

GEOSPATIAL PORTFOLIO PLANNING

MINI GRIDS FOR HALF A BILLION PEOPLE



WORLD BANK GROUP
Energy & Extractives

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June 27, 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**.

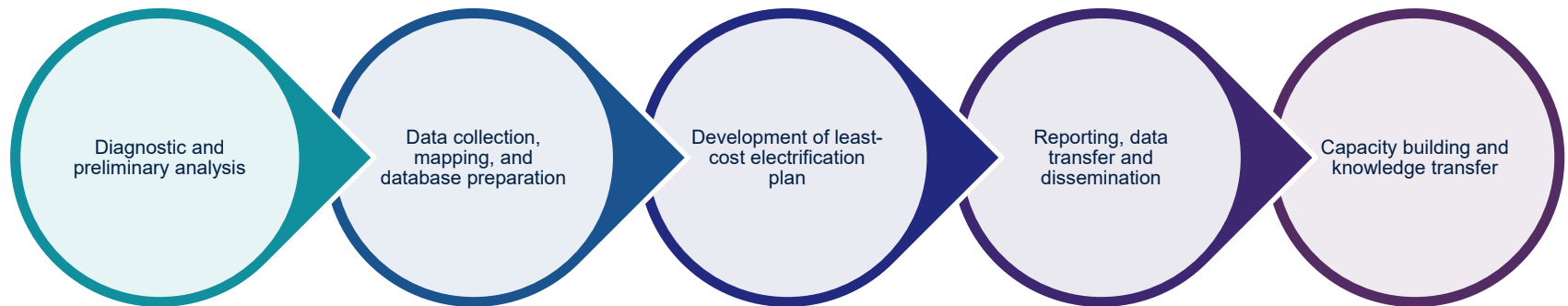
10 Building Blocks need to be addressed in countries to deploy mini grids at scale: (i) solar-hybrid technology and costing, (ii) **geospatial portfolio planning**, (iii) income-generating uses of electricity, (iv) community engagement, (v) local and international industry, (vi) access to finance, (vii) 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

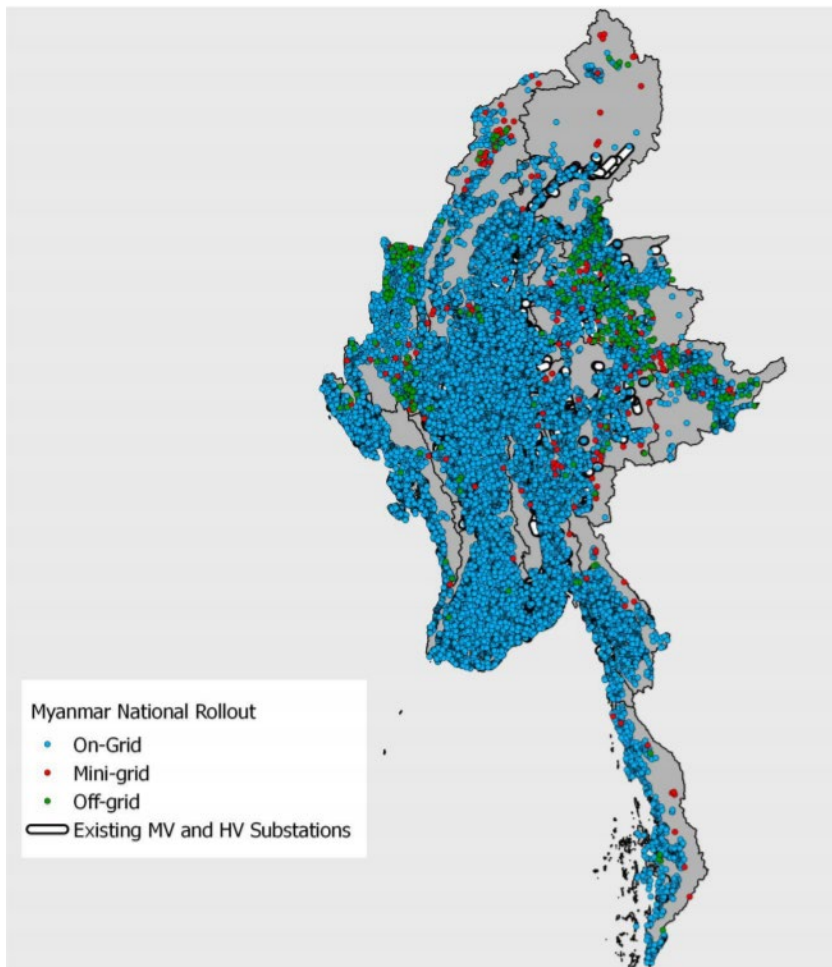
National Least-Cost Electrification Planning

Typical Least-Cost Electrification Planning Sequence



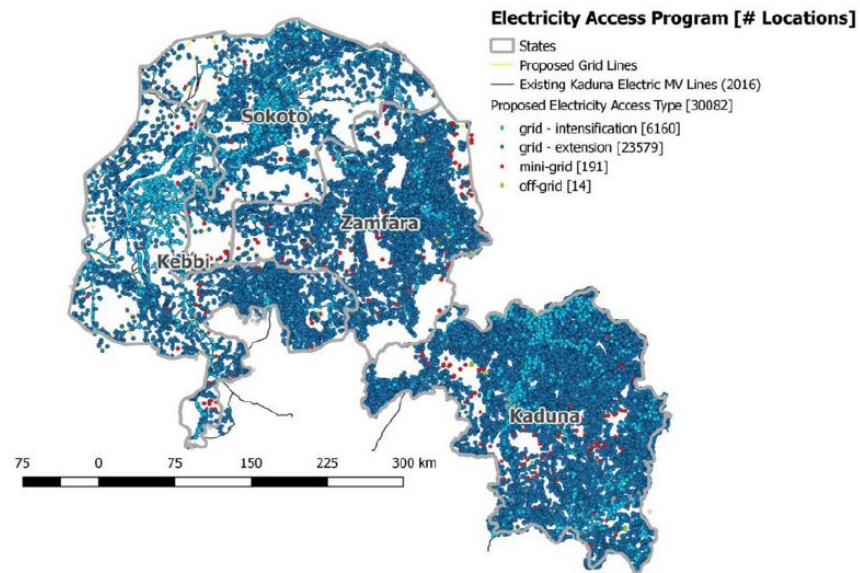
National Least-Cost Electrification Planning Outputs

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

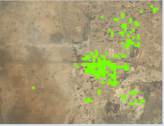





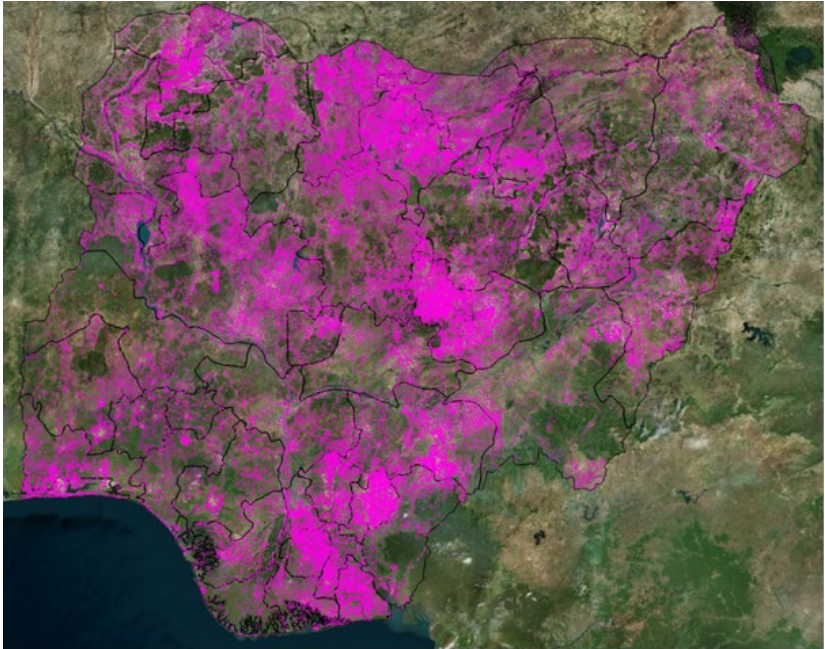
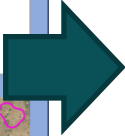
Mini Grid Portfolio Planning

Mini Grid Portfolio Planning



Site Identification and Prioritization

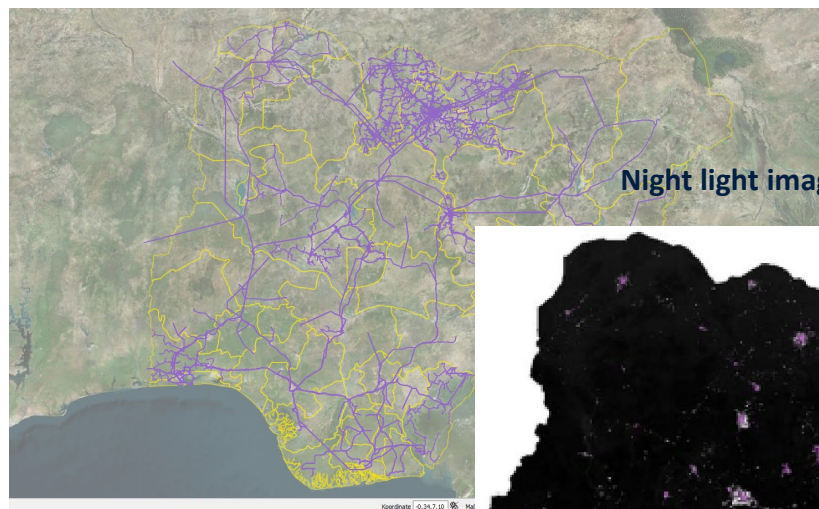
Input Data		Processing	Result
<p><u>Build-up raster data</u></p> <p>Pixels with presence of build-up structures are depicted in light colors</p> 	<p><u>Vectorizing, Buffering & Dissolving</u></p> <p>in order to indicate precise settlement boundaries</p>	<p><u>Settlement Clusters</u></p> <p>Outline of 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 & 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 & Clustering</u></p> <p>Finding additional buildings not covered in other data sets and clustering them</p>		



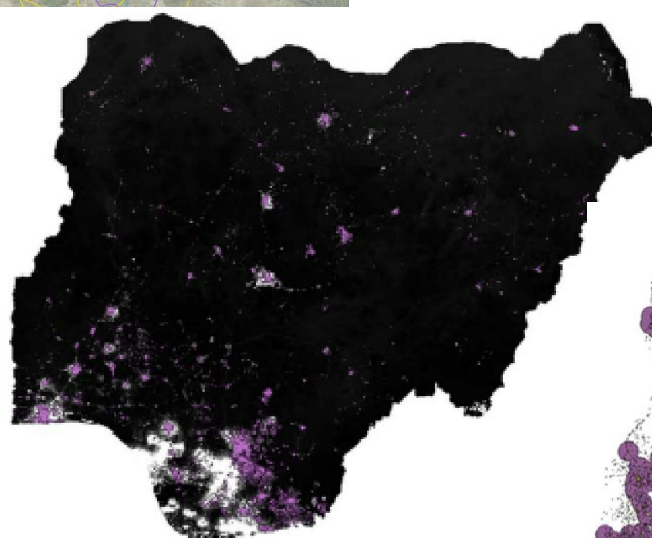
Source: RLI and Integration

Site Identification and Prioritization

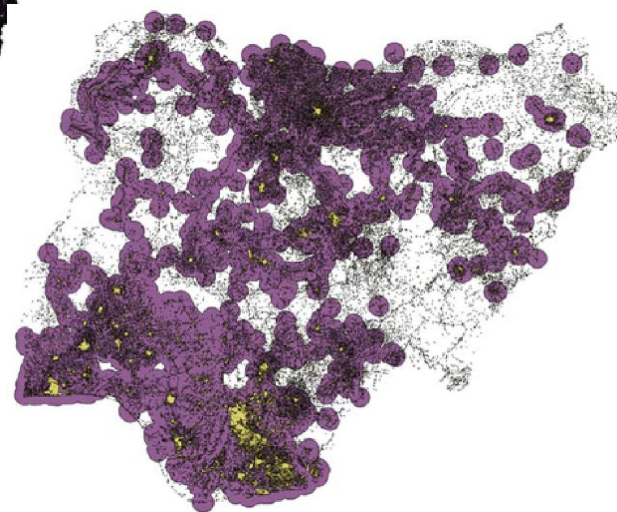
Map of available geospatial grid data coverage in Nigeria



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.

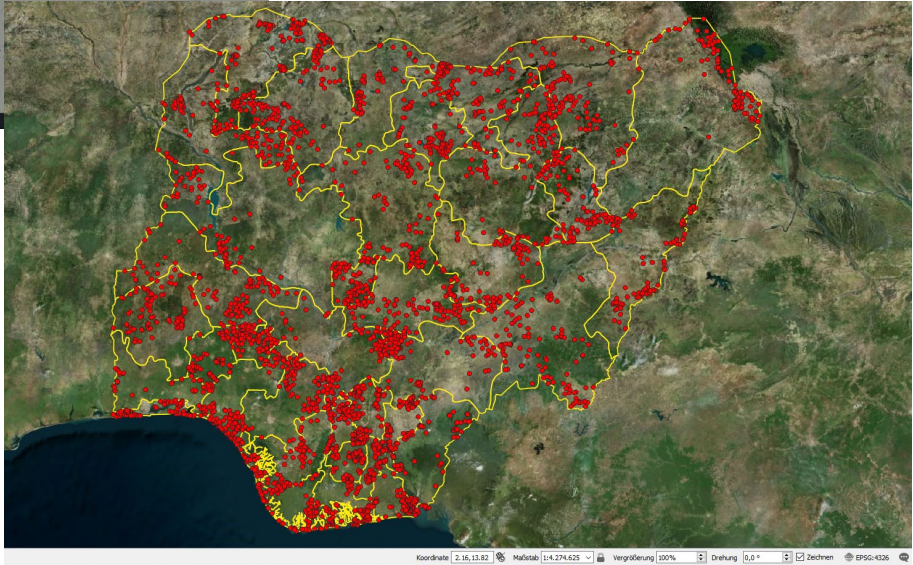
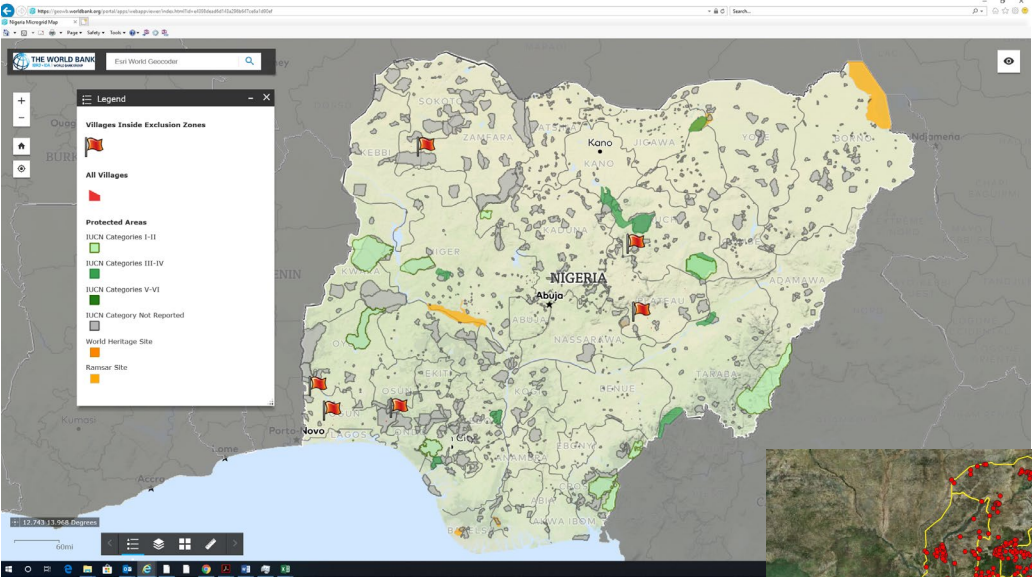
Exclusion Criteria:

- 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:

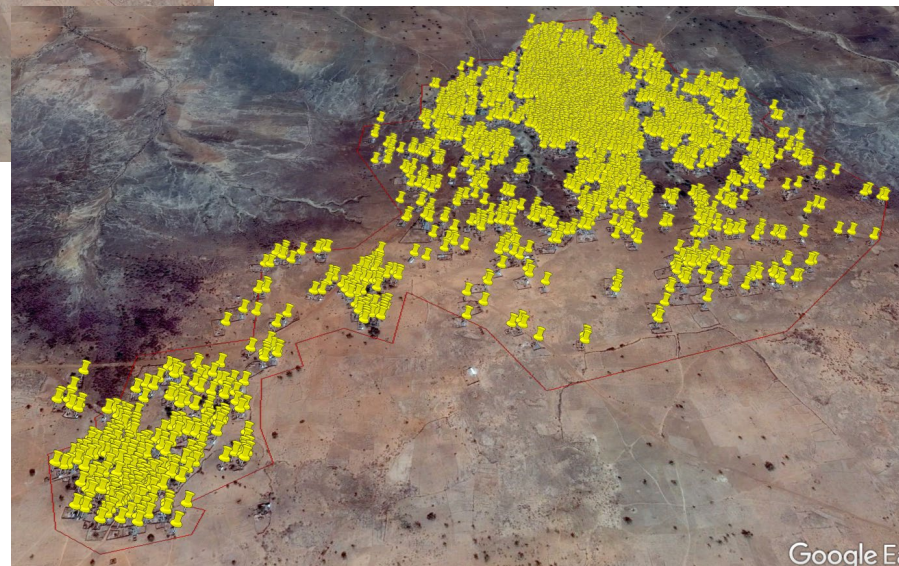
- Ranking of sites based on population, density, schools, health facilities, distance to grid, anchor customers.

Site Identification and Prioritization

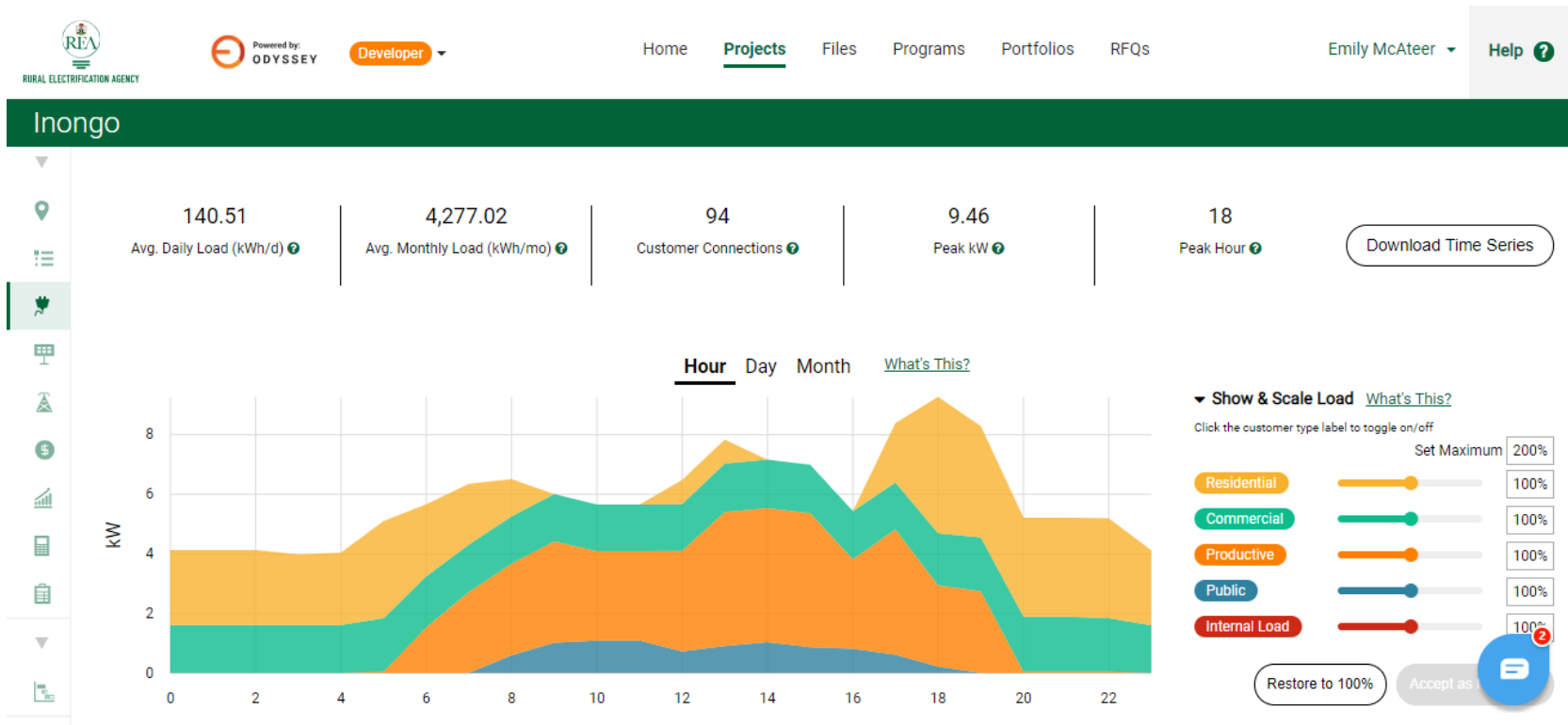


Source: RLI and Integration

Customer Mapping



Survey Data Collection and Load Modeling



System Optimization

SCHEMATIC

AC Primary Load DC
 13.20 MWp
 4.34 MW peak
 Converter
 G10
 G3
 PV
 SECS25P

DESIGN

Name: Sample-PhilippineVillageOfSicud
 Author: Tony Jimenez
 Location: Puerto Princesa North Road, Puerto Princesa, Palawan, Philippines (9°50.1'N, 125°59.0' E)

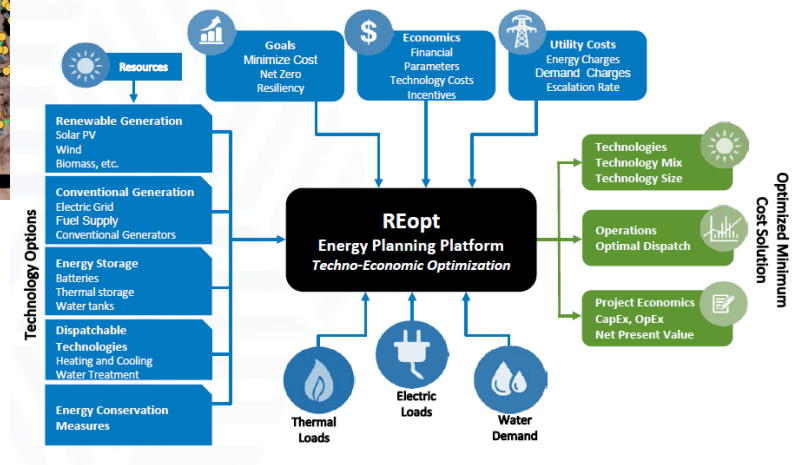
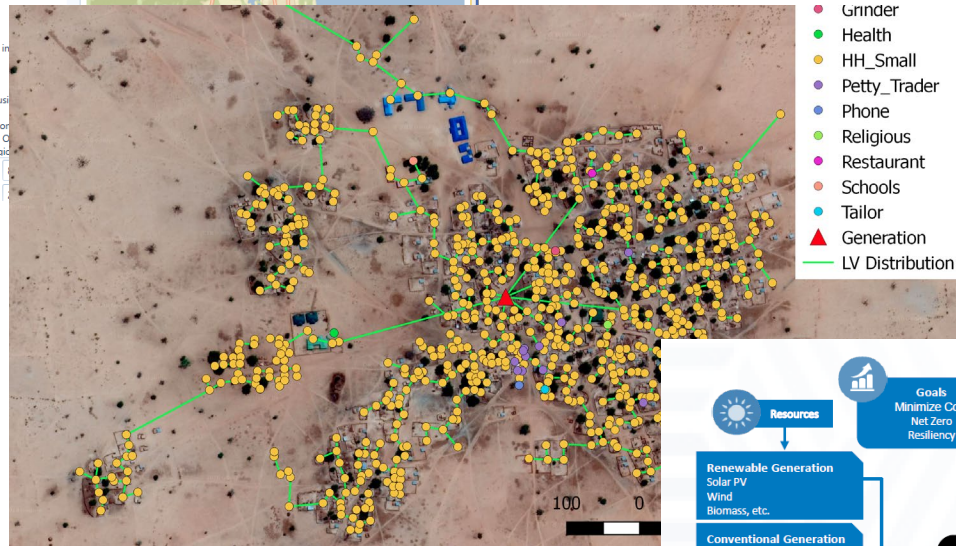
DESCRIPTION:
 Sicud is a small village in Palawan, Philippines. This analysis investigates the options for providing electricity to the village using wind, solar, or diesel power. The results show the impact of different assumptions about the wind resource, fuel price, and required system reliability.

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 (%):



Online Platform

The screenshot displays the REA Online Platform interface, which is used for managing energy projects. The interface is divided into several sections:

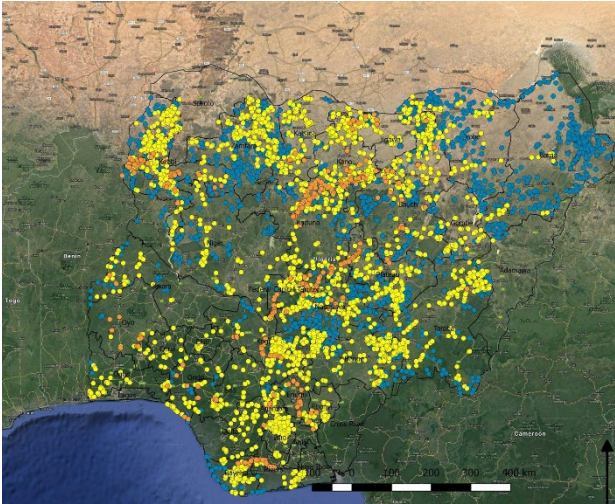
- Map View:** A satellite map showing project locations in a rural area with various markers and labels like 'Mankwago' and 'Mametsi'.
- My Projects Table:** A table listing projects with columns for State/Province, Project Name, Country, Customers, and PV Capacity (kW).

State/Province	Project Name	Country	Customers	PV Capacity (kW)
Sokoto (20)	Zuru (Buron_Gazp)_Official_NEP_Minimum_Subsi...	Nigeria	668	318.44
	Awilkiti_Official_NEP_Minimum_Subsidy_Tender_(De...	Nigeria	553	65.23
	Bamama_(Mamander)_Official_NEP_Minimum_Subsi...	Nigeria	1617	0
	Dalmi_Official_NEP_Minimum_Subsidy_Tender_(De...	Nigeria	263	0
	Darna_Silva_(Parna_Sabon_Gari)_Official_NEP_Mini...	Nigeria	591	0
	Diddba_(Guamasse)_Official_NEP_Minimum_Subsi...	Nigeria	452	0
	Ganusa_(Banyo)_Official_NEP_Minimum_Subsidy...	Nigeria	950	0
	Gunou_(Mafafa)_Official_NEP_Minimum_Subsidy_Te...	Nigeria	363	0
	Kanpni_(Sakusam)_Official_NEP_Minimum_Subsi...	Nigeria	393	0
- Customer Connections Table:** A table showing connection details and costs.

Type	Details	Quantity	Unit Cost	Unit	Total Cost	
Cabling	Cabling & Poles: 150 kVA	50	\$25.00			
Cabling	Cabling & Poles: 100 kVA	100	\$15.00			
Cabling	Cabling & Poles: 50 kVA	1500	\$10.00			
Customer Connections					\$38/connection	\$6,535
Metering	Single-phase Meter & Customer Connecti...	88	\$70.00	customer	\$6160.00	
Metering	Three-phase Meter & Customer Connecti...	3	\$125.00	customer	\$375.00	
- Generation Designs Table:** A table listing generation designs with columns for Name, Source, Solar PV, Generator, Storage, Load Met, Renewable Fraction, OPEX, and CAPEX.

Name	Source	Solar PV	Generator	Storage	Load Met	Renewable Fraction	OPEX	CAPEX
Category 2a*	HOMER	65 kW	Diesel, 45 kW Acid	281.23 kWh, Lead	100%	60.69%	\$19,034.14/yr	\$148,673.45
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:** A detailed view of a generation design for 'Sample Project 4'. It shows a 'DC-Coupled System' with components like Solar PV, Charge Controller/MPPPT Tracker, System Inverter, Generator, and Load. A diagram illustrates the flow of energy between these components. Other components include a 'Balance of System and Fixed Costs'.

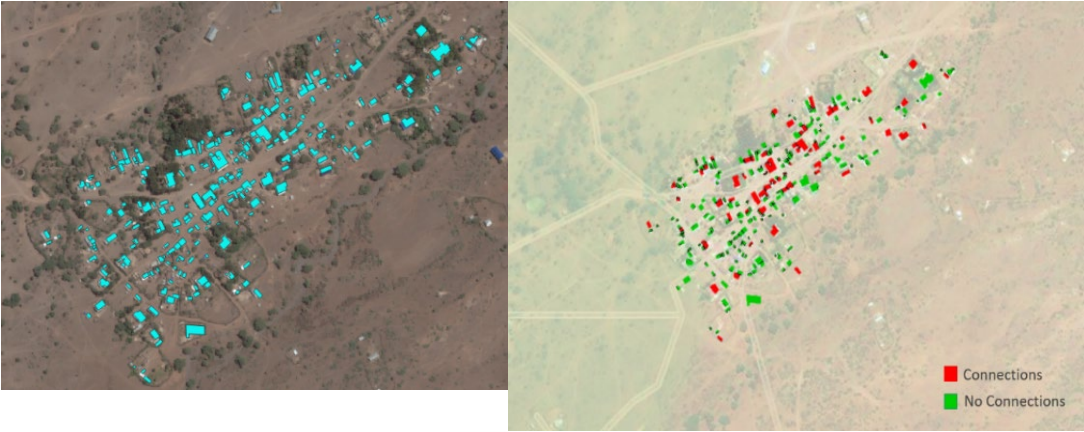
Private Developer Initiatives



Powerhive

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

Engie



■ Connections
■ No Connections

Conclusions

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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