

# **GEOSPATIAL PORTFOLIO PLANNING**

## **MINI GRIDS FOR HALF A BILLION PEOPLE**



**WORLD BANK GROUP**  
Energy & Extractives

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June 26, 2019

# 10 building blocks to deploy mini grids at scale

## Where We Are Today

**47 million people** connected to **19,000 mini grids**, mostly hydro and diesel-powered, at an investment cost of **\$28 billion**. Plus: *7,500 mini grids planned, mostly in Africa, mostly solar-hybrid, connecting more than 27 million people at an investment cost of \$12 billion.*

## Where We Want to Be to Reach Universal Access by 2030

**490 million people** served at least cost by **210,000 mini grids**, mostly solar-hybrids, requiring an investment of **\$220 billion**.

**10 Building Blocks** need to be addressed in countries to deploy mini grids at scale: (i) solar-hybrid technology and costing, (ii) **geospatial portfolio planning**, (iii) income-generating uses of electricity, (iv) community engagement, (v) local and international industry, (vi) access to finance, (vii) training and skills-building, (viii) institutional framework, (ix) workable regulations, and (x) enabling business environments.

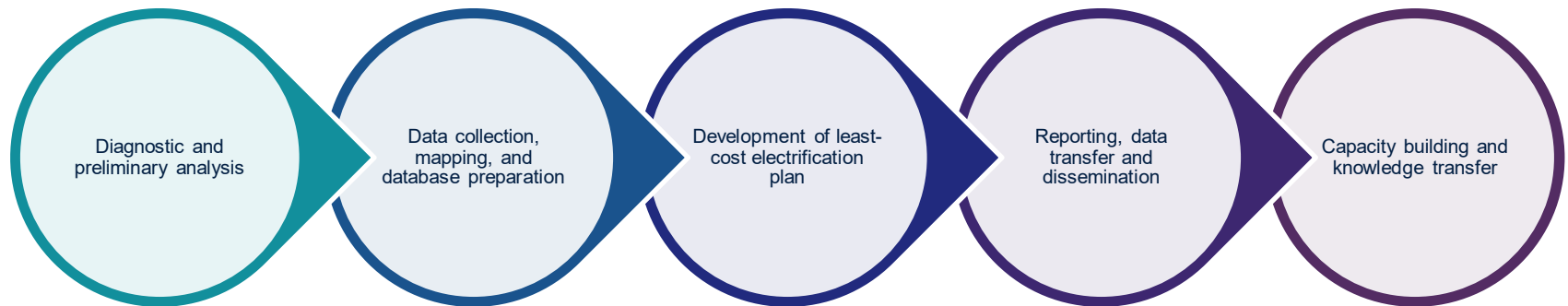
# Why geospatial planning, why now?

- Technological advances and cost reductions in satellite imaging and machine learning
- Increased sophistication of algorithms and analytical software
- Proliferation of global positioning system (GPS) devices and Web-based and mobile technologies
- Availability of high-quality open-source software
- Accessibility of big data and cloud-based computing

# National Least-Cost Electrification Planning

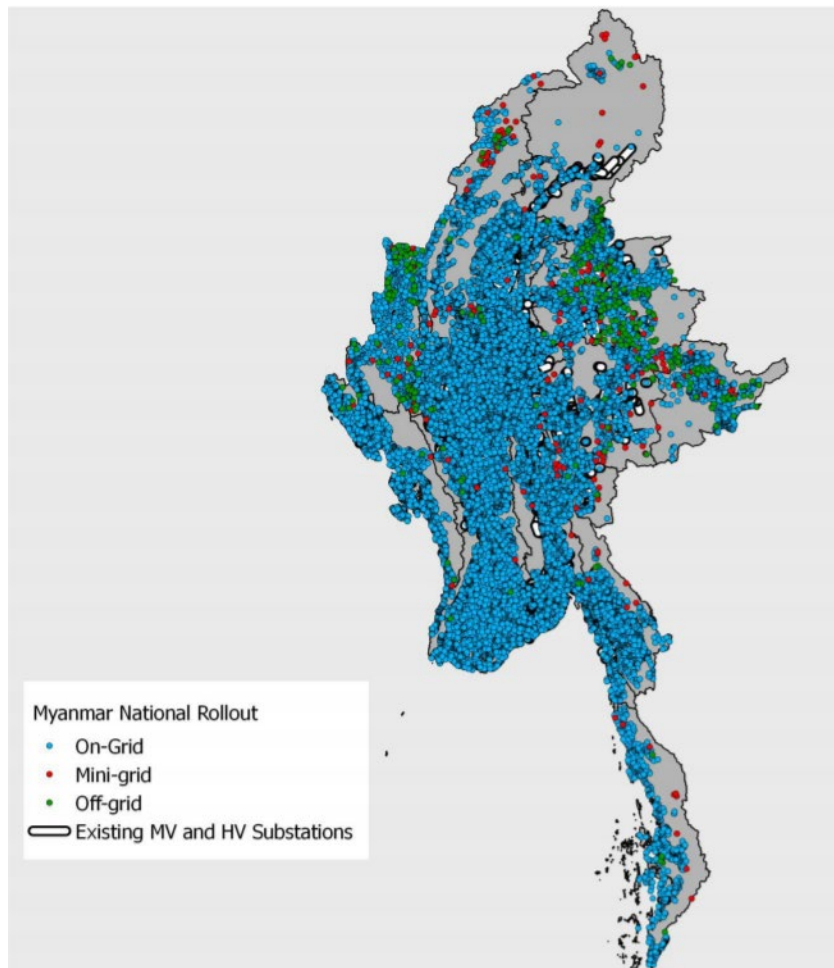
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# Typical Least-Cost Electrification Planning Sequence



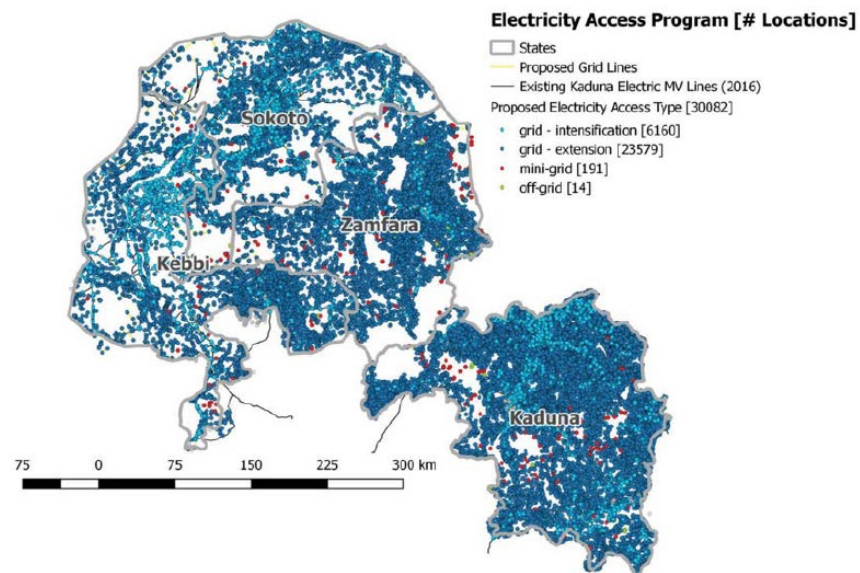
# National Least-Cost Electrification Planning Outputs

## Myanmar



Source: Myanmar National Electrification Program (NEP) Roadmap and Investment Prospectus, Castalia, 2014; Achieving Universal Access in the Kaduna Electric service area, World Bank, 2015

## Nigeria (4 states)



# National Least-Cost Electrification Planning in Africa



# Mini Grid Portfolio Planning

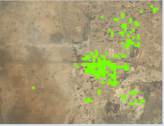



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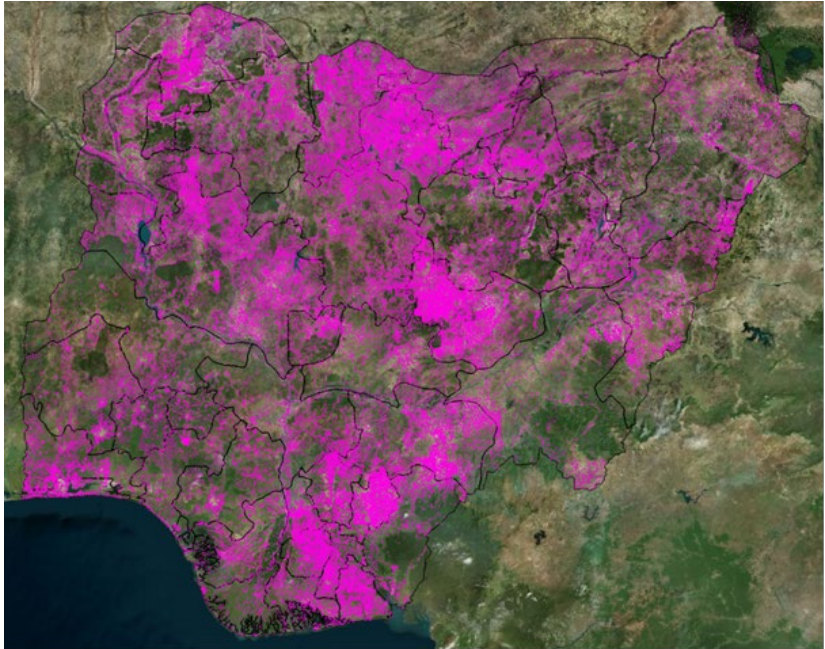
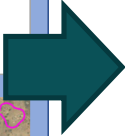


# Mini Grid Portfolio Planning



# Site Identification and Prioritization

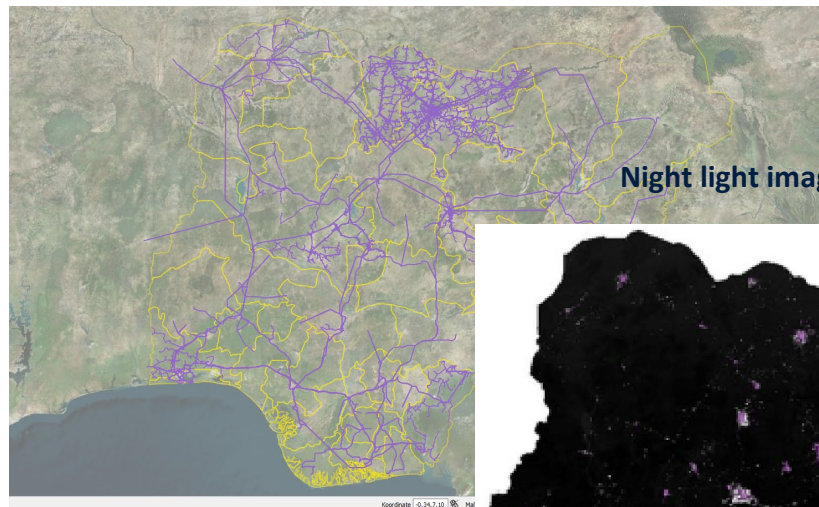
Input Data		Processing	Result
<p><u>Build-up raster data</u></p> <p>Pixels with presence of build-up structures are depicted in light colors</p> 	<p><u>Vectorizing, Buffering &amp; Dissolving</u></p> <p>in order to indicate precise settlement boundaries</p>	<p><u>Settlement Clusters</u></p> <p>Outline of settlement structures result from merging the three input data types.</p>	
<p><u>OSM Land use</u></p> <p>Land use types are colored individually (residential in red, industrial in blue)</p> 	<p><u>Filtering, Buffering &amp; Dissolve</u></p> <p>Extracting residential landuse and reducing polygon count</p>		
<p><u>OSM Buildings</u></p> <p>Open source mapped polygons ....</p> 	<p><u>Clipping &amp; Clustering</u></p> <p>Finding additional buildings not covered in other data sets and clustering them</p>		



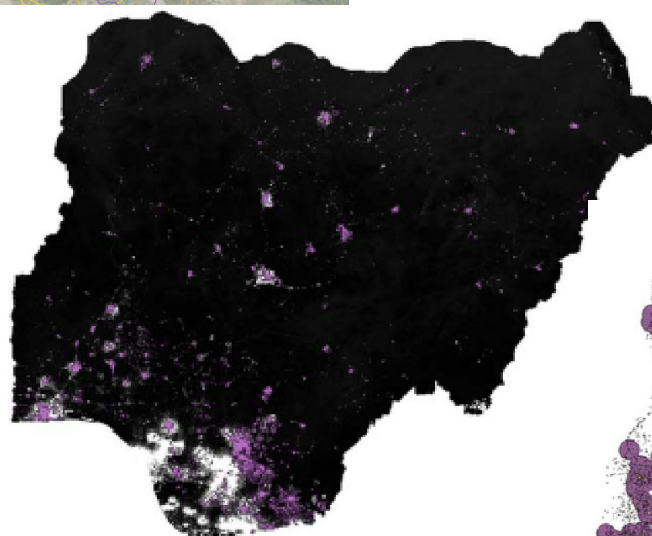
Source: RLI and Integration

# Site Identification and Prioritization

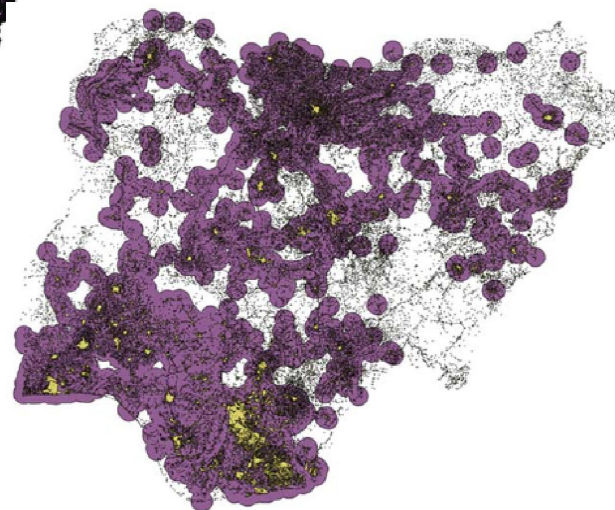
Map of available geospatial grid data coverage in Nigeria



Source: <https://energydata.info>



20-kilometer buffer zones



# Site Identification and Prioritization

Additional socio-economic data available for entire Nigeria are number of schools, health facilities and telecom towers currently relying on diesel generators.

## Exclusion Criteria:

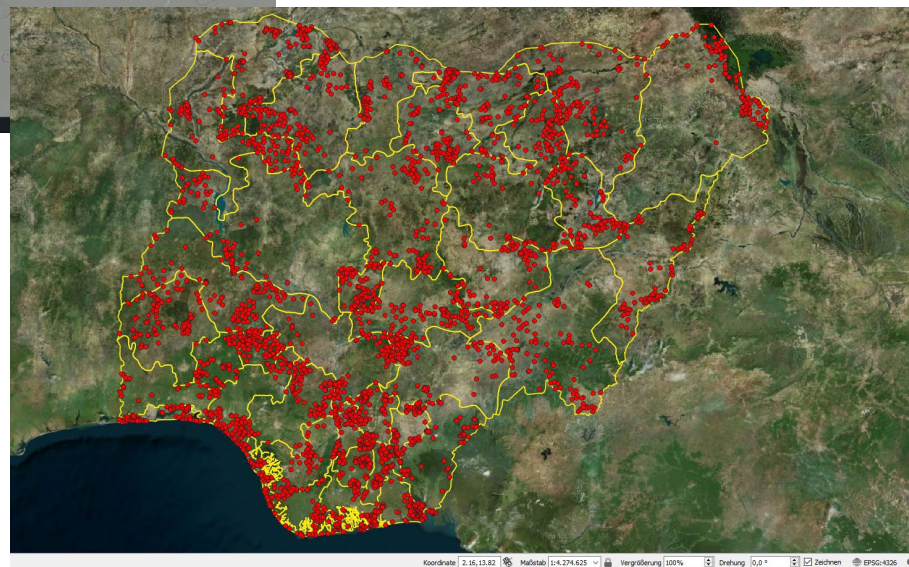
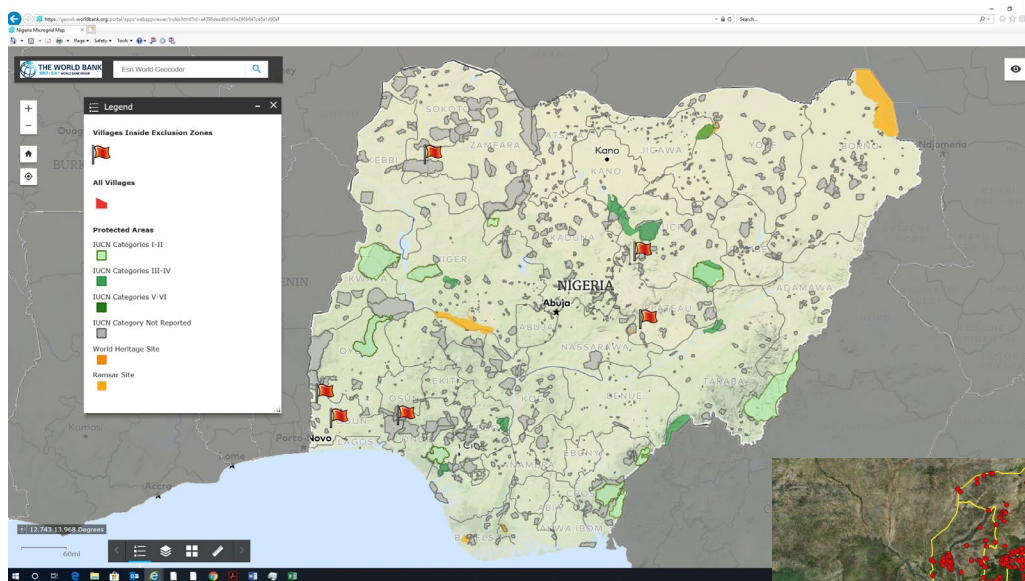
- Exclusion of sites with distance to grid <5km
- Exclusion of sites with population < 1,000
- Exclusion of sites that fall within protected areas, national parks and other ecologically sensitive zones

## Prioritization Criteria:

- Ranking of sites based on population, density, schools, health facilities, distance to grid, anchor customers.

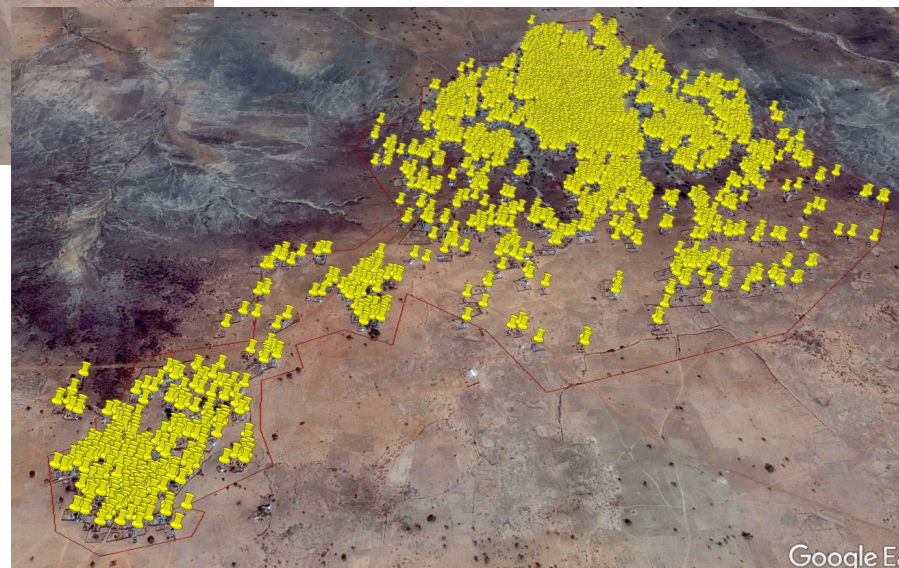
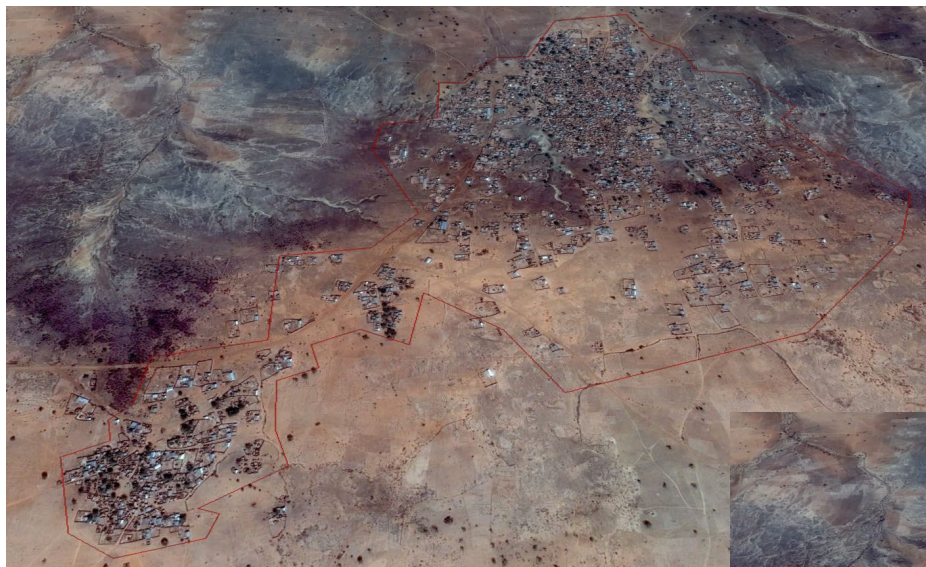


# Site Identification and Prioritization

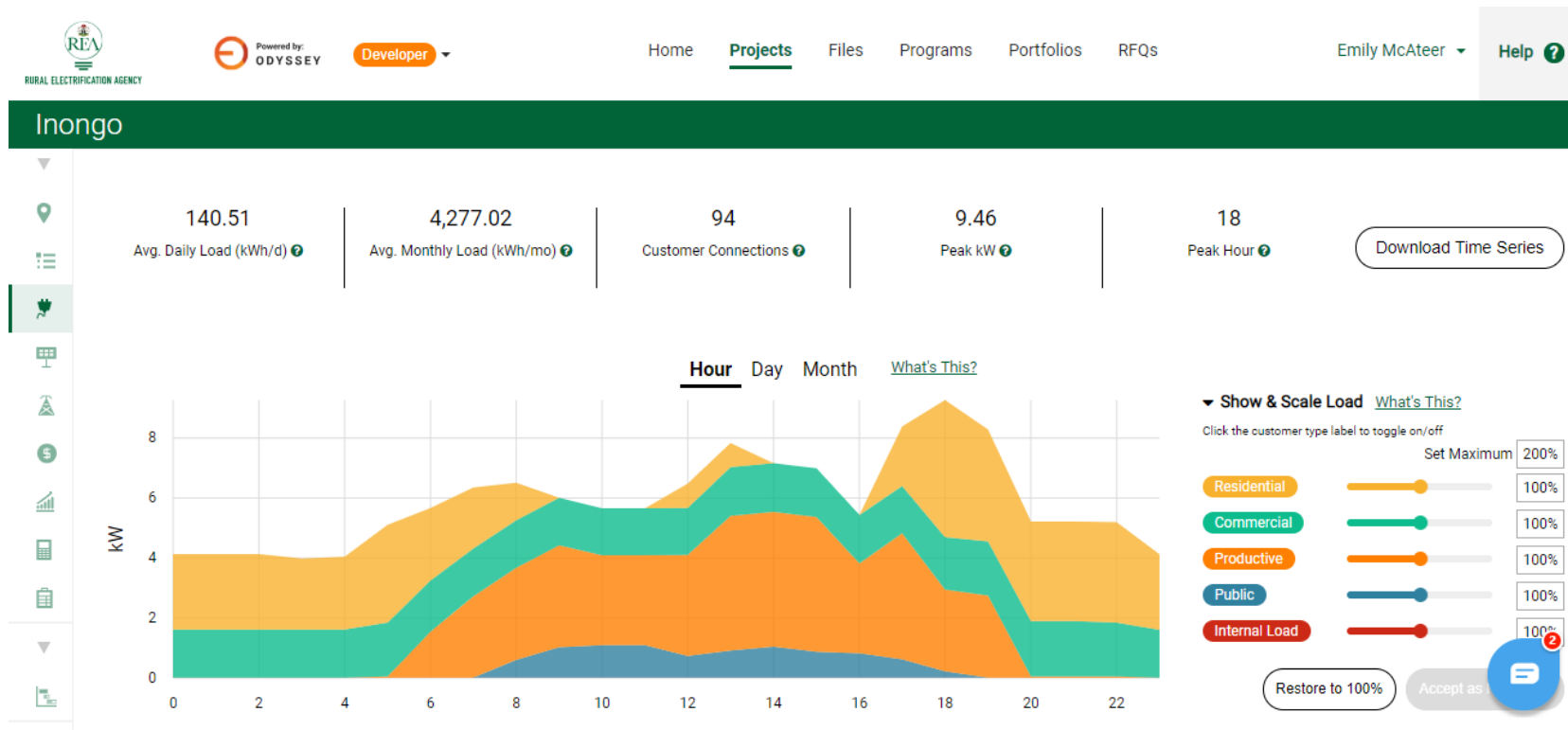


Source: RLI and Integration

# Customer Mapping



# Survey Data Collection and Load Modeling





# System Optimization

**SCHEMATIC**

AC Primary Load DC

38.00 kWp  
4.54 MW peak  
Converter

G10

G3

PV

SEC525P

**DESIGN**

Name: Sample-PhilippineVillageOfSicud Puerto Princesa North Road, Puerto Princesa, Palawan, Philippines (9°50.1'N)

Author: Tony Jimenez

**Description:**

Sicud is a small village in Palawan, Philippines. This analysis investigates the options for providing electricity to the village using wind, solar, or diesel power. The results show the impact of different assumptions about the wind resource, fuel price, and required system reliability.

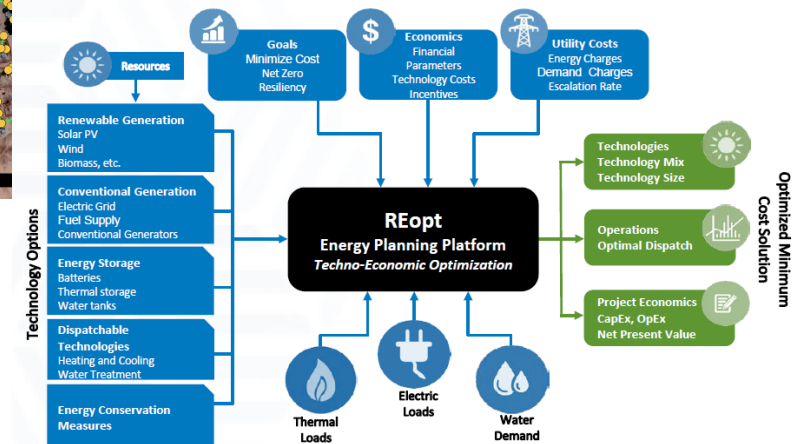
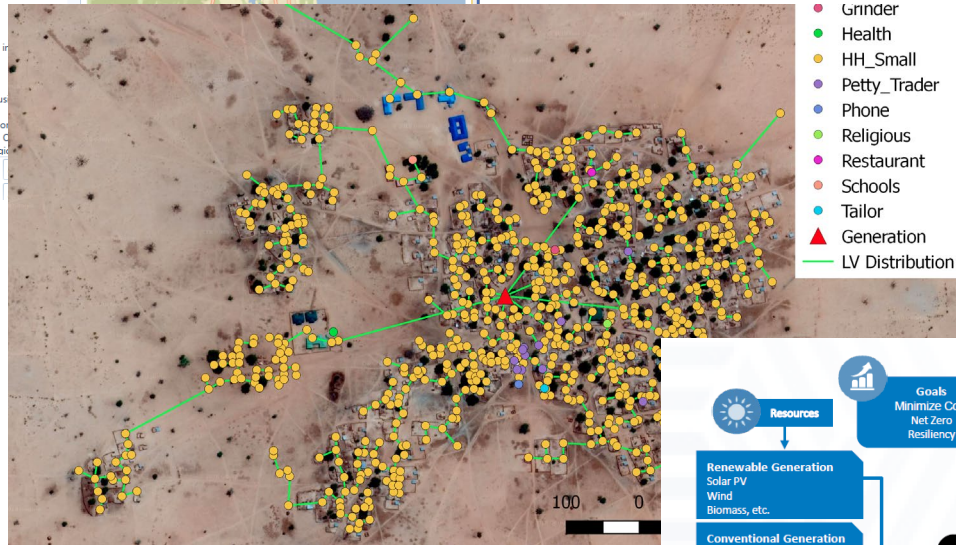
**RESOURCE DATA**

**Solar Resource**  
The solar resource data used in this analysis is an actual imported file.

**Wind Resource**  
The wind file was generated using a wind data generator. The daily profile is based upon measurements taken on site. The parameters are typical for the region.

Discount rate (%):  
Inflation rate (%):

**SUGGESTIONS:**





# Online Platform

**My Projects**

Select all projects within a state by clicking on the checkbox to the left of the state name.  
 Tip: Drag any project header to the area below to group your projects into folders. Check out the [Help Guide](#) to learn how to use pivot tables on your pipeline.

State/Province	Project Name	Country	Customers	PV Capacity (kW)
<input type="checkbox"/> Sokoto (20)	Zuru (Suron_Gazo)_Official/NEP Minimum Subsi...	Nigeria	668	318.44
	Awilkiti_Official/NEP Minimum Subsidy_Tender /De...	Nigeria	553	65.23
	Bamama /Mamandari_Official/NEP Minimum Subsi...	Nigeria	1617	0
	Dalmi_Official/NEP Minimum Subsidy_Tender /De...	Nigeria	263	0
	Darna Silva /Darna Sabon/Gari_Official/NEP Mini...	Nigeria	591	0
	Diddba /Guamasse/LOfficial/NEP Minimum Subsi...	Nigeria	452	0
	Ganusa /Kanyaji_LOfficial/NEP Minimum Subsidy...	Nigeria	950	0
	Guroni /Mafafa_LOfficial/NEP Minimum Subsidy_T...	Nigeria	363	0
	Kanopri /Stakusanyi_LOfficial/NEP Minimum Subsi...	Nigeria	393	0

Total Rows: 21

Type	Details	Quantity	Unit Cost	Unit	Total Cost
<input type="checkbox"/>	Cabling	Cabling & Poles: 150 kVA	50	\$25.00	
<input type="checkbox"/>	Cabling	Cabling & Poles: 100 kVA	100	\$15.00	
<input type="checkbox"/>	Cabling	Cabling & Poles: 50 kVA	1500	\$10.00	

Customer Connections: \$38/connection, \$6,535

Type	Details	Quantity	Unit Cost	Unit	Total Cost	
<input type="checkbox"/>	Metering	Single-phase Meter & Customer Connecti...	88	\$70.00	customer	\$6160.00
<input type="checkbox"/>	Metering	Three-phase Meter & Customer Connecti...	3	\$125.00	customer	\$375.00

**Awilkiti\_Official(NEP Minimum Subsidy Tender (Demo))**

**Generation Designs**

Below is a list of all generation designs you have created for this load. To let us know which load and design you would like to use for future calculations, you must select one as your final design by clicking the **Final Design** and selecting as a final design.

Name	Source	Solar PV	Generator	Storage	Load Met	Renewable Fraction	OPEX	CAPEX	
Category 2a*	HOMER	65 kW	Diesel, 45 kW	281.23 kWh, Lead Acid	100%	60.69%	\$19,034.14/yr	\$148,673.45	Final Design
Category 3	HOMER	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	
Category 2b*	HOMER	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	
Category 1	HOMER	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	Not Calculated	

**Sample Project 4**

**Generation Design**

Model with HOMER: **Enabled**

DC-Coupled System

DC-Coupled System Components

Drag and Drop components into your custom generation design.

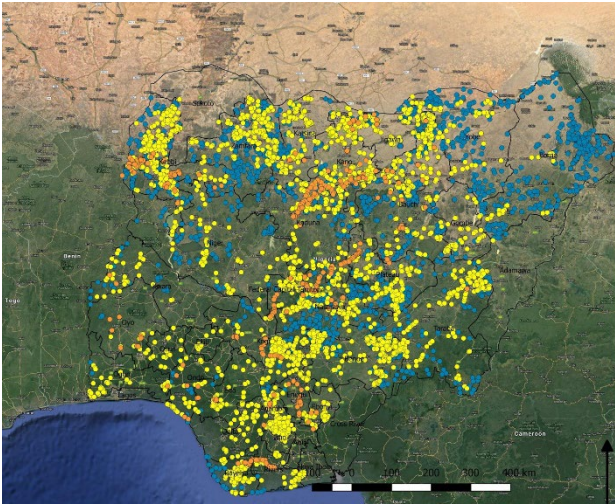
Other Components

Balance of System and Fixed Costs

meter \$15000.00

Delete Add

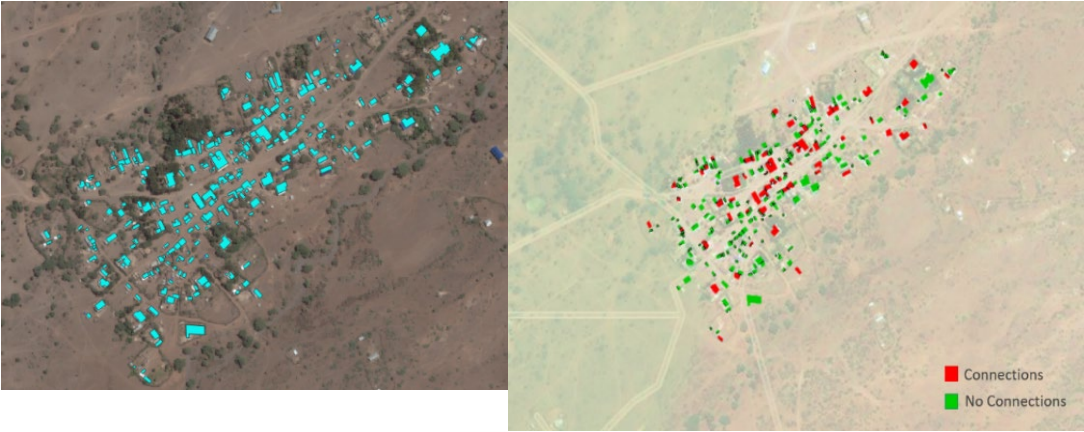
# Private Developer Initiatives



Powerhive

Legend  
● SURVEYED SITES  
● SITES CLOSE TO P  
● IDENTIFIED SITES

Engie



# Conclusions

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# Impact of Geospatial and Digital Tools

- Significant **reduction in pre-investment costs** associated with mini grid development
- **Unprecedented scale** possible because of the low costs involved
- **Swifter speed** compared to traditional approaches that require the deployment of multi-disciplinary teams at considerable expense
- Experience from Nigeria suggests mini grid portfolio planning already feasible at a cost of approximately \$2300 per site, with scope for further cost reduction

# Thank You

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