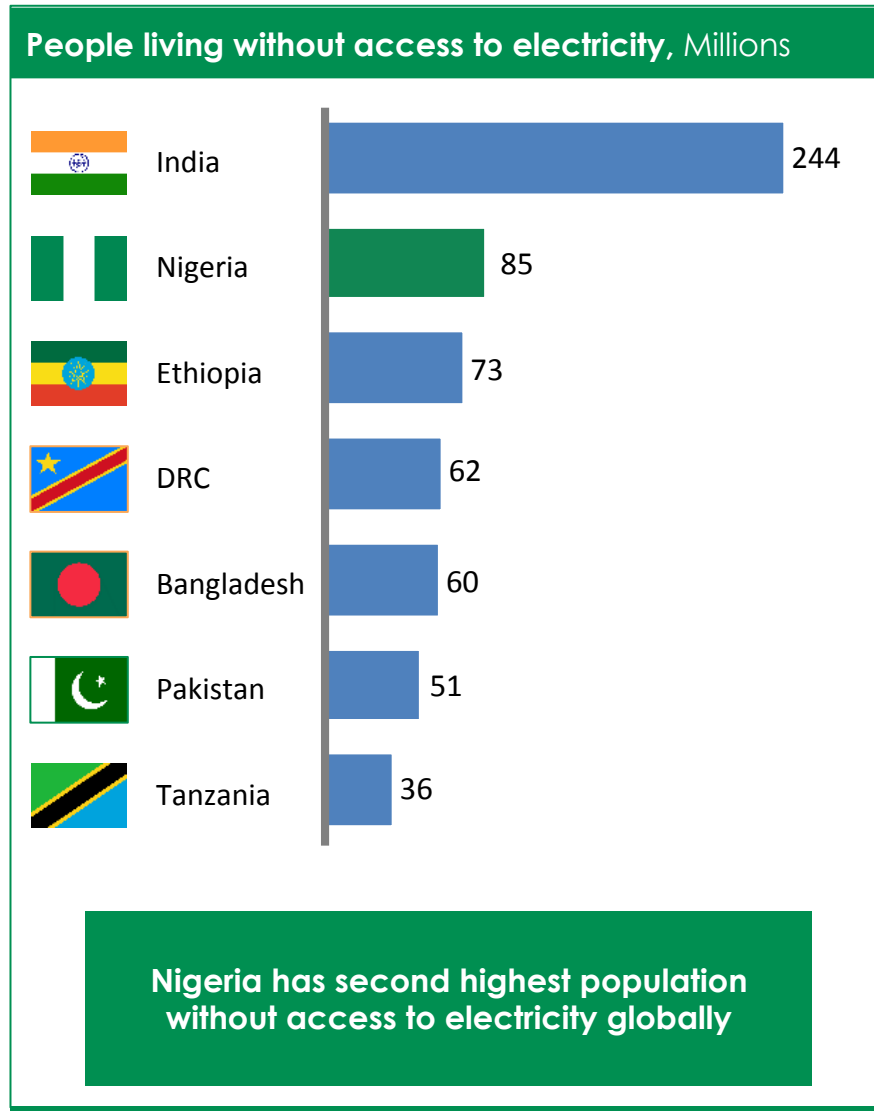
- **Mission** : *To provide access to reliable electric power supply for rural dwellers irrespective of where they live and what they do, in a way that would allow for reasonable return on investment through appropriate tariff that is economically responsive and supportive of the average rural customer.*
- **Mandate:**
  - I. Promote Rural Electrification in the Country
  - II. Co-ordinate the Rural Electrification Programs in the country
  - III. Administer the Rural Electrification Fund (REF) to promote, support and provide rural electrification through Public and Private Sector Participation

Achieving REA mandate has far reaching implications for the welfare of Nigeria's citizens

# AVERAGE ELECTRIFICATION RATE ACROSS THE COUNTRY



# GLOBAL ACCESS TO ELECTRICITY RANKING



- Of this amount in Nigeria, 64% live in rural areas
- Even those with access have limited availability of electricity

# THE OPPORTUNITY

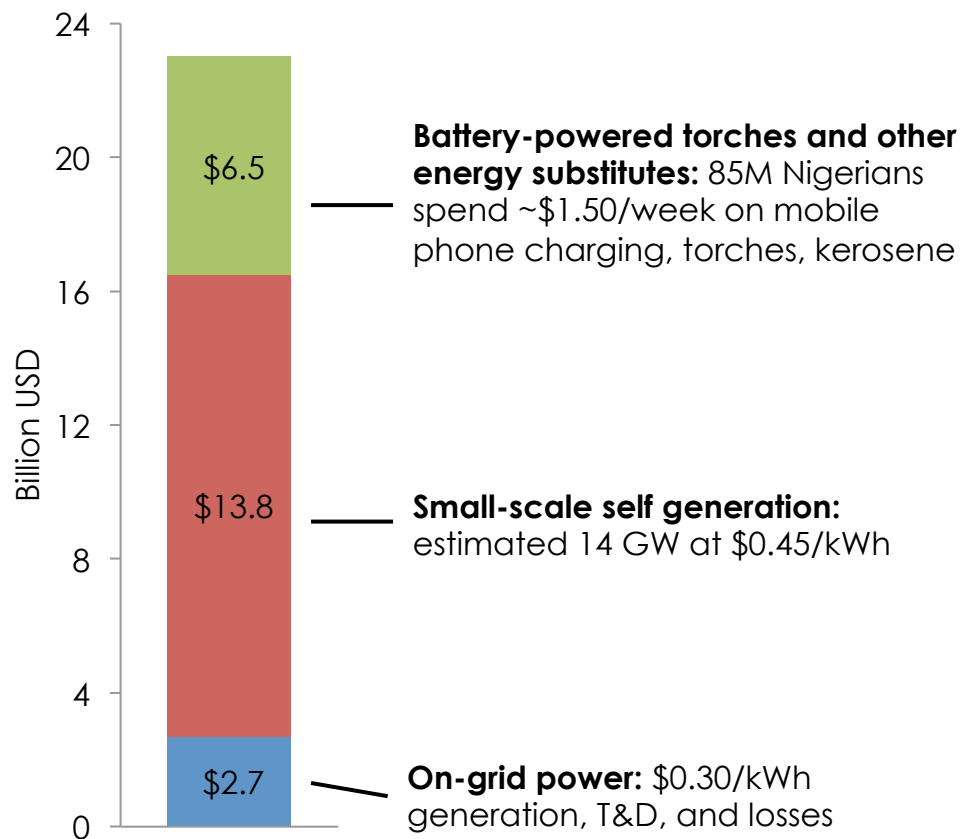


# NIGERIA OFFERS THE BEST OFF-GRID MARKET OPPORTUNITY IN AFRICA

Nigeria has the **largest population and GDP** in Africa with significant rural economic activity

- **14 GW served by small gen-sets**, compared with just 4GW of usable power from the grid
- Nigerians are already spending **\$14B annually on off-grid power** from small self generators
- **\$10 billion annual market opportunity** to supply off-grid and under-grid electricity with mini grids and solar home systems\*

Annual on- and off-grid electricity expenditures in Nigeria, 2016



Source: RMI analysis

# THE STRATEGY





# OFF GRID ELECTRIFICATION STRATEGY

Shift from centralized power generation and distribution to decentralized approach

- Economic Viability
- Demand-driven
- Market-oriented
- Private sector focused

## Stand-alone systems

- Promote the development and roll-out of stand-alone systems
- These systems to help provide critical services for hardest-to-reach customers

## Mini-grids

- Encourage the development of mini-grids by communities and private enterprises
- Grids below 100 kW do not require permit, between 100 kW to 1 MW a permit is required from NERC

## Energizing Education

- This is a rural electrification initiative with the prime objective of developing off grid independent power plant ("IPP") projects for the generation and provision of adequate power supply to thirty (37) Federal Universities (the "Universities") and seven (7) University Teaching Hospitals and surrounding communities

## Energizing Economies

- Promote efficient, clean and sustainable power to catchment areas that have high growth impact on the economy.
- Select economic clusters primarily for their high level of commercial activities

## Energy Database

- Online visualization on communities, economic clusters, population, energy demand, solar irradiance etc.

# UPSCALING MINI GRIDS



---

# NIGERIAN RURAL ELECTRIFICATION PROJECT

The Nigerian Rural Electrification Project (NEP) is a **\$350m** Rural Electrification programme supported by the World Bank to provide a pipeline of potential local investments and financial incentives to catalyze the Nigerian off-grid market, through the provision of detailed **Market Data, Grant Funding** and **Technical Assistance**

The NEP is broken up into three main components:

1. **Solar Hybrid Mini-Grid**
2. **Stand Alone Solar Systems**
3. **Energizing Education Programme**



**RURAL ELECTRIFICATION AGENCY**

ENERGY = EMPOWERMENT = EFFICIENCY



# INNOVATIVE FIELD DATA COLLECTION

Field Surveys conducted to collate data on:

- **Population density**
- **Baseline community data**
- Number and type of **productive end-uses**
- Presence of **community infrastructure** such as schools, water pumps and health facilities
- Presence of **telecommunication** towers
- **Agro-processing** and other agricultural activities and their associated electricity demand

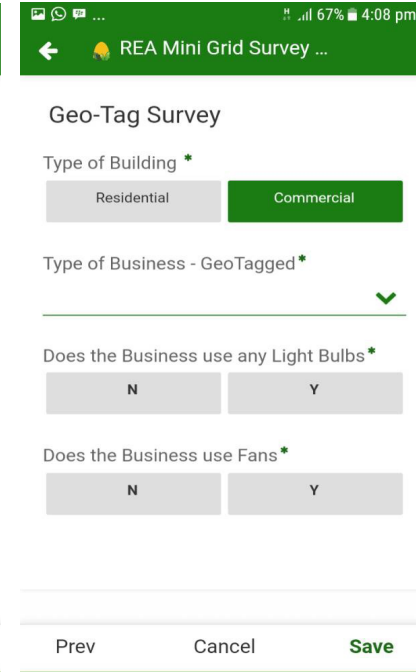
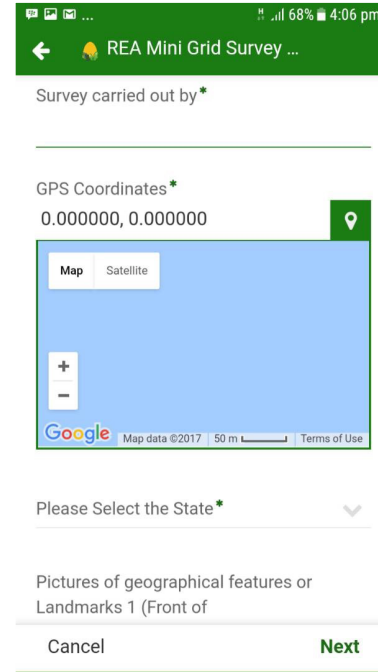
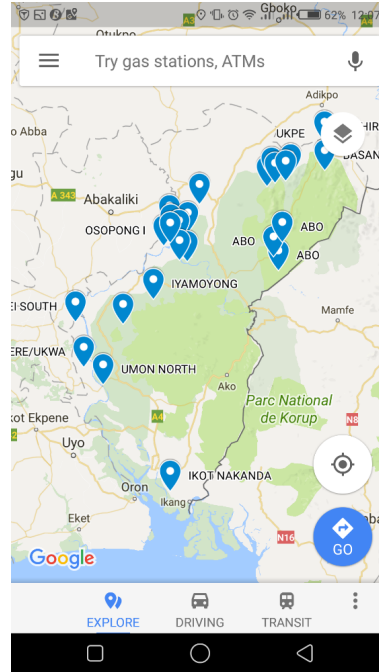


Fig 1: Screenshot of REA Survey Application

# REA FIELD DATA COLLECTION



**Fig 1: Survey at Barber shop, Ogun**



**Fig 2: Survey with Community Leader, Cross River**



**Fig 3: Survey at Provisions shop, Niger**



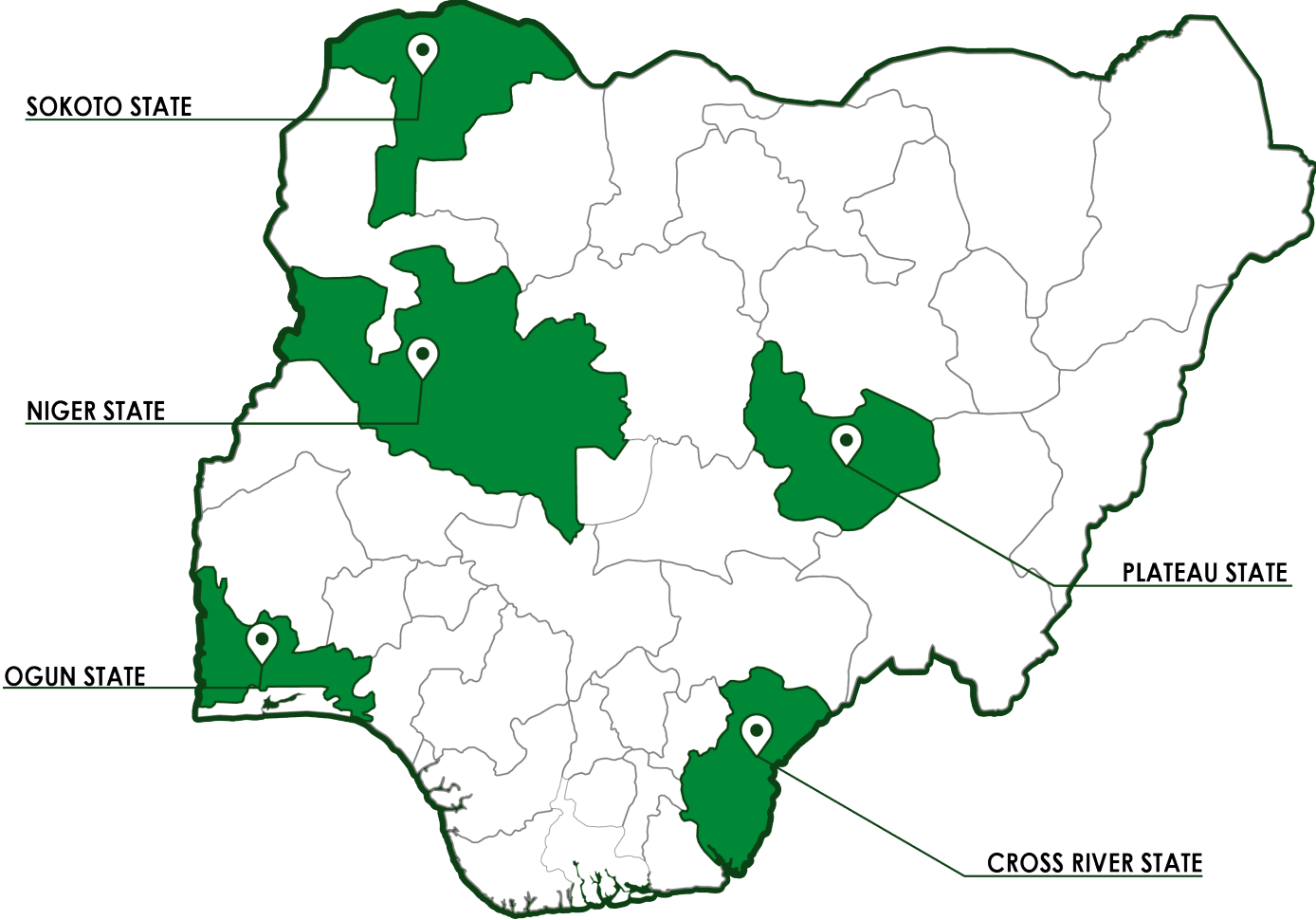
**Fig 4: Survey at Farmer shop, Plateau**



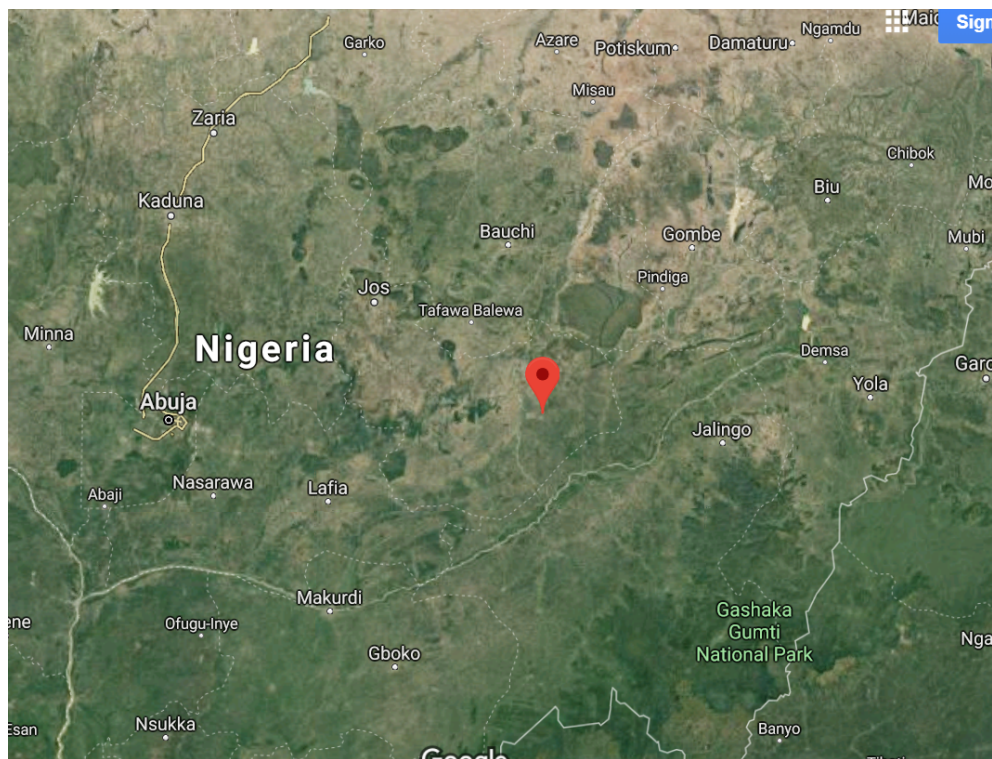
**RURAL ELECTRIFICATION AGENCY**

ENERGY = EMPOWERMENT = EFFICIENCY

# NEP: MINI-GRID COMPONENT



# SAMPLE SITE: MAVO, PLATEAU STATE



- Location – 9.017 N, 10.055 E
- Number of Households – 2000
- Commercial/productive loads: 59
- Daily consumption – 3510 kWh/day
- Annual Irradiation – 2084 kWh/m<sup>2</sup>



# SAMPLE SITE: MAVO, PLATEAU SITE

Total Households: 2000

Household Penetration rate:		75%
	Count	Avg. kWh/day
<b>Household distribution</b>		
Small HH - Hut	388	0.3
Med HH - Bungalow	714	1.9
High HH - Modern House	388	4.8
<b>Public</b>		
Health Center - Small	1	10
Health Center - Med	0	60
Health Center - Large	0	150
School small	5	3
School large	0	10
Community center	0	3
Religious buildings	2	3
<b>Commercial</b>		
Beauty salon	0	3
Tailor	5	3
Petty trader	16	3
Barbing saloon	1	3
<b>Productive</b>		
Welder	1	12
Restaurant	1	6
Farmer (grinding)	5	7
Farmer (milling)	2	7
Recharge vendors	2	3
Phone chargers	6	3
Furniture Makers	2	3
Fuel dealers	10	3



Fig:1 Distribution network for the community

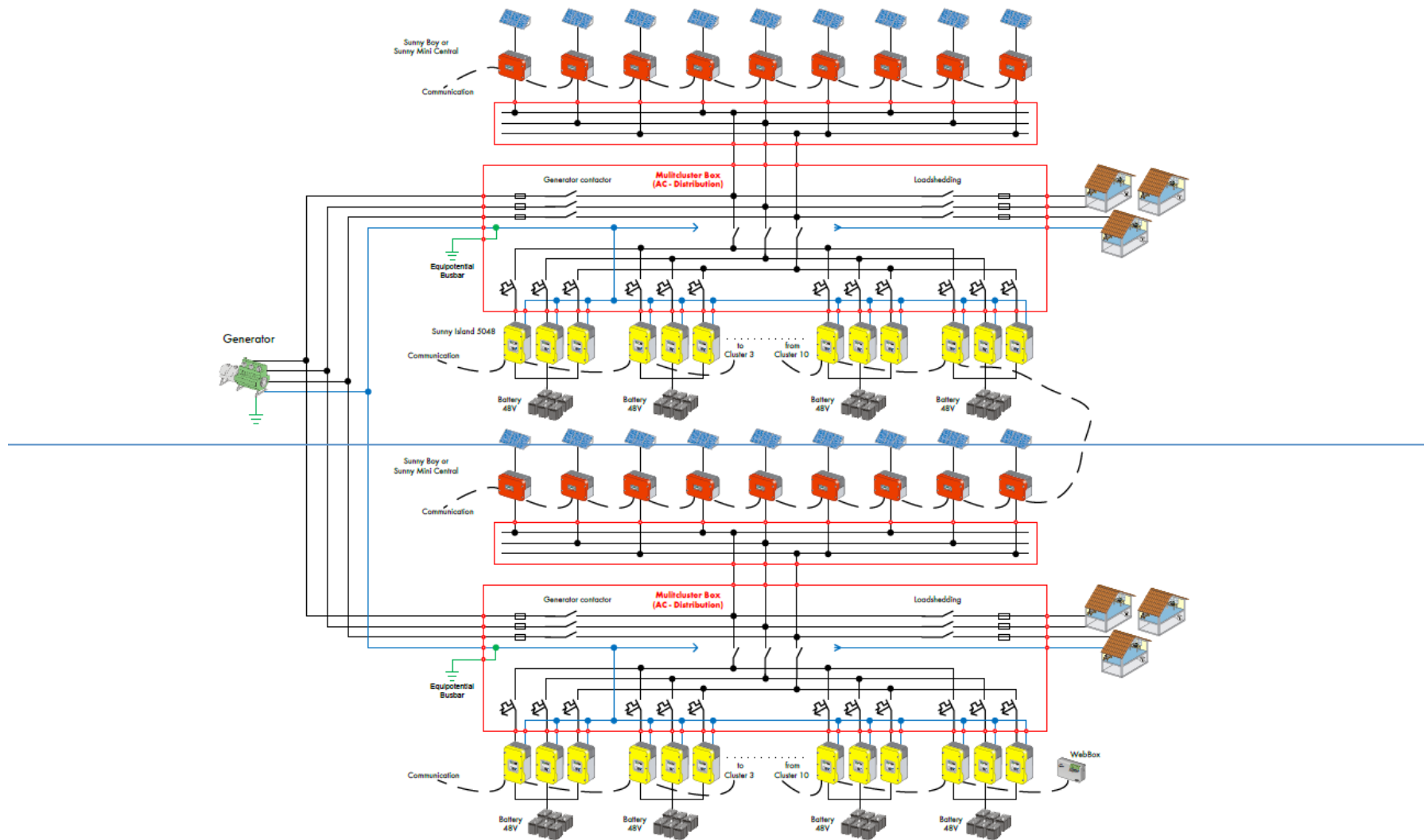
# SAMPLE SITE: MAVO, PLATEAU SITE

<b>Capital cost:</b>						
	<b>No diesel constraint</b>		<b>Diesel limited to 50%</b>		<b>Diesel limited to 20%</b>	
	Size	Capital (USD \$)	Size	Capital (USD \$)	Size	Capital (USD \$)
Solar PV + installation	<b>535 kW</b>	<b>374,150</b>			<b>914 kW</b>	<b>639,450</b>
Battery + installation	-	-			<b>9174 kWh</b>	<b>1,994,400</b>
Diesel Generator	<b>350 kW</b>	<b>126,000</b>			<b>100 kW</b>	<b>36,000</b>
Inverter	<b>403 kW</b>	<b>84,304</b>			<b>404 kW</b>	<b>84,304</b>
MPPT Charge controller	-	-				<b>96,634</b>
Network + distribution transformer	<b>17.33 km</b>	<b>284,386</b>			<b>17.33 km</b>	<b>284,386</b>

<b>Network Design:</b>		
Name	Length (km)	Capital (USD \$)
Weasel	<b>13.4</b>	<b>160,735</b>
Ferret	<b>0.5</b>	<b>6,305</b>
Rabbit	<b>0.86</b>	<b>12,019</b>
Horse	<b>0.17</b>	<b>2,930</b>
Dog	<b>0.96</b>	<b>19,280</b>
Dingo	<b>0.42</b>	<b>10,233</b>
Panther	<b>0.45</b>	<b>12,454</b>
Zebra	<b>0.31</b>	<b>23,637</b>

# SAMPLE SITE: MAVO, PLATEAU SITE

## DOUBLE MINI-GRID FOR LARGER SITES



## PV – Battery – Diesel System

High Renewable Fraction

Photovoltaic Panels	2880X Canadian Solar 330 Wp Modules
Solar Inverter	30X SMA Sunny Tripower 25000TL-30
Battery Technology	Lithium Ion
Batteries	2 Sets of 36X Tesvolt TS40 (8 Modules)
Battery Inverter	2 Sets of 36X SMA Sunny Island 8.0
Generator	1X 500 kW Diesel Genertor

## PV – Battery – Diesel System

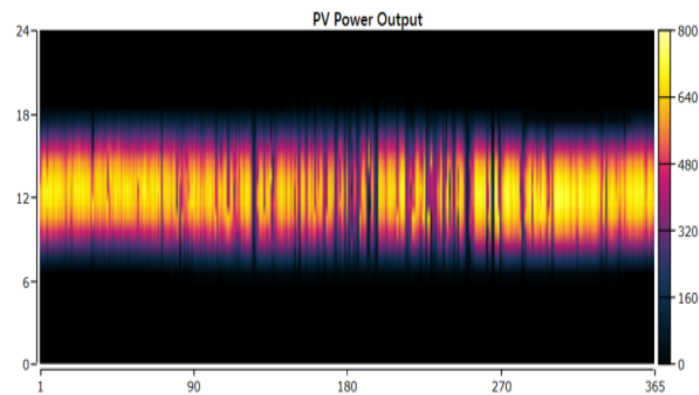
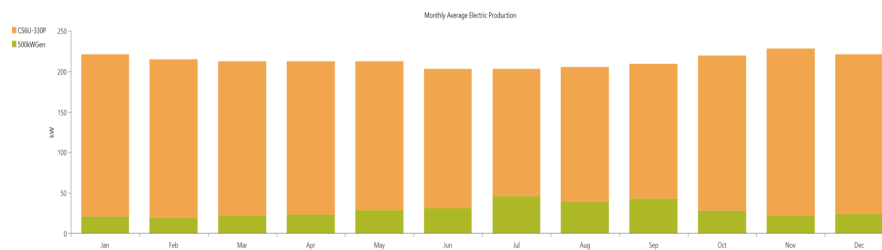
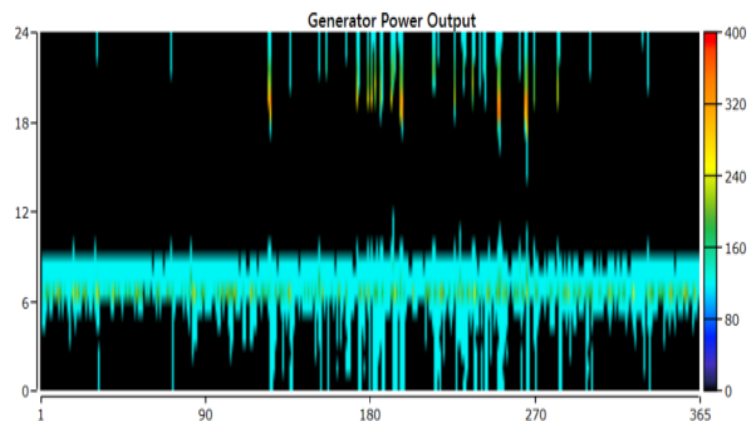
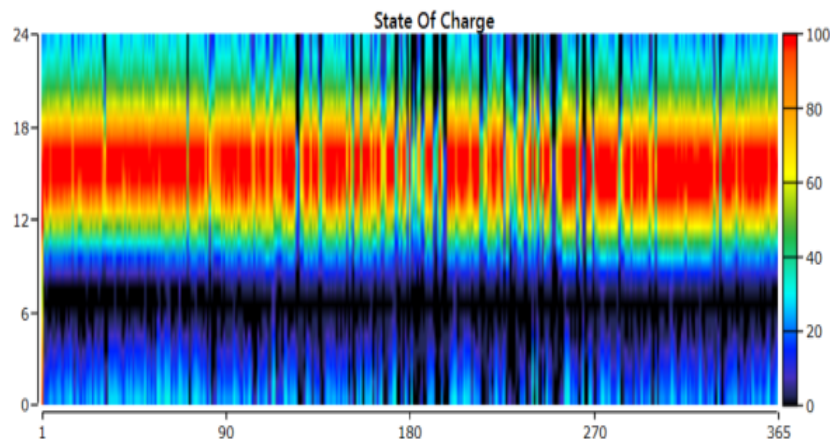
Low Renewable Fraction

Photovoltaic Panels	1920X Canadian Solar 330 Wp Modules
Solar Inverter	20X SMA Sunny Tripower 25000TL-30
Battery Technology	Lithium Ion
Batteries	2 Sets of 24X Tesvolt TS40 (6 Modules)
Battery Inverter	2 Sets of 36X SMA Sunny Island 8.0
Generator	1X 500 kW Diesel Genertor

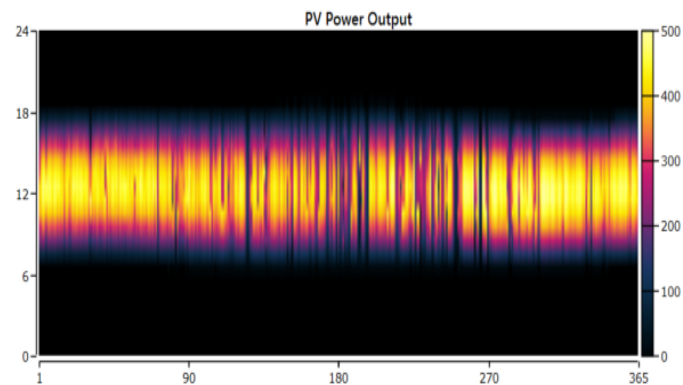
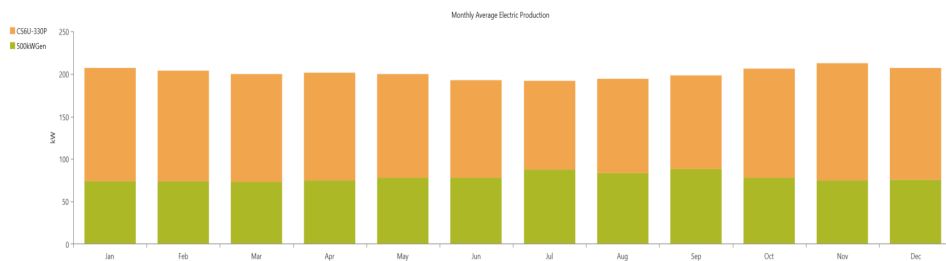
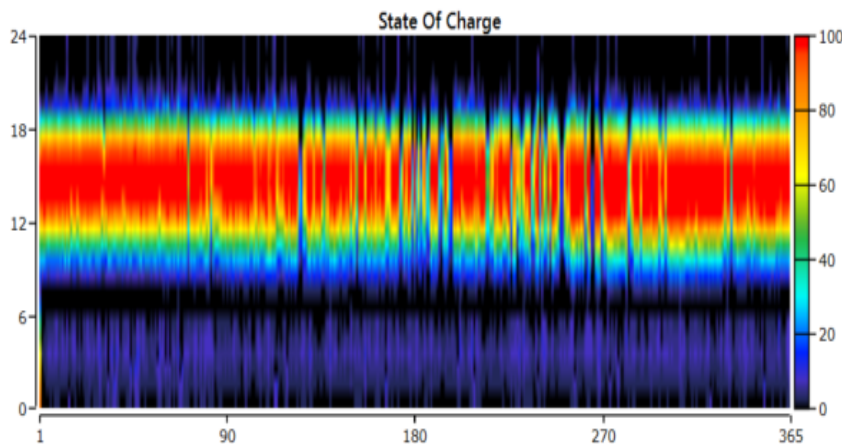
## Comparison of Systems

	High Renewable Fraction	Low Renewable Fraction
Renewable Fraction	83.0%	54.3%
Total Consumption	1,504 MWh	1,504 MWh
PV System Production	1,614 MWh	1,076 MWh
Excess Production	170 MWh	152 MWh
Diesel Energy Production	256 MWh	687 MWh
Hours of DG Operation	1874 hours/year	4977 hours/year
Battery Consumption Share	54.75%	29.86%
Levelized Cost of Electricity		

## Annex 1: High Renewables Fraction



# Annex 2: Low Renewables Fraction







# RURAL ELECTRIFICATION AGENCY

ENERGY = EMPOWERMENT = EFFICIENCY

For further information please contact:

**Damilola Ogunbiyi**  
Managing Director & CEO  
RURAL ELECTRIFICATION AGENCY  
damilola.ogunbiyi@rea.gov.ng

**Lolade Abiola**  
Head of Renewables  
RURAL ELECTRIFICATION AGENCY  
lolade.abiolai@rea.gov.ng

[www.rea.gov.ng](http://www.rea.gov.ng)