Nigerian Rural Electrification Agency

Mini-Grid Action Learning Event

Addis Ababa, Ethiopia

RURAL ELECTRIFICATION AGENCY

ENERGY = EMPOWERMENT = EFFICIENCY

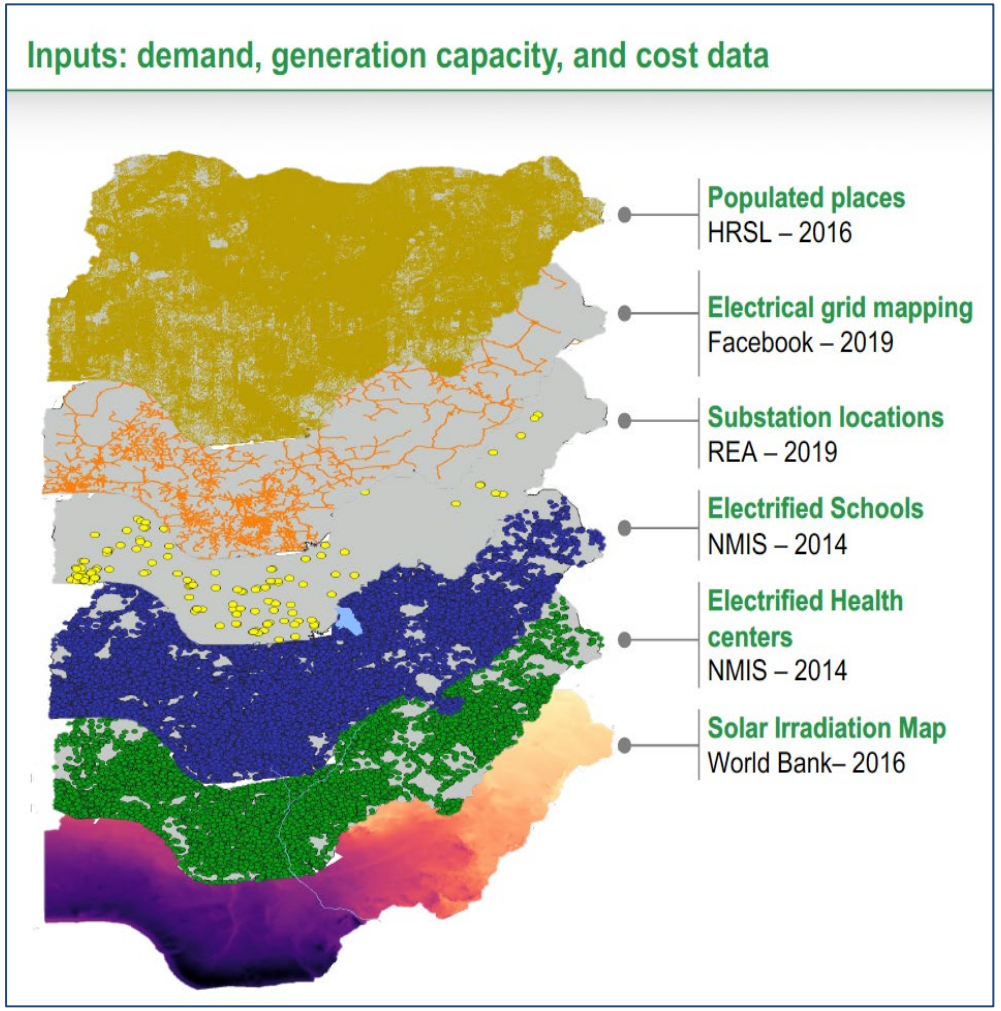
February 2020

CONTENTS

NIGERIAN UNVERSIAL ACCESS ELECTRIFICATION MODEL

A geospatial model was developed to determine the least-cost electrification mix to electrify Nigeria's unelectrified population

1 Define unelectrified households	2 Calculate household demand	3 Determine energy generation potential	4 Determine least-cost technology per household	5 Test sensitivities of key inputs
a Identify unelectrified population	Define level of consumption in tiers	Define sources of energy generation mapped to consumption tiers	Define bottom up cost of each technology per connection	Check input sensitivity to provide assurance on model logic
b Define settlements in rural and urban areas	Map settlements to consumption tiers		Select least-cost technology per settlement	
c Project future population density	Project future demand growth			

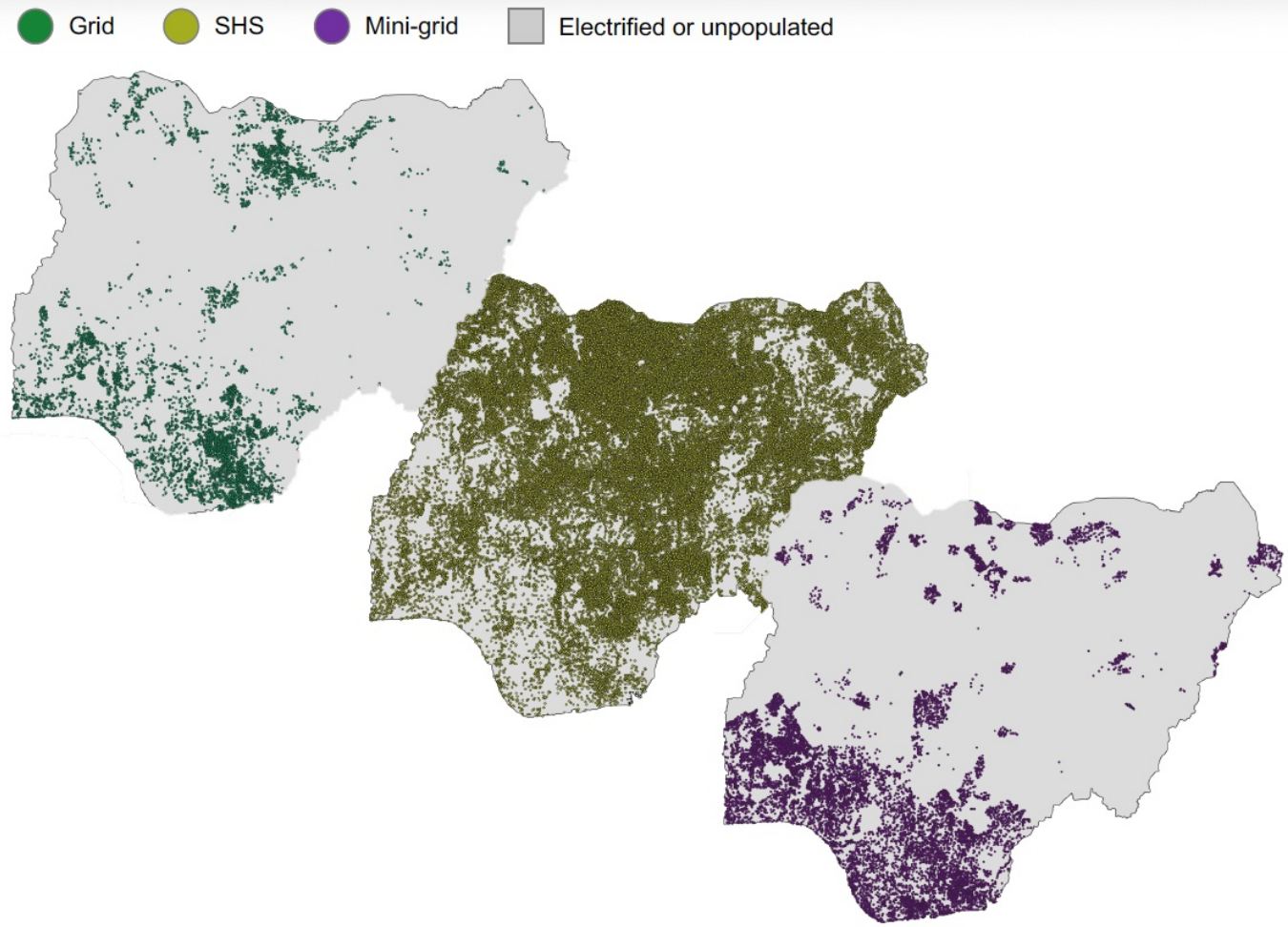


SOURCE: Rural Electrification Agency

NIGERIAN UNVERSIAL ACCESS ELECTRIFICATION MODEL

Mini Grids are estimated to be the least-cost electrification method for approx. 15.3 million people

2024 least-cost technology mix: Grid extension possible within 10km of grid



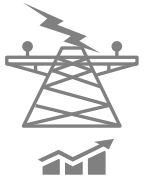
	Grid	Mini-grid	SHS	Total
# of residential connections	3.6m	1.4m	7.5m	12.5m
% of residential connections	29	11	60	100
# of settlements	6,723	11,720	70,897	89,340
Total Cost, (USD B)	3.9	1.5	7.1	12.4
Population (millions)	32.0	15.3	69.6	116.9
Total Energy (GW)	0.9	0.3	0.9	2.1

SOURCE: Rural Electrification Agency

NIGERIA ELECTRIFICATION PROJECT Overview

Objective: Increase access to electricity services for households, public educational institutions, and micro, small and medium enterprises throughout Nigeria

US$350 million facility with 4 components



Component 1: Solar Hybrid Mini Grids for Rural Economic Development ($150m)

Provide subsidies and performance-based grants for mini-grid developers to build solar hybrid mini-grids in rural areas.

1. **Minimum Subsidy Tender ($80m)**
2. **Performance based Grants ($70m)**

Component 2: Standalone Solar Systems for Homes, Enterprises ($75m)

Provide market-based incentives to standalone solar system providers to install solar home systems (SHS) for underserved households and SMEs

1. **Output Based Fund ($60M)**
2. **Market Scale Up Challenge Fund ($15M)**

Component 3: The Energizing Education Programme (EEP) ($105m)

Support the construction and operation of solar hybrid mini grids for federal universities and adjoining teaching hospitals under Phase II of the Programme.

Component 4: Technical Assistance ($20m)

Support project implementation, broad-based capacity building, and help develop a framework for scaling up rural electrification.

Minimum Subsidy Tender - Programme Design

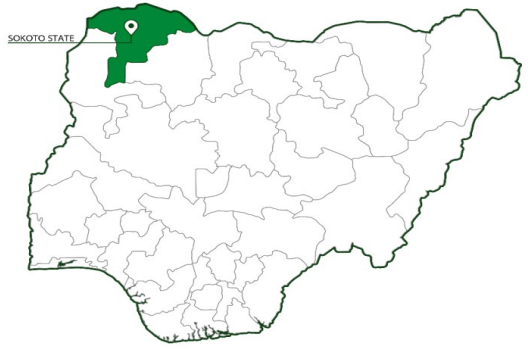
OBJECTIVES

- Develop mini grids on a build-own-operate model and catalyze mini grid deployment at scale to kick-start the market
- **250** sites to be tendered based on geo-referenced data on population clusters and sites, including population density, number and type of productive end-uses, productive loads and estimated load profiles

PROGRAMME DESIGN

- **Phase 1:** Tender for 57 sites across four states: Niger, Sokoto, Ogun, and Cross River states
- **Phase 2:** Scale up to complete 250 sites across these four states

Sokoto State



Ogun State

Niger State

Cross-River State

Phase 1 tender expected to bring clean energy to:

- 20,000 households
- 1,000 small and medium businesses and public institutions

PERFORMANCE BASED - PROGRAM DESIGN

PROGRAMME DESIGN

- A Performance-Based Grant will be available for eligible projects on a rolling basis.
- Developers will carry out geospatial studies, energy audit and community surveys to select viable sites
- REA provides support through the Zonal offices in accessing remote offgird locations
- Grant will be set at **USD350 per new connection**
- Eligible projects:
  - Solar hybrid mini grids
  - Mini grids in unserved areas
- Grant disbursement once connection is made, on a first-come first-served basis

APPLICATION AND APPROVAL PROCESS FOR PERFORMANCE BASED GRANTS

Pre-Qualification Stage

A

Site Specific Stage

B

Grant Agreement Signing

C

Build

D

Verification & Disbursement

E

1. **Developer Submits Program Application on Odyssey Platform**
2. **Program Application Evaluation**
3. **Notification of Qualification of Developer**
4. **Developer Submits Site-Specific Technical Application on Odyssey**
5. **Site-Specific Technical Application Evaluation**
6. **Notification of Project Approval of Developer**
7. **Grant Agreement Signing Between REA and Developer**
8. **Developer Constructs Mini grid**
9. **Developer Installs meters**
10. **Developer Uploads connection details on Odyssey**
11. **Developer Submits Claims 90 Days After Connections**
12. **Connections Verified via installed meters**
13. **Developer Receives fixed Subsidy of $350 per Connection**

Additional Information for the Performance Based Grant Submissions on Odyssey

I. If REA requires more from the developer, the applicants will be contacted - leaving the Project stage in **"Pending"**.

II. If REA approves the project, they will update the Project stage to "**Approved**" in the project sharing tab

III. Once paid, REA will update Connection status to "**Paid**."

IV. If REA declines the project, they will update the Project stage to "**Declined**" in the project sharing tab.

V. Developer can resubmit connections for verification or continue via the claim dispute and or REA's manual verification process.

VI. Developers will alert REA of connections they believe were incorrectly marked as "**Not Verified**"

VII. If the connection is deemed valid, Odyssey will update the status to **"Verified."**

(ROKATA COMMUNITY)

First PBG Site Commissioned under Nigerian NEP

December Of 2019

The project, which is a 64KWp solar hybrid mini grid in Rokota Community, Edati Local Government Area, Niger State, was constructed by PowerGen Renewable Energy Nigeria Limited . The mini grid will benefit 3,000 people and provide 350 end users with clean, safe, affordable and reliable electricity to improve their quality of life and boost economic activities.

RURAL ELECTRIFICATION AGENCY

MINIGRID PRE-FEASIBILITY EVALUATION AND SITES SELECTION

First-cut prioritization with existing data has identified 200+ sites with at least 100kW demand

Detailed surveys completed: REA visited top 200 sites across 5 priority states (Nov. 2017)

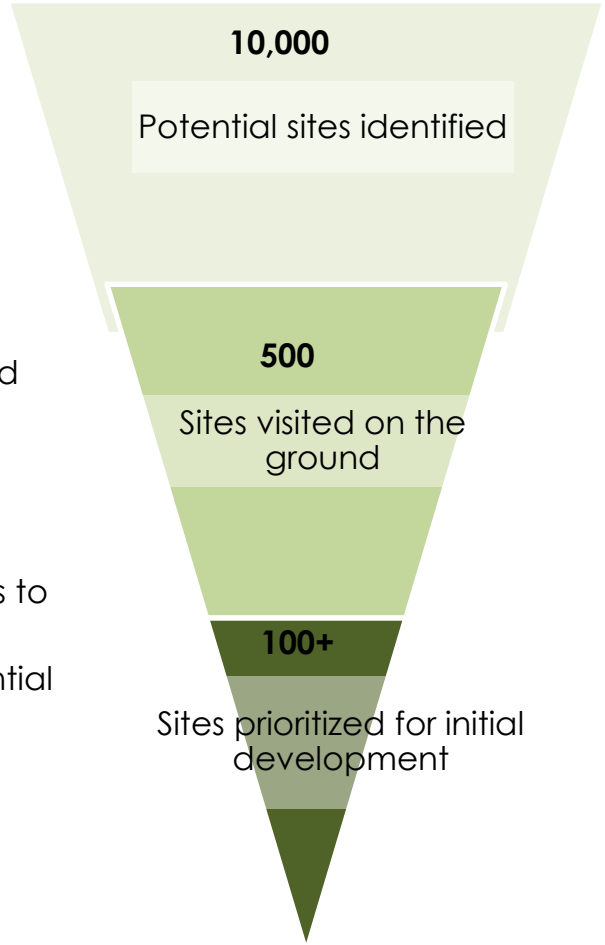
REA teams prioritized sites by:

- Sufficient load/density
- Productive-use, daytime, and flexible loads
- Supportive local and state government
- Community engagement
- Accessibility

REA teams are gathering detailed data at these sites and using that data to improve site-selection

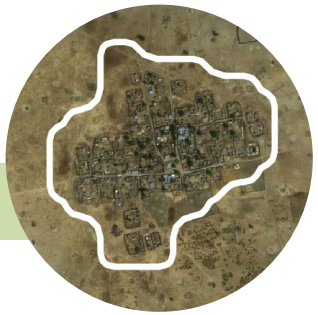
REA survey data includes:

- Number of households, shops, productive loads, and other institutions
- Appliances, productive loads, time of use
- Estimated load profile
- Existing self generation (size and number of units)
- Fuel price and availability
- Cellular service (providers and reliability)
- Current income and willingness to pay
- GIS data for villages and potential customers



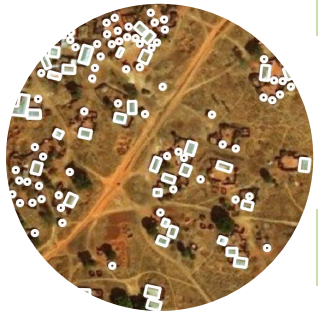
REA site selection process provides clarity, reduces risk, and accelerates process for private minigrid development

Data Collection- Process overview



Step 1: Geospatial Cluster analysis

Automatic identification of settlement locations using primarily HRSL data (http://ciesin.columbia.edu/data/hrsl/)



Step 2: On-site Electrification Verification surveys

Site visits to confirm grid connection status and identify any existing grid infrastructure.

Step 3: Remote Mapping

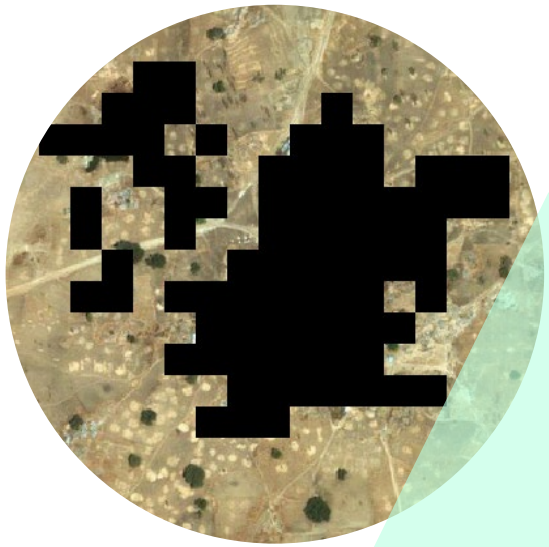
Manual mapping of buildings and other features within an identified cluster to better describe the cluster characteristics

Step 4: On-site Energy Audit surveys

Collection of primary data that cannot be viewed remotely (e.g. detailed information on building use type and businesses)

Graphics sources; Background: Bing Aerial, building outline: © OpenStreetMap contributors

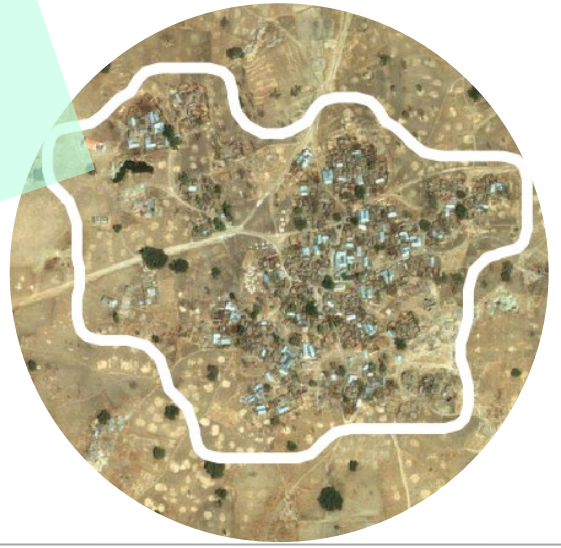
Geospatial Cluster analysis



Input:
High resolution settlement layer

Processing:
- Vectorizing
- Buffering
- Dissolving

Output:
Cluster boundaries



The first step "Cluster analysis" is the processing of country-wide secondary datasets to generate an accurate view of where built-up areas are located.

A key settlement used in generating the cluster dataset for Nigeria is the HRSL layer. This layer can be combined with other secondary datasets to create additional attributes for the cluster.

The clusters can then be **ranked** in order of priority to provide a sequence plan for the remote mapping activity.

Graphics sources; Background: Bing Aerial, HRSL: http://ciesin.columbia.edu/data/hrsl/

On-Site Electrification Verification

Community – Zuguma

- Pre-survey Name – Mashegu,5
- Updated Name – Zuguma (Gboban)
- Available GPS - 10.015710, 4.957080
- Updated GPS - 10.015710, 4.957100
- Is this community connected to the grid? YES
- Is there any visible grid infrastructure? YES
- Comments: Zugurma community is electrified and connected to National grid.

Community Signboard or Landmark 1

Community Signboard or Landmark 2

Transformer

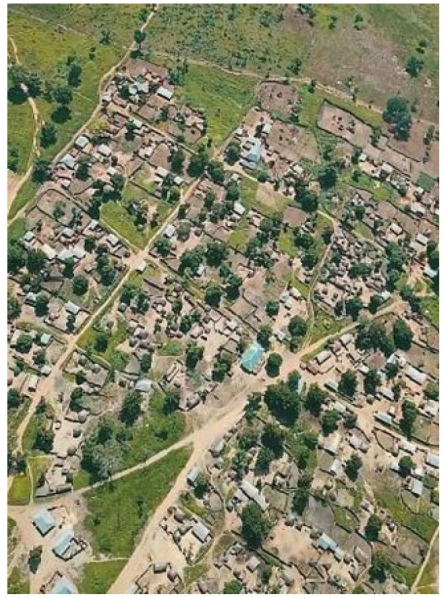
Distribution Lines

Substation

Drone Image 1

Drone Image 2

Drone Image 3



Key Objectives of Verification Exercise

1. Confirm Electrification Status
2. Confirm Presence of Grid infrastructure
3. Confirm actual Name of community
4. Update GPS information
5. Capture Hi-Res Drone Imagery

Average accuracy of Geospatial Cluster Analysis

States	Off Grid (OG)	Grid Connected (GC)	Total
Ogun	51	85	136
Niger	33	20	53
Cross River	68	8	76
Sokoto	67		67
Total	219	113	332

November 2017 – 66% of Surveyed communities Confirmed to be off-grid

States	Off Grid with no Infrastructure (OGN)	Off Grid with Infrastructure (OGI)	Grid Connected (GC)	Total
Anambra	5	7	10	22
Abia	6	7	14	27
Kano	26	3	6	35
Bauchi	8	4	25	37
Ogun	26	13	12	51
Ondo	28	2	5	35
Sokoto	48	17	33	98
Total	147	53	105	305

March 2019– 65% of Surveyed communities Confirmed to be off-grid **48% (OGN)**

States	Off Grid with no Infrastructure (OGN)	Off Grid with Infrastructure (OGI)	Grid Connected (GC)	Total
Ogun	9	5	5	19
Niger	48	13	12	73
Cross River	20	5	3	28
Sokoto	66	7	8	81
Total	143	30	28	201

August 2019 – 86% of Surveyed communities Confirmed to be off-grid **71% (OGN)**

Average of (OGN+OGI)

72%

Average of (OGN)

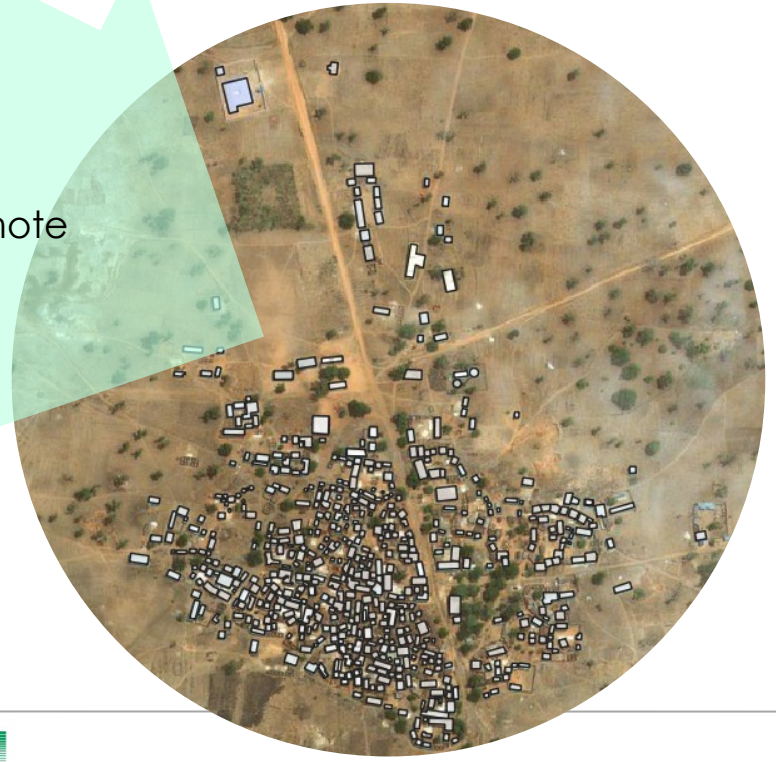
61%

Remote mapping – Work in Progress

Input:
Cluster boundaries

Digitizing:
- Building outlines
- Other remote features

Output:
Digitized features



Cluster area is digitised for features that are visible from a satellite image. Such as

- Building area
- Roads and paths,
- Vegetation,
- Land use and compound walls.

The data generated during this remote mapping phase is new valuable primary data that can give population indications (e.g. number of buildings in each cluster, or distribution of structure types).

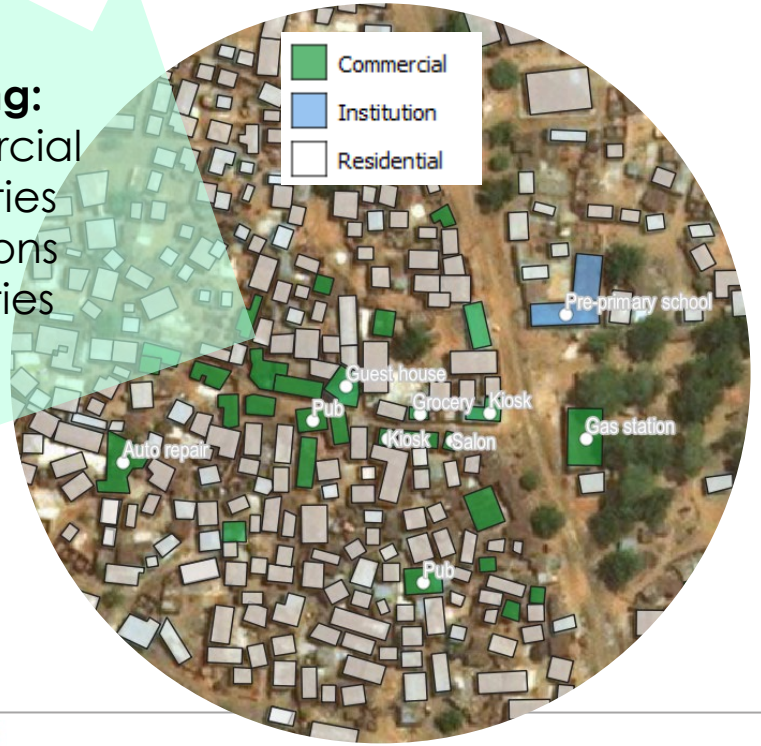
Graphics sources; Background: Bing Aerial, Building outline: © OpenStreetMap contributors

On-site surveys

Input:
Digitized features

Surveying:
- Commercial properties
- Institutions
- Amenities

Output:
Labelled points of interest

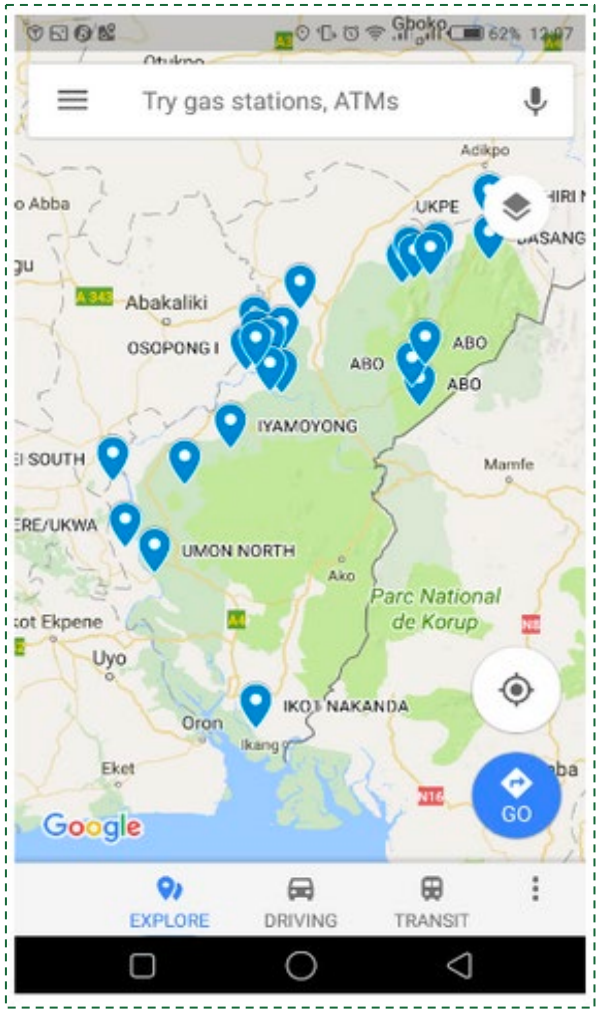


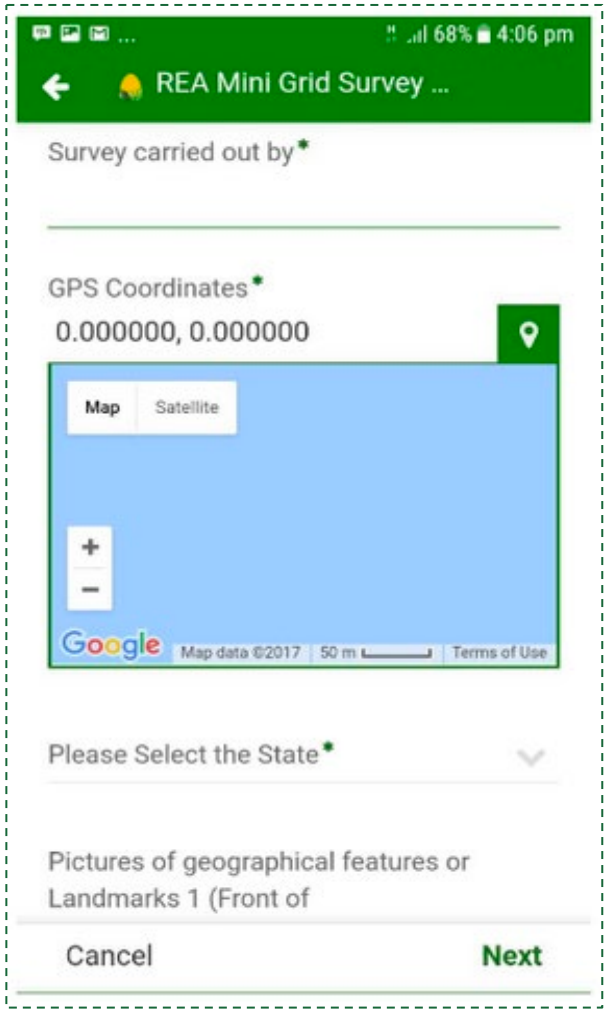
- Electrification Verification to identify off-grid sites and shortlist potential Wards
- Clusters will be selected for a visit based on favourable attributes seen remotely. This settlement will then be surveyed, and data will be collected which is not visible on satellite imagery.

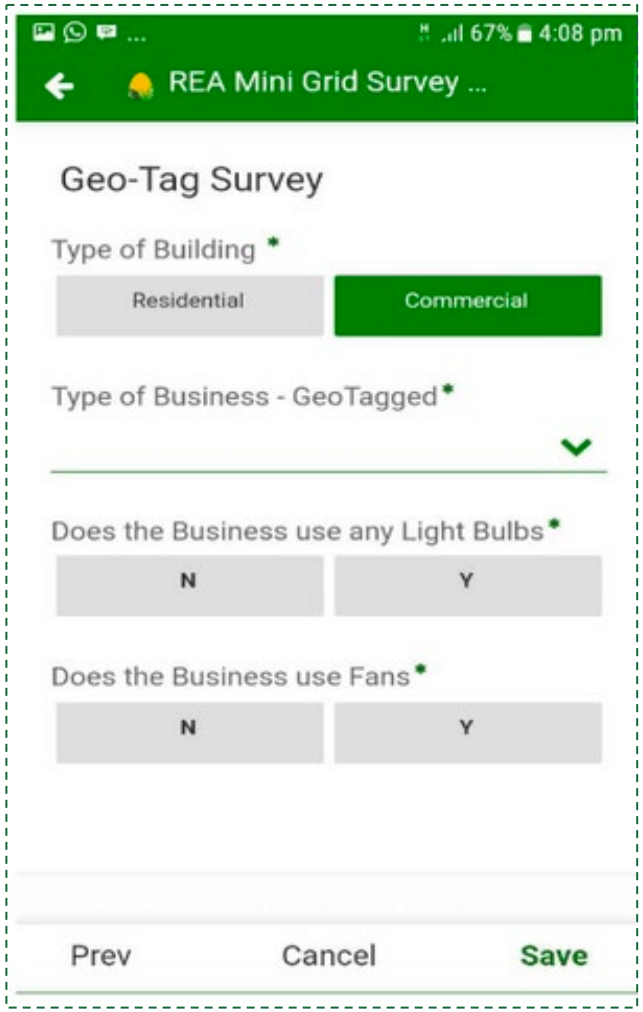
Land use type and business / institution names will be collected. This allows a full detailed view of the cluster with key primary datasets to be collected.

Surveys Carried out using computer aided personal interview app on an Android device

1. Community survey
2. Simplified household Census Survey
3. Commercial Survey
4. Geo-tag Survey







COMMUNITY ENGAGEMENT

Objective

To attain the buy-in of NEP communities through tactical community engagement activities. Engagement will include advocacy, consultation and collaboration in the communities throughout NEP 5 year implementation.

Stakeholder Groups

- Community Leaders
- Women's Groups
- Youth Groups
- Physically challenged
- Religious Organizations
- Schools
- Healthcare Facilities
- Community Vigilante
- Electricity Users Association

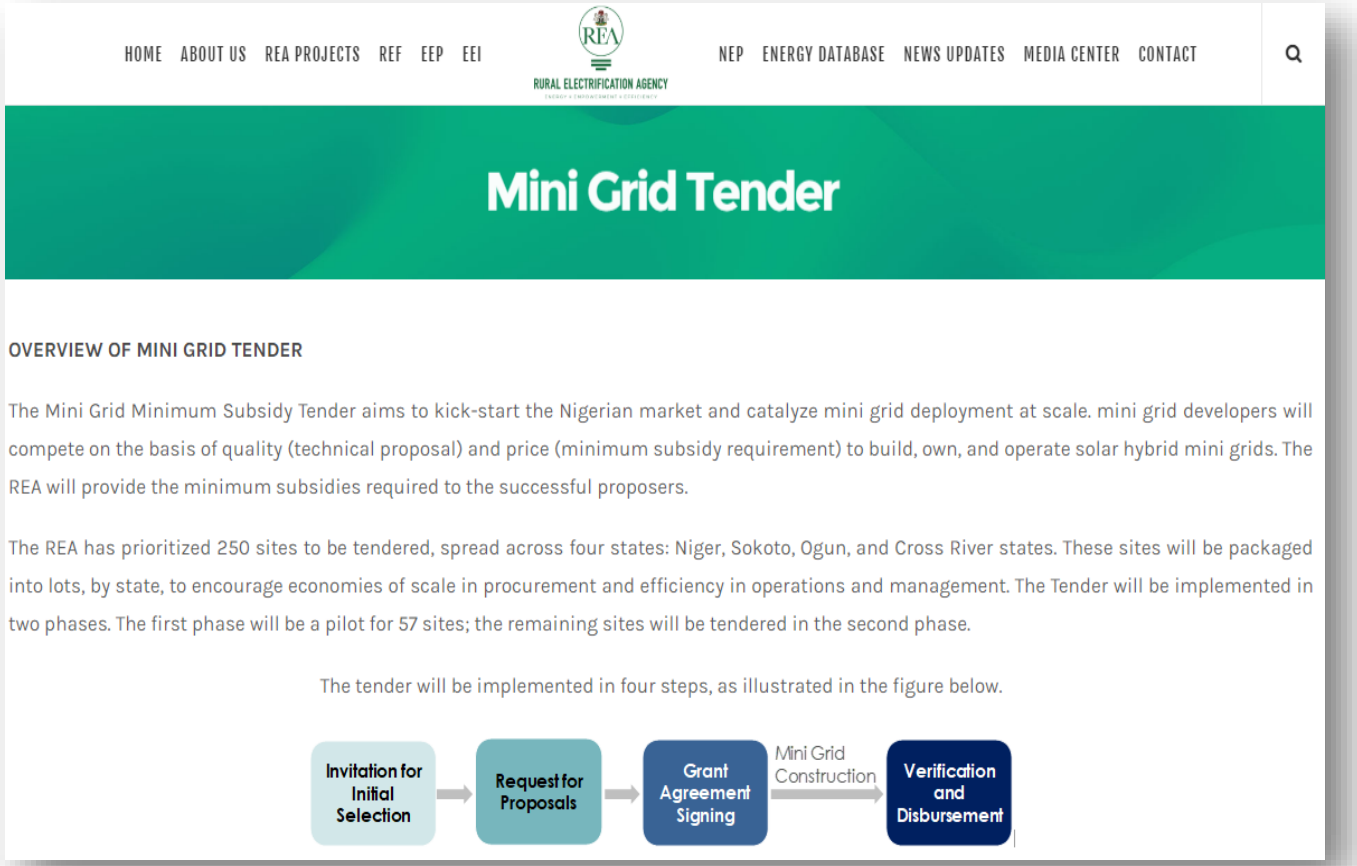
REA teams visited 100 communities to sensitize the communities on NEP

Project Planning, Implementation and Monitoring: Integration with Odyssey

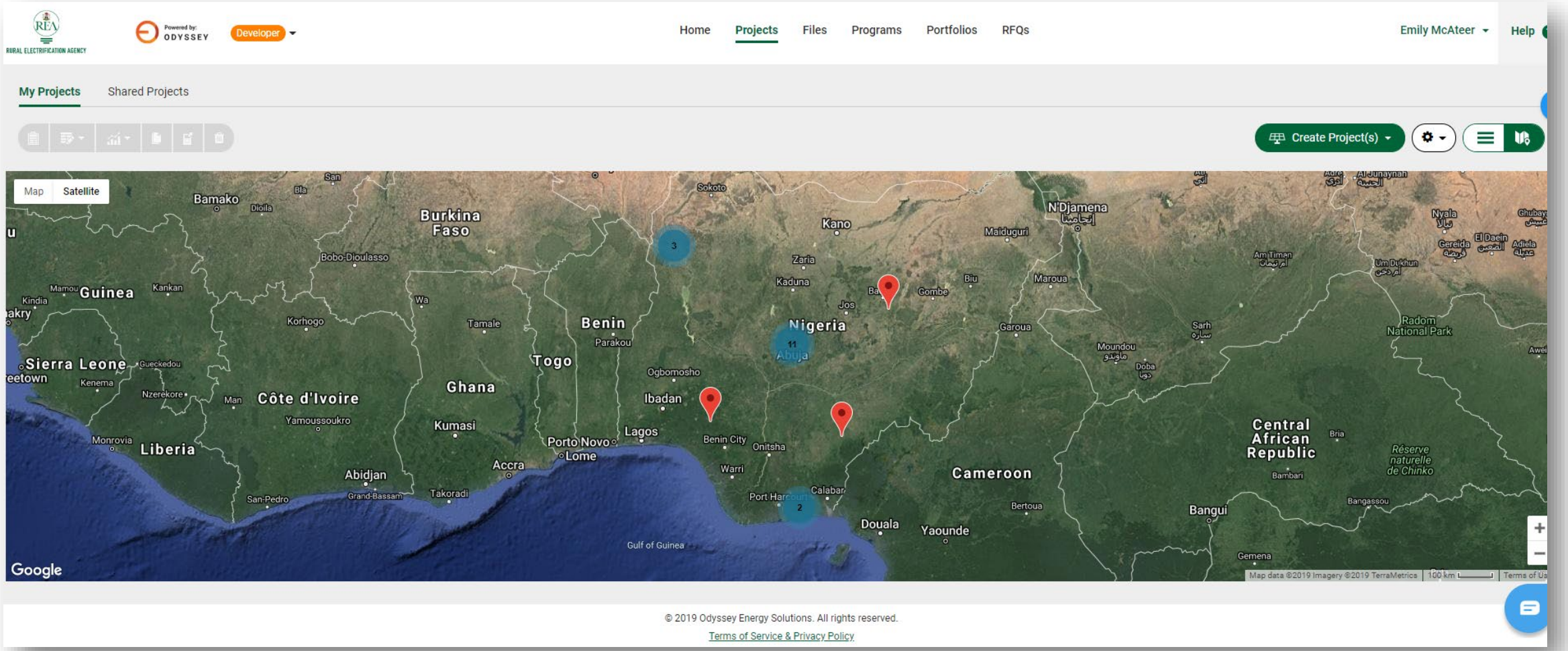
The Opportunity: In Nigeria, the REA and World Bank has launched the **$350M Nigeria Electrification Program**

The Challenge: How to manage three different financing windows, survey sites and share that data with applications, track results for results based financing, make data publicly available, and do it all at a **scale of thousands of projects?**

The Solution: Odyssey has created one central NEP hub, that enables data driven decision making and an efficient project evaluation process. **Odyssey built the tool for conducting and managing data for hundreds of feasibility studies. Odyssey is tracking all connections and project performance all while driving down the costs of running the program**

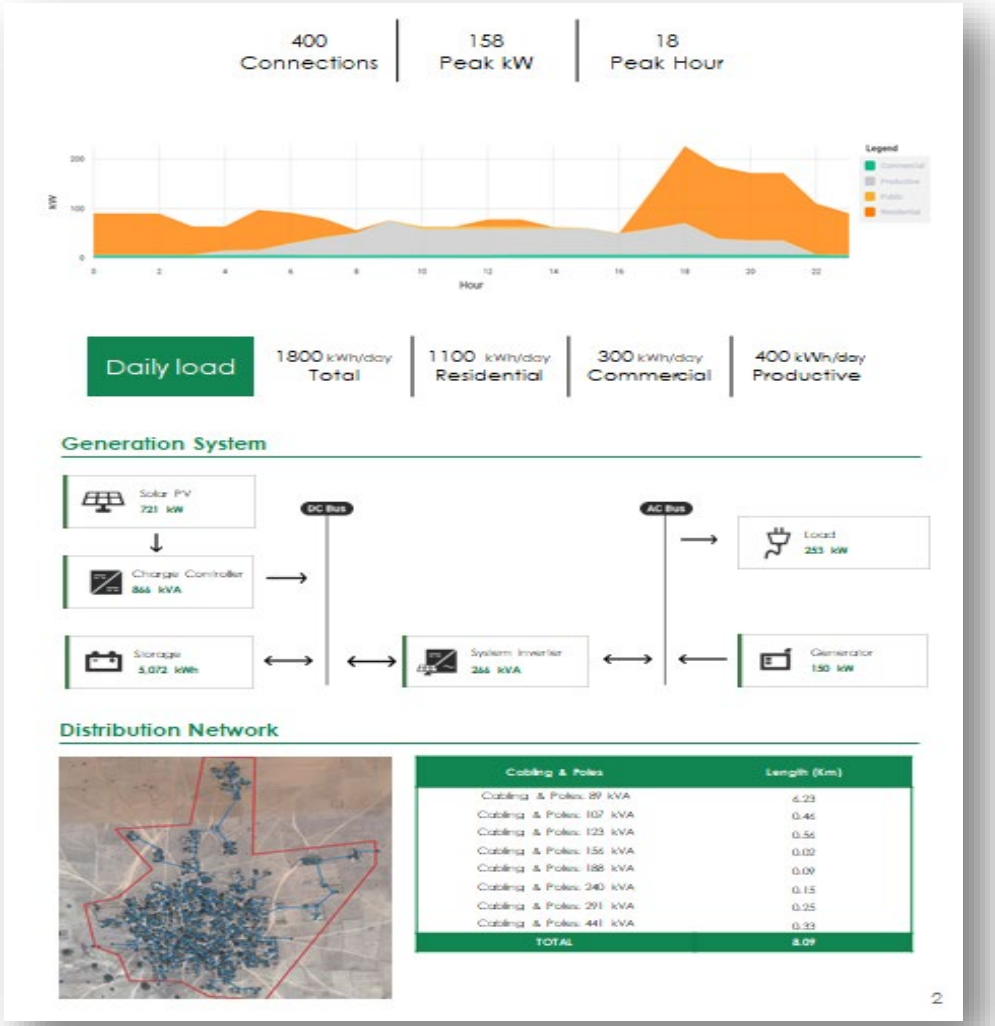


Odyssey is the official web-based platform of the Nigeria Electrification Project



With Odyssey, REA is able to manage <u>all</u> mini-grid and solar home system data through the entire lifecycle of the project – across thousands of deployed systems in the country

Odyssey and REA are creating the world's largest database of detailed site-specific mini-grid data and analysis



As REA's data platform, Odyssey is:

- Generating forecasted load profiles, generation system sizes, optimized distribution designs & financials for hundreds of sites
- Enabling the Rural Electrification Agency to run data queries & analytics across hundreds of mini-grid projects to understand customer loads, costing trends, and more
- Giving project developers sophisticated tools to create more comprehensive & detailed proposals modeled via third-party standards
- Streamlining evaluation with consistent and transparent bids
- Aligning commercial investors on the platform to close the capital stack
- Enabling post-construction project monitoring

Lessons Learned

1. Mini Grids are not the only solution to solving the problem of energy access. Investment into a least cost geospatial model to determine the proper energy mix will be very valuable.

2. As useful as Geospatial models are they can not provide all the answers and should be used in conjunction with first hand primary data collected during actual field surveys (boots on ground)

3. During Field visits it is important to identify current and potential productive uses in the community as these will improve sustainability and profitability of mini grid projects

4. Community Engagement is essential to properly gain the buy-in from the community and ensure success and sustainability of the projects.

5. Data management with the creation of a central hub to house both survey data and developer data is key. REA's NEP Portal enables data driven decision making and an efficient project evaluation process.

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THANK YOU FOR LISTENING

For further information please contact:

RURAL ELECTRIFICATION AGENCY
info@rea.gov.ng
www.rea.gov.ng

www.rea.gov.ng