SEED: SUSTAINABLE ENERGY FOR ECONOMIC DEVELOPMENT

Minigrid Funding and Investment Roundtable:
Accelerating Deployment of Minigrids for Timely and Low-Cost Electrification

ROCKY MOUNTAIN INSTITUTE

London - April 19th

Washington, D.C. - April 23rd

REA
RURAL ELECTRIFICATION AGENCY

Meeting objectives

1) Review the **current state of the minigrid opportunity** and actions that can accelerate, amplify, and broaden the impact

2) Review the **current efforts and enabling environment** that make **Nigeria** a prime candidate for investment in the minigrid space

3) **Test and refine the opportunities** that have been presented today and discuss concrete next steps to increase investment, impact, and scaling

Introductions

Please share with the group:

1) Your name
2) Your organization
3) What you hope to get from the conversation today

Meeting agenda

1) Context, agenda, and introductions (10min)

2) Minigrids: Building on the current state to unlock more impact (10min) – **RMI**

3) Near term opportunities (10min each):
   - Nigeria's off-grid investment strategy – **Nigerian Rural Electrification Agency**
   - Nigeria Electrification Project and the provision of performance-based viability grants – **The World Bank**
   - Energizing Economies Initiative – **McKinsey & Company**
   - Experiences with real project development – **Rensource**

4) Concrete actions to increase investment and impact (45min)

5) Next Steps (10min)

Minigrids: Potential vs. Reality

- Minigrids can fill the need for widespread, low cost power to underpin economic development while becoming a very large business opportunity.
- Efforts over the past 5 years have made real progress and poised the sector for a leap ahead
- Focusing on a small number of improvements can lead to widespread adoption:
  - Further cost reduction
  - Improved capacity utilization
  - Support for demand growth
  - Enabling regulatory environment
  - Pipeline of capital of different risk appetites
- Addressing these needs while capturing the near term opportunity in Nigeria will amplify the investments there and ensure that more challenging countries can benefit as well

Sub-Saharan Africa is the only region in the world where the number of people lacking access to electricity is set to rise

634
MILLION
Africans lack access to electricity

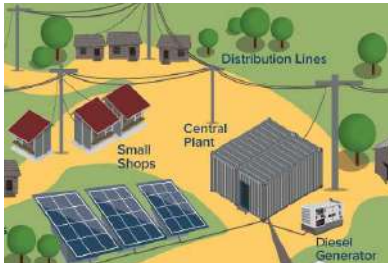
$10
BILLION
Spent on energy by Africans living on less than $2.50/day

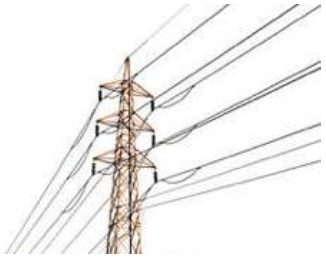
$11+
BILLION
Spent by governments annually to cover utility deficits

Sources: 2014 World Energy Outlook; 2015 World Energy Outlook; Africa Progress Panel 2015

Minigrids have a critical role to play in providing power to homes and businesses

Minigrids can serve productive-use loads underpinning economic development





	Solar home system (tier 1)	Minigrid	Grid extension	Alternative energy or no energy
Cost per customer	$6 to $12/month for basic services	$6-$10/month for basic service	$0.74 to $12/month for basic service	Typically, costs are $25/ month for customers with a petrol generator or $35/month for diesel. Costs are $11/month per customer using energy substitutes (including torches, kerosene, candles, or cell phone charging)
LCOE*	$2/kWh or higher	$0.50-$1.00/kWh	$0.15-$1.00/kWh, if including cost of grid extension	
Can it serve productive loads?	Currently only small and medium enterprises	Yes	Yes	
Time to deploy	Fast	Fast	Slow	
Least-cost role	Providing energy access to isolated residential customers	**Providing energy access to remote or underserved villages with significant load**	Either for those near existing grid, or very high loads that are farther from the grid	None

*Levelized cost of electricity

Source: RMI industry interviews and analysis, field visits to un-electrified villages

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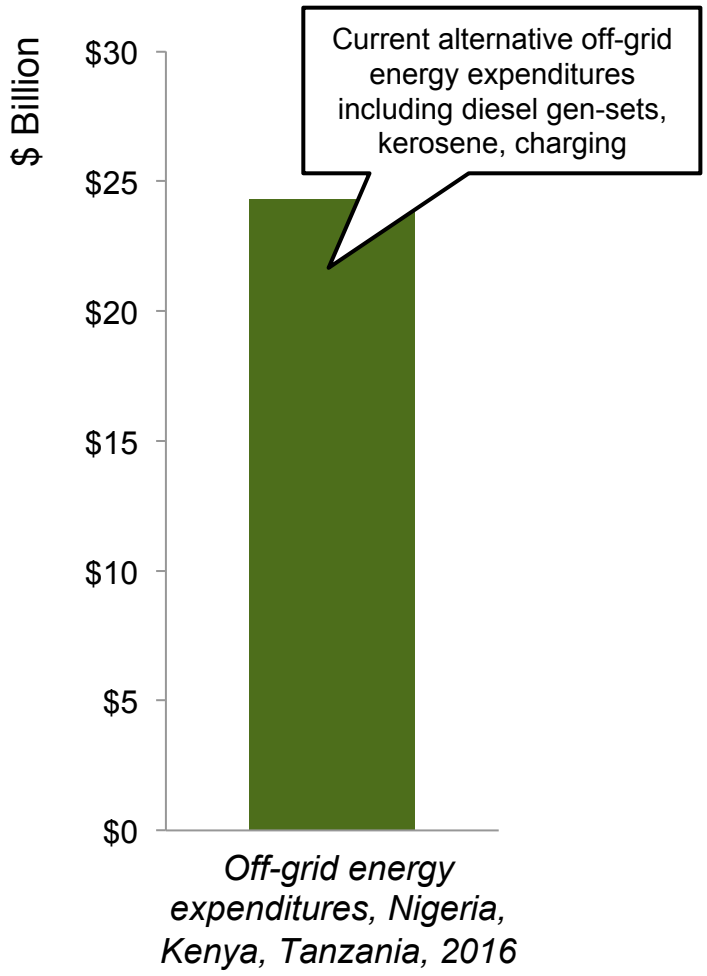
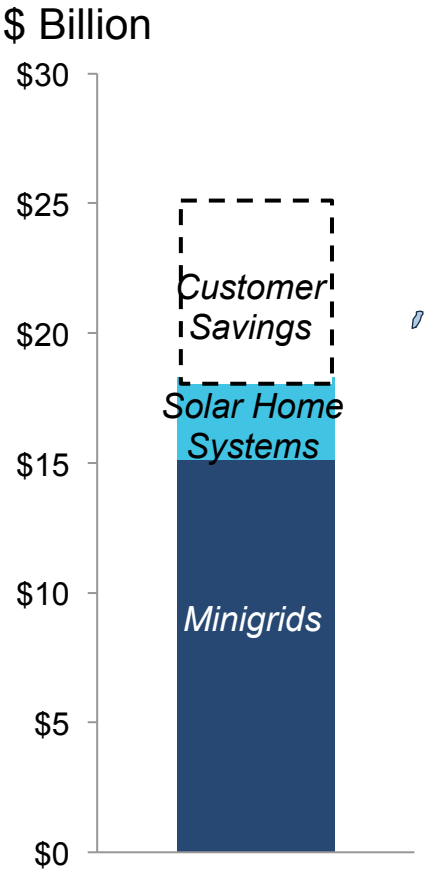
A profitable minigrid business model is a multi-billion dollar market opportunity

$24 billion spent currently on off-grid alternatives in three leading markets

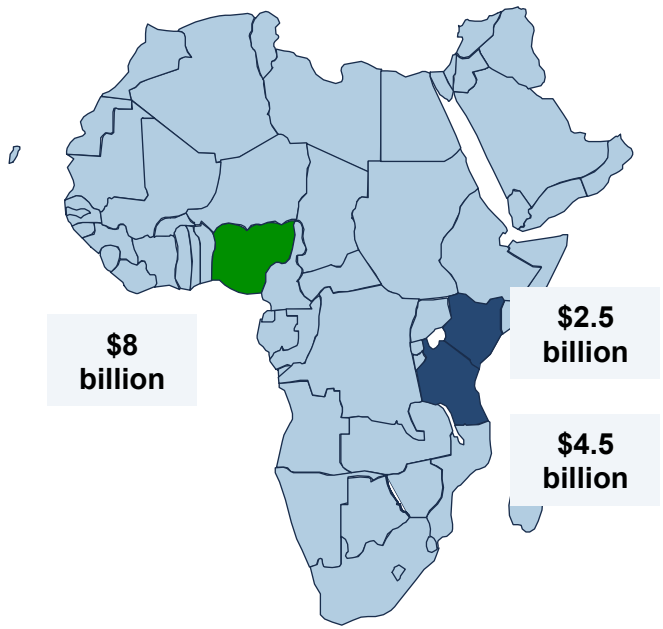


Off-grid energy expenditures, Nigeria, Kenya, Tanzania, 2016

Capturing just 60% is an $18 billion market opportunity; growth will drive that size higher



Potential annual SHS and minigrid revenue



Minigrid market in three leading countries

Source: RMI, analysis from "Energy Within Reach" and internal analysis; potential minigrid market based on percentage of population without grid electricity with the ability to pay for over $6/month, SHS for those with less than $6/month ability to pay

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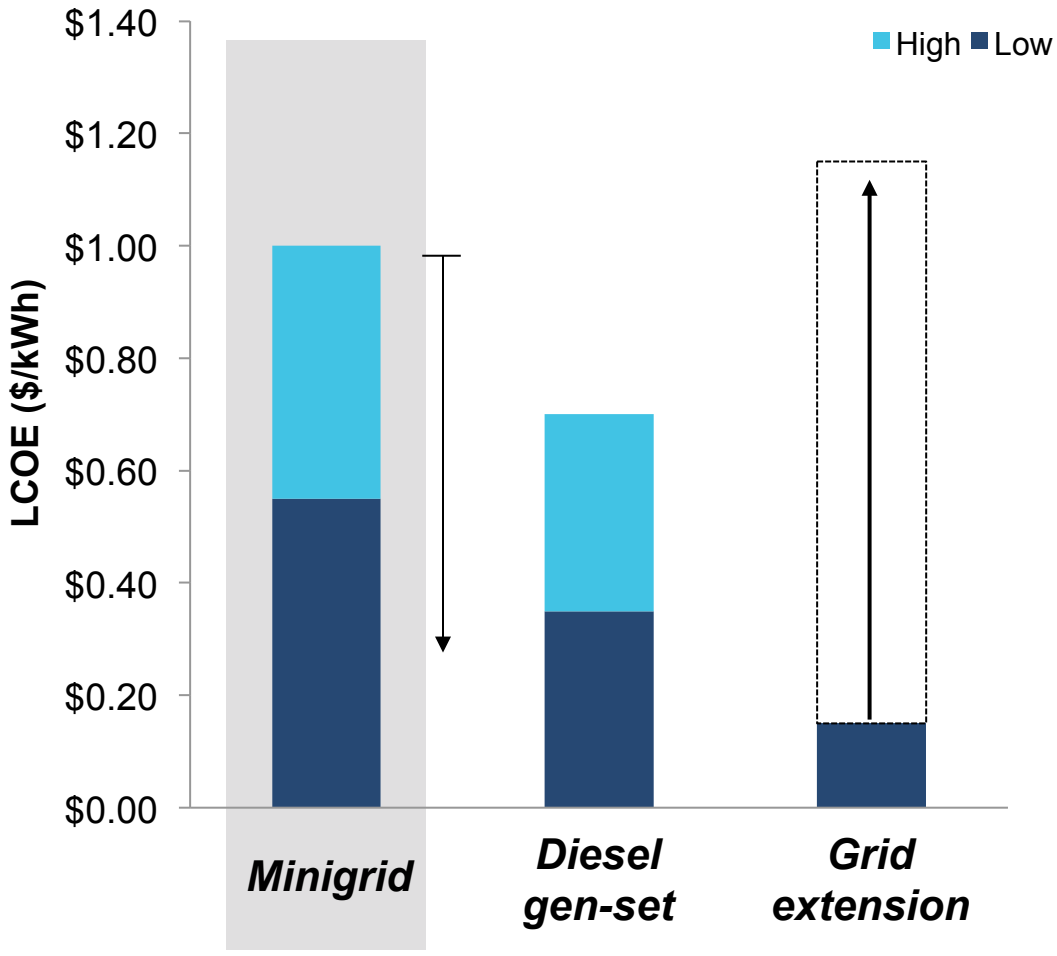
Investments, innovation, and insights have poised minigrids to become financially viable in the most promising regions

Minigrid cost comparison with alternatives



Real Progress and Success

- Over $300m invested
- Technically viable
- Hundreds of sites operating
- Maturing business processes
- Greater understanding of business economics
- Improved understanding of demand drivers
- Better understanding of regulatory needs

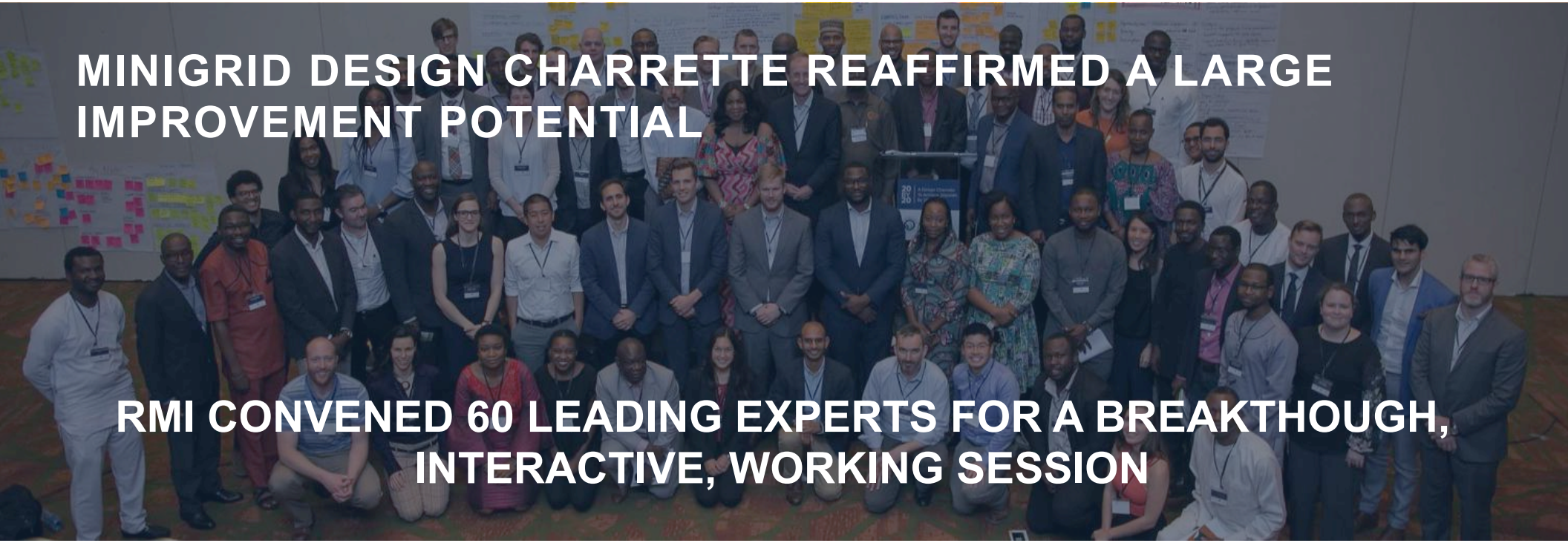
Source: RMI analysis and field visits

RURAL ELECTRIFICATION AGENCY

Finding a profitable and scalable minigrid business model requires addressing a small number of barriers

Need	Opportunities
• Further capital cost reduction	• Standardization, supply chain integration, volume leverage
• Improved capacity utilization	• Demand management, energy efficiency, time of use pricing
• Support for demand growth	• Financing, education, training
• Enabling regulatory environment	• Clarity on buyouts and backward integration
• A pipeline of capital of different risk appetites	• Consortium of capital working together

MINIGRID DESIGN CHARRETTE REAFFIRMED A LARGE IMPROVEMENT POTENTIAL



RMI CONVENED 60 LEADING EXPERTS FOR A BREAKTHOUGH, INTERACTIVE, WORKING SESSION

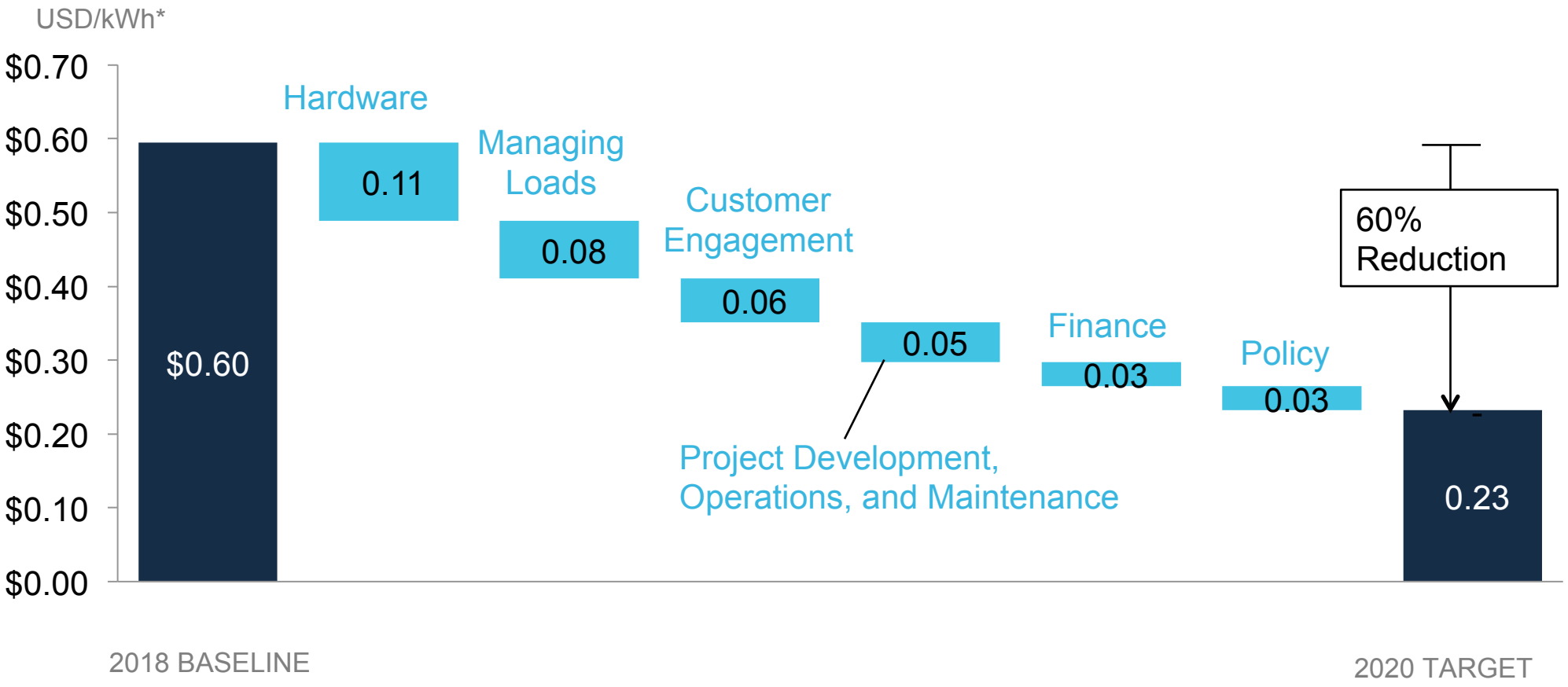
THE AGENDA WAS DESIGNED TO ANSWER **THREE CRITICAL QUESTIONS:**

1. How can we reduce costs and improve customer engagement to reach **a profitable and scalable business model in the next 3–5 years**?
2. What **size and type of funding** is required to accelerate progress, and what **program design** is needed to apply these funds most effectively?
3. What are the **next steps** and who are the **partners** for immediate action?

Goal: Achieving $0.20/kWh cost of service by 2020

Opportunities exist for a 60% cost reduction—enough to reach a profitable and scalable business model

COST-REDUCTION OPPORTUNITIES



*LCOE for total cost of service including all cost.

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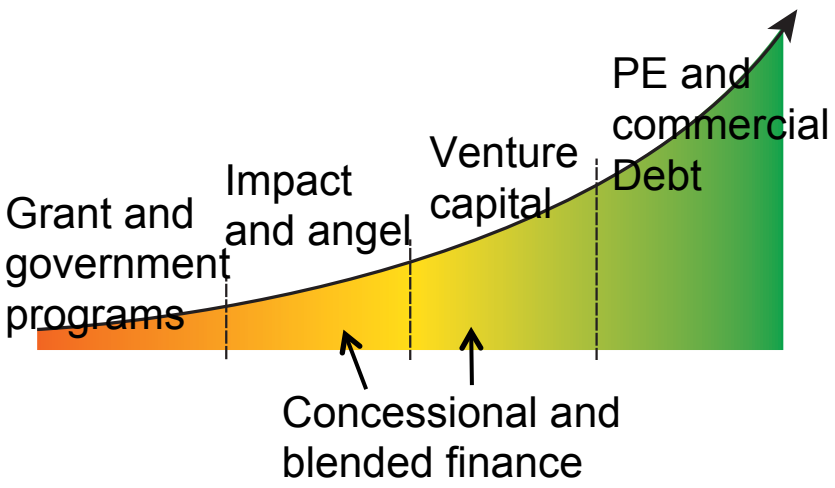
A small amount of grant funding will complement and amplify existing activities and accelerate market development



Where are we now?

- Major effort in Nigeria will push innovation and cost reduction
- But current developers will each learn on their own
- Need mechanism to test key improvement areas and disseminate the lessons to all parts of the ecosystem

Impact of grant funding applied in *Aikido* fashion

- Create cost reduction proof points
- Test new demand stimulation approaches
- Test demand management opportunities
- Test innovative customer acquisition models
- Test new business and ownership models
- Refine regulatory mechanism
- Address under-grid and grid integration needs
- Inform investors on what is possible

An Open Source, shareable set of well designed "minigrid experiments" will inform all participants in the ecosystem that will amplify and speed current efforts while accelerating the potential for minigrids across the globe

Nigeria is a promising market and a good test case for developing a profitable minigrid business model that scales

Nigeria is an attractive market for testing and scaling minigrids

- Nigeria has the **largest population and GDP** in Africa with significant rural economic activity
- **14 GW served by small petrol and diesel generators**
- Nigerians already spend **$14B annually on off-grid power** from small generators
- There are **85 million people** underserved and/or unconnected to the grid, which is an enormous investment opportunity
- The market is large - installing **1,000 minigrids each year for the next 10 years** would only serve 20% of the current off-grid population

Success and lessons learned from Nigeria will spread to other markets

- The range of **community and economic structures** in Nigeria is **very broad** ranging from nomadic to agricultural to large cities near and far from grid
- **Hardware and O&M** cost reductions are broadly **transferable**
- The **government's experience** with developing and applying minigrid policy can be **common** across sub-Saharan Africa
- The details of **community engagement** and **customer acquisition** may be location-specific but general **approaches are transferable**

Source: RMI Analysis

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DESPITE THE CHALLENGES, MINIGRIDS ARE APPROACHING COMMERCIAL VIABILITY IN NIGERIA

	Case Study #1: Small Off-Grid *Obot Ekpene, Cross River*	**Case Study #2: Medium Off-Grid** *Onyen-Okpon, Cross River*	**Case Study #3: Medium Underserved Peri-urban** *Mokoloki, Ogun*	**case Study #4: Large Underserved Peri-urban** *Okun-Owa, Ogun*
Peak Load	16 kW	200 kW	85 kW	1.8 MW
Current Cost, Diesel Generation*	$0.75/kWh	$0.52/kWh	$0.39/kWh	$0.25 (industrial)
Estimated Tariff Today (15% IRR)**	**$0.51/kWh**	**$0.40/kWh**	**$0.42/kWh**	**$0.33/kWh**
Customer Savings	$0.24/kWh	$0.12/kWh	-$0.03/kWh	-$0.08/kWh***
IRR if Tariff Matches Current Cost	**26%**	**22%**	**13%**	**6%*** **
Capital Cost	$130,000	$1.1 M	$600,000	$9.7 M
Consumption per Day	200 kWh	2,500 kWh	1,300 kWh	27,000 kWh

Minigrids: now is the time

A combination of recent activity, strong partners, and underlying market characteristics make Nigeria an ideal candidate to create a breakthrough and prove the minigrid business model.

Existing activities and partners

REA/government support:
- Innovative
- Responsive, capable, and action oriented

$150M WBG debt and subsidy:
- To support rapid scaling of off-grid market providing a project pipeline

Market potential
- 90M off-grid
- Latent demand, esp. productive-use
- Ability/willingness to pay

Private sector capabilities
- Several local minigrid companies operating today

What's needed next

Equity investors
- Investments now can complement and leverage WBG funding.

Grant funding
- Grant funding best amplify this opportunity and help to overcome barriers?

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ENERGY = EMPOWERMENT = EFFICIENCY

MINI GRID FUNDING AND INVESTMENT ROUNDTABLE

London & Washington DC
April 2018

ESMAP

WORLD BANK GROUP

ROCKY MOUNTAIN INSTITUTE

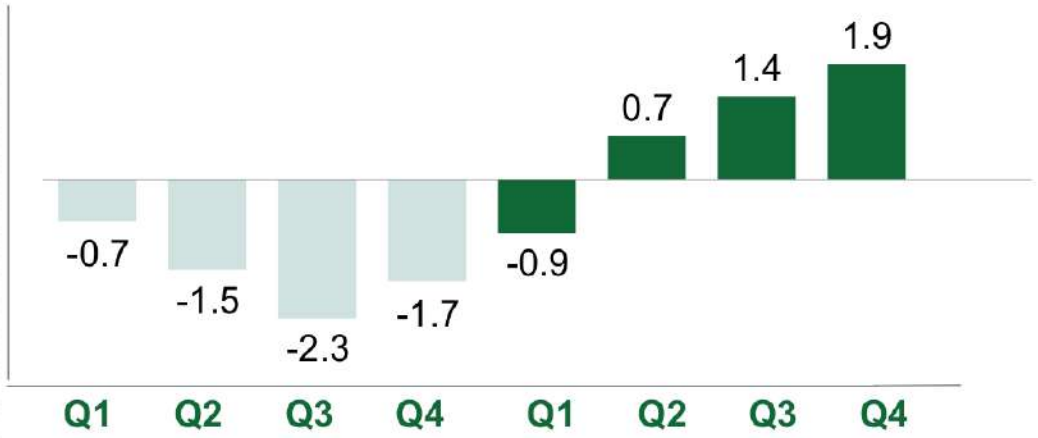
Nigerian macro-economic context

Strengthening oil prices and increased daily production has improved Nigeria's foreign reserves…

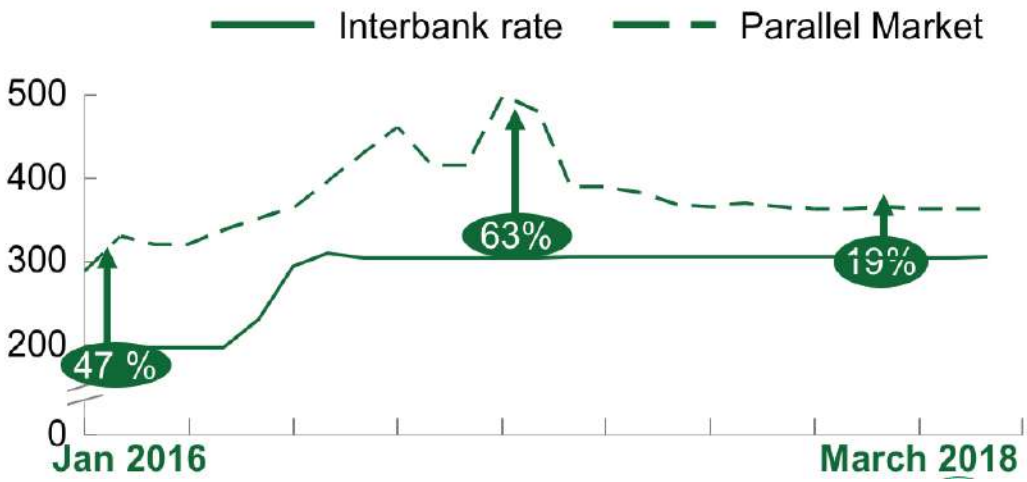
Economic factor	From, 31.03.16	To, 13.04.18
Oil prices[1]	USD 39/barrel	USD 73/barrel
Daily production	1.6 mmb/d[2]	1.8 mmb/d[3]
FX reserve	USD 27 bn	USD 49 bn

…this has led to an improvement in Nigeria's overall macroeconomic situation

GDP Growth, %



Exchange rates, Naira/USD



Nigerian Economic Recovery and Growth Plan (ERGP)

Stabilize the macro-economic environment

1. Align monetary, trade and fiscal policies
2. Accelerate non-oil revenue generation
3. Drastically cut costs
4. Privatize selected public enterprises/ assets

Achieve agriculture and food security

5. Deliver on agricultural transformation

Improve transportation infrastructure

6. Deliver targeted high priority transportation projects
7. Enable private sector financing of infrastructure

Ensure energy sufficiency in power and petroleum products

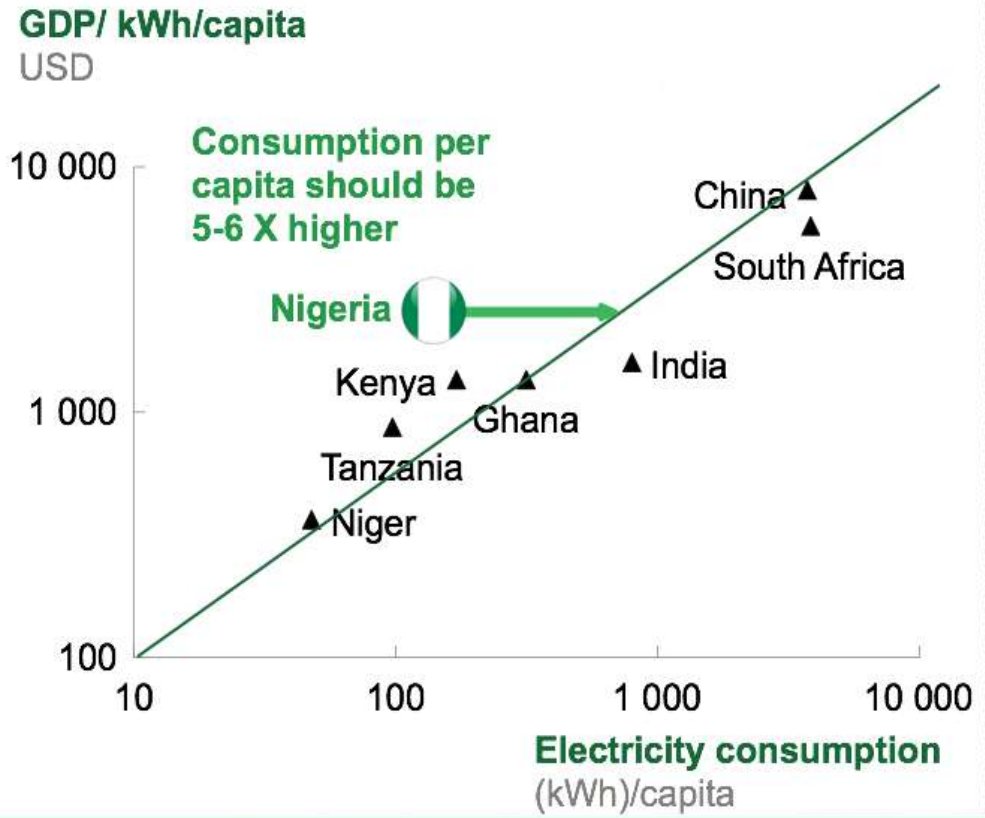
8. Urgently increase oil production
9. Expand power sector infrastructure
10. Boost local refining for self-sufficiency

Drive industrialization focusing on SMEs

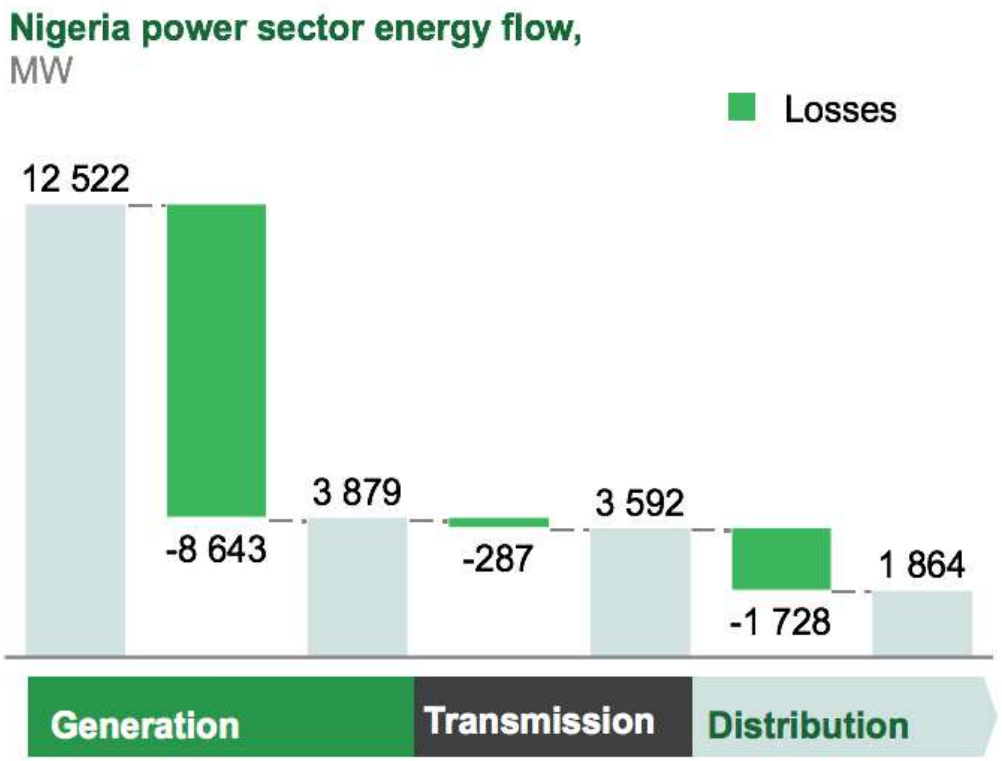
11. Improve Ease of doing business
12. Accelerate National industrial revolution plan implementation

Role of Off-grid in Power Sector Recovery Programme (PSRP)

Given its GDP, Nigeria's electricity consumption per capita should be 5-6 times higher



Nigeria's on-grid electricity infrastructure suffers significant losses across the value chain



- **Nigeria's on-grid electrification rate is 56%**
  - Ghana's electrification rate: 78%
  - South Africa electrification rate: 86%
- **82 million Nigerians have no access to on-grid electricity**

- **Generation losses** primarily caused by pipeline vandalism and gas/water management constraints
- **Transmission losses** mainly caused by insufficient maintenance & poor system management
- **Distribution losses** the result of high levels of technical, commercial and collection losses

ABOUT US

INTRODUCTION

- The Nigerian Rural Electrification Agency (REA) is the Implementing Agency of the Federal Government of Nigeria tasked with electrification of rural and unserved communities.
- REA has developed the **Off Grid Electrification Strategy**. The primary objective is to increase electricity access to rural and underserved clusters.
- Part of this strategy is to fast track development initiatives towards achieving the overall objective of the FGN Economic and Recovery Growth Plan (ERGP) and the Power Sector Recovery Programme (PSRP).

POWER SECTOR RECOVERY PROGRAMME

The Power Sector Recovery Programme ("PSRP") is a series of policy actions, operational, governance and financial interventions to be implemented by Federal Government of Nigeria over the next five (5) years to restore the financial viability of Nigeria's power sector, improve transparency and service delivery, resolve consumer complaints, reduce losses and energy theft and **RESET** the Nigerian Electricity Supply Industry for future growth.

The Federal Government of Nigeria developed the PSRP in collaboration with the World Bank Group. Holistically, the objectives of the Power Sector Recovery Programme are to

i) **Restore the sector's financial viability;**
ii) **Improve power supply reliability to meet growing demand;**
iii) **Strengthen the sector's institutional framework and increase transparency;**
iv) **Implement clear policies that promote and encourage investor confidence in the sector; and**
v) **Establish a contract-based electricity market.**

THE OFF -GRID ELECTRIFICATION STRATEGY

The aim of the Off Grid Electrification Strategy is **to provide access to clean and sustainable electricity to millions of Nigerians**

OBJECTIVES

- To develop a **data driven off grid model** for Nigeria that will become an exemplar for **Sub Saharan Africa**;
- To utilize the funding from the **Nigerian Electrification Project (NEP)** as a catalyst to scale up rapid implementation of off- grid solutions across Nigeria;
- To increase **gender Inclusion** in the Nigerian power sector;
- To promote the use of **decentralized, multi-demographic approach** to power infrastructure delivery;
- To develop **10,000 mini grids by 2023** which will provide power to 14% of the population;
- To increase **economic growth** in critical sectors e.g. **Agriculture**;
- To provide **reliable power supply for 250,000 SMEs;**
- To provide **uninterrupted power supply** in Federal Universities and University Teaching Hospitals;
- To improve the **quality of educational systems** at the **tertiary level**;
- To deploy **5 million solar standalone systems** for residential and SMEs by 2023;
- To supports the FGN's climate change obligations under the **Paris Agreement**, with respect to **promoting renewable** and **reducing carbon emissions**.

ENABLING ENVIRONMENT

Government, donor partners, and the private sector are actively working together in Nigeria to create enabling conditions for successful minigrid development

- Nigeria is providing an **enabling environment for off-grid market growth**, including:
  - **Developer protection** through the NERC Minigrid Regulations.
  - An innovative and **best practice site-selection process** to de-risk projects has already identified over 250 promising sites.
- The **government and development partners are inviting the private sector** to work with them to capture this opportunity, while saving Nigerians money and powering economic development to further expand the market.
- With an enabling environment, continued cost reductions, and targeted finance, the **Nigerian minigrid market can scale rapidly** to over 10,000 sites by 2023, powering 14% of the population with capacity up to 3,000 MW and creating an investment potential of nearly $20 billion and annual revenue opportunity exceeding $3 billion.

REA'S PROGRAMMES TO SUPPORT ECONOMIC DEVELOPMENT AND ENERGY ACCESS

REA programmes

	Stand-Alone Systems	Minigrids	Energizing Education	Energizing Economies
Who will be served?	Remote customers with low load or low ability to pay	Communities with load less than 1 MW	37 universities, 7 teaching hospitals, and the surrounding communities	Economic clusters: areas with high commercial activity and high growth impact on the economy
What is REA's role?	Promote development and roll-out	Promote community, private development	Develop independent power plants to serve	Project development and enabling environment
Benefits to community	Provide critical basic services; cheaper than kerosene or other energy alternatives; create jobs	Promotes economic activity; interconnection potential	Provide nearly 100 MW generation across 6 geo-political zones; improve educational quality	Replace costly, inefficient, polluting diesel with centralized power source; promote MSME growth
Benefits to developer	Supportive regulatory environment, coordination around market expansion, education and awareness	10,000+ potential sites offer high customer density, clustering; access and scaling in Africa's largest market	Solar hybrid and gas engine plant generation opportunities	High load and customer concentration; clear value proposition to customers

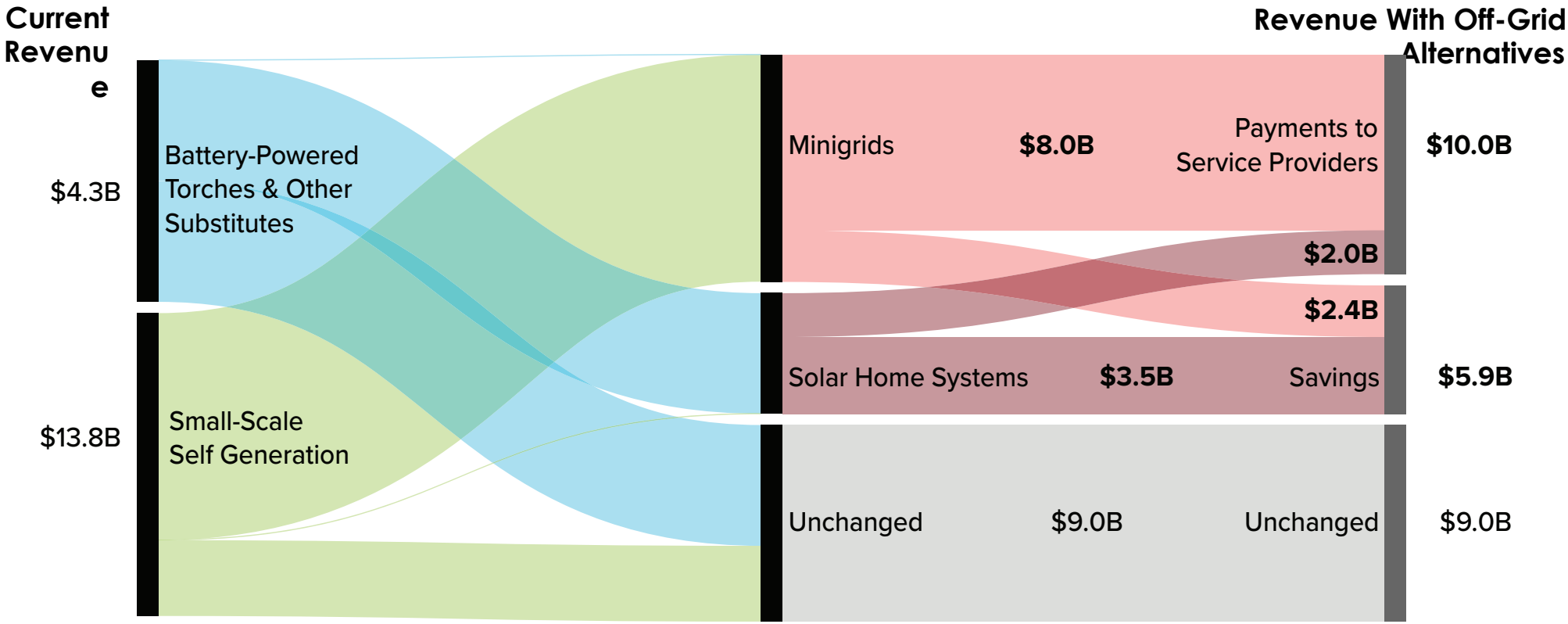
Crosscutting energy database – online visualization of resources for energy development

Source: REA strategy presentation

THERE IS A $10B/YR MARKET OPPORTUNITY *TODAY* FOR MINIGRIDS AND SOLAR HOME SYSTEMS THAT WILL SAVE NIGERIANS $6B/YR

- **$10 billion annual market opportunity** to supply off-grid and underserved customers with minigrids and solar home systems*
- With 8% economic growth through 2030 there is an **additional $670 billion** value proposition
- This estimate is based on current expenditures, but customers **may pay more for superior service**
- This shift from expensive generating sets would **save Nigerians customers $6B/yr** over current energy costs

Today's off-grid and underserved annual market size in Nigeria, by off-grid technology*



Source: RMI analysis

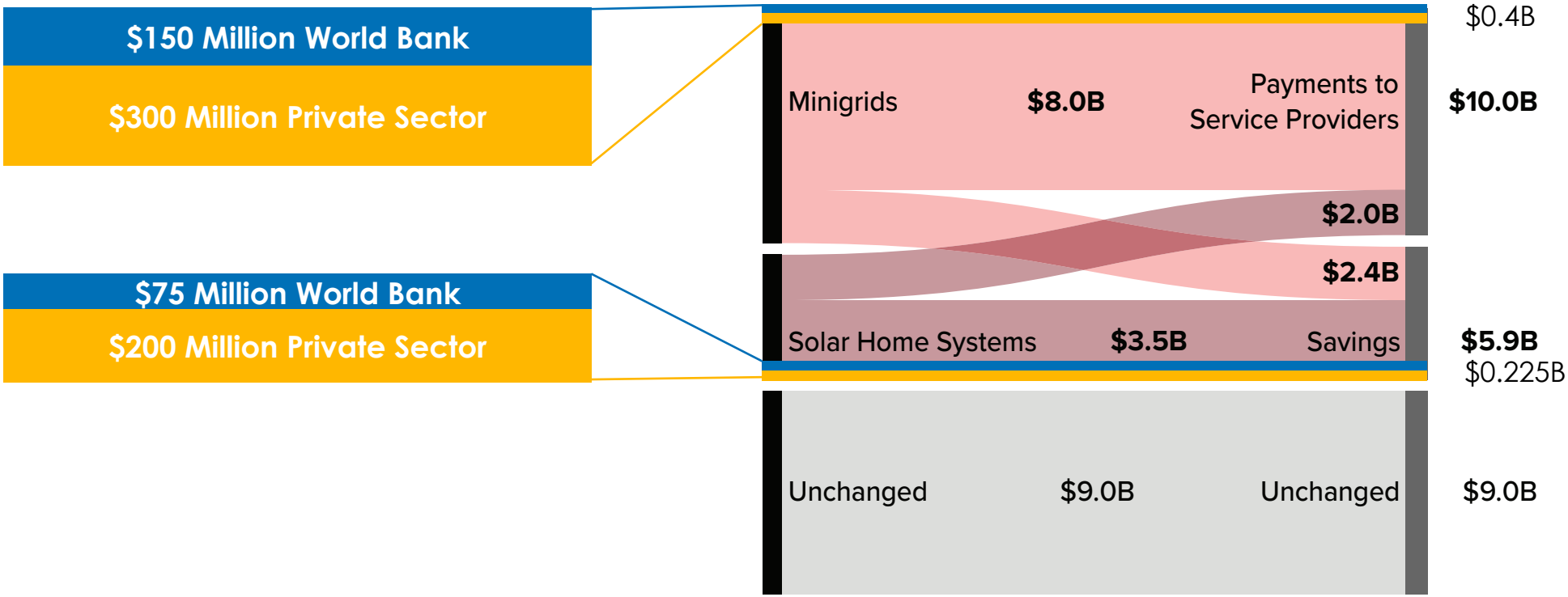
* Assumes 50% adoption of solar home systems by torches and other substitutes, and 75% adoption of minigrids by small-scale self generation; conservatively does not assume growth in electricity use

OFF-GRID INVESTMENT OPPORTUNITY:

Financing: $1BILLION IN immediate INVESTMENT need with an initial Investment of $350M from World Bank secured through the Nigerian Electrification Project (NEP).

- **$1 billion initial investment opportunity** to catalyze the $10 billion market
- An **initial 1000 mini grids** to build a national market **requiring $300 million in private sector investment**
- **Scaling the SHS market by an order of magnitude** (10's to 100's of thousands of sales per month) requires $200 million in private sector investment
- Providing power solution for **37 universities and 7 university teaching hospitals through the 'energizing education'** programme requires $150 million
- **Significant opportunities for first-mover advantage** in mini grids and solar home systems

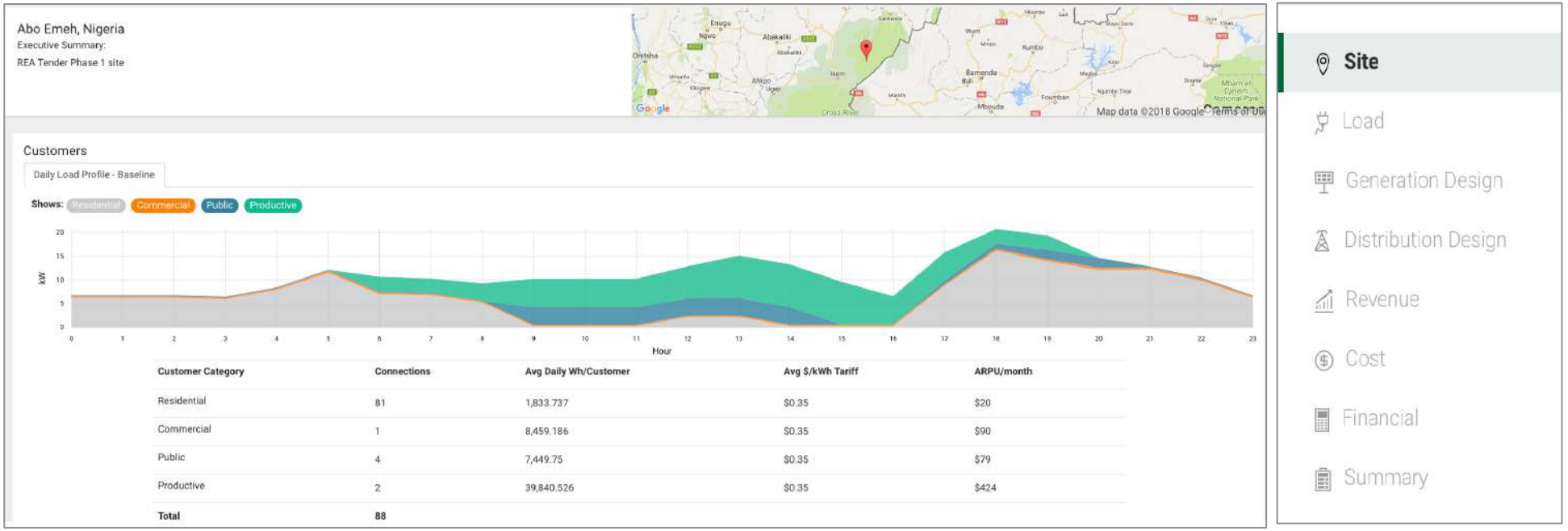
This $1 billion initial investment opportunity is the catalyst for a $10 billion mini grid and SHS market



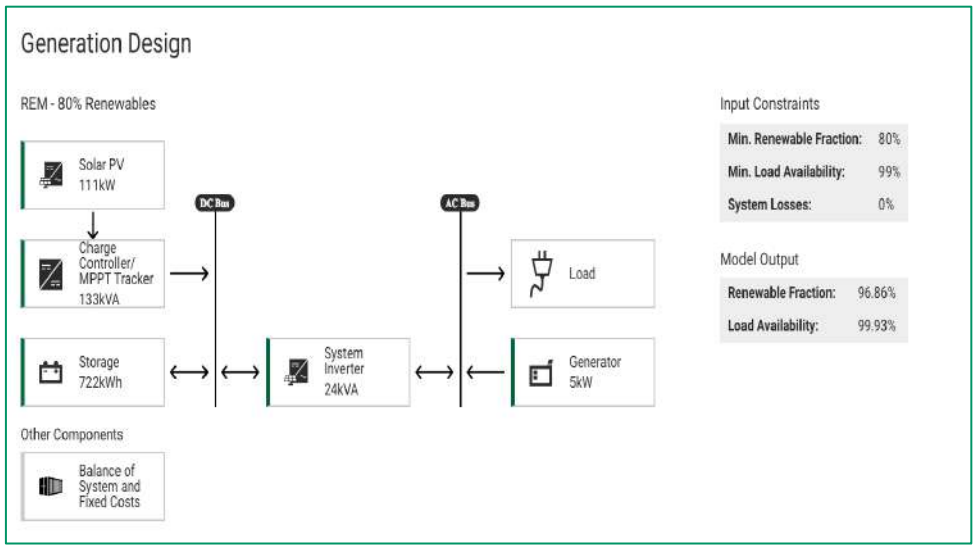
OFF-GRID INVESTMENT OPPORTUNITY:

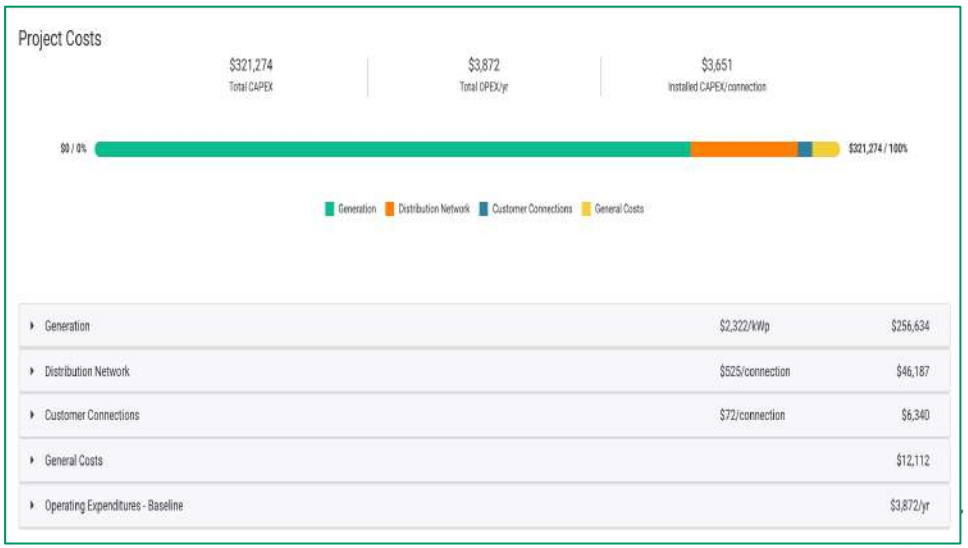
Market Intelligence for Mini Grid Development

REA Online Projects Database and Development Tool Powered by Odyssey



Customer Category	Connections	Avg Daily Wh/Customer	Avg $/kWh Tariff	ARPU/month
Residential	81	1,833.737	$0.35	$20
Commercial	1	8,459.186	$0.35	$90
Public	4	7,449.75	$0.35	$79
Productive	2	39,840.526	$0.35	$424
Total	**88**			





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OFF -GRID INVESTMENT OPPORTUNITY:

ENERGIZING ECONOMIES INITATIVE

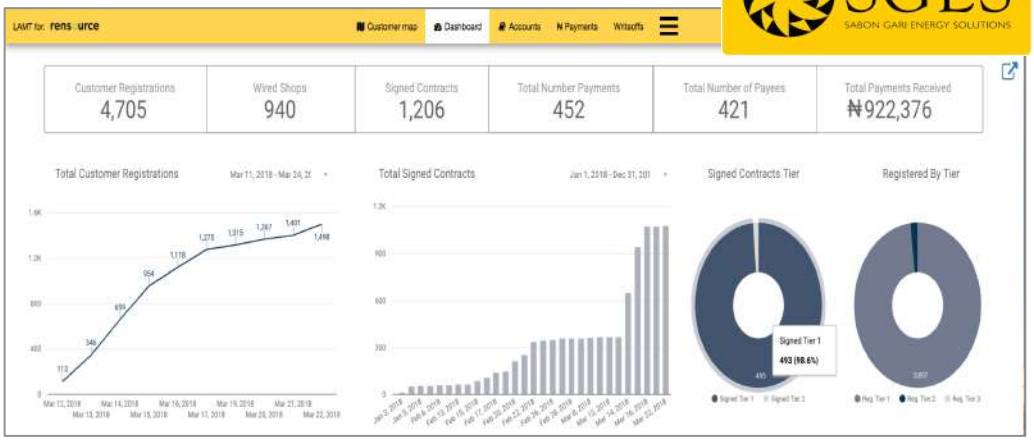
Energizing ECONOMIES

Case Study– Sabon Gari Market

- **13,000 shops**, 11,000 of which currently use electricity
- Currently spend **$15,000/day (₦5.3M/day)** on electricity
- Currently unconnected to the grid
- **1 MW+ of high capacity solar standalone systems powered by Rensource**
- **Phase 1 was commissioned in February 2018**
- Constant power allows for value added services e.g. **Internet, micro pensions, e-commerce etc.**

Online Dashboard

SGES
SABON GARI ENERGY SOLUTIONS



Sabon Gari Energy - Customer Service Centre

The **private sector** is responsible for funding, generation, distribution, metering, and collections, and the **REA** conducted the energy audit and facilitated all interactions with the various state and federal level Ministries, Departments and Agencies

OFF-GRID INVESTMENT OPPORTUNITY:

ENERGIZING EDUCATION PROGRAMME

University & Hospital Power Systems

Objectives:

- Support to Nigerian Government's Energizing Education Program
- Provide new or improved power systems for 37 federal universities and 7 associated teaching hospitals

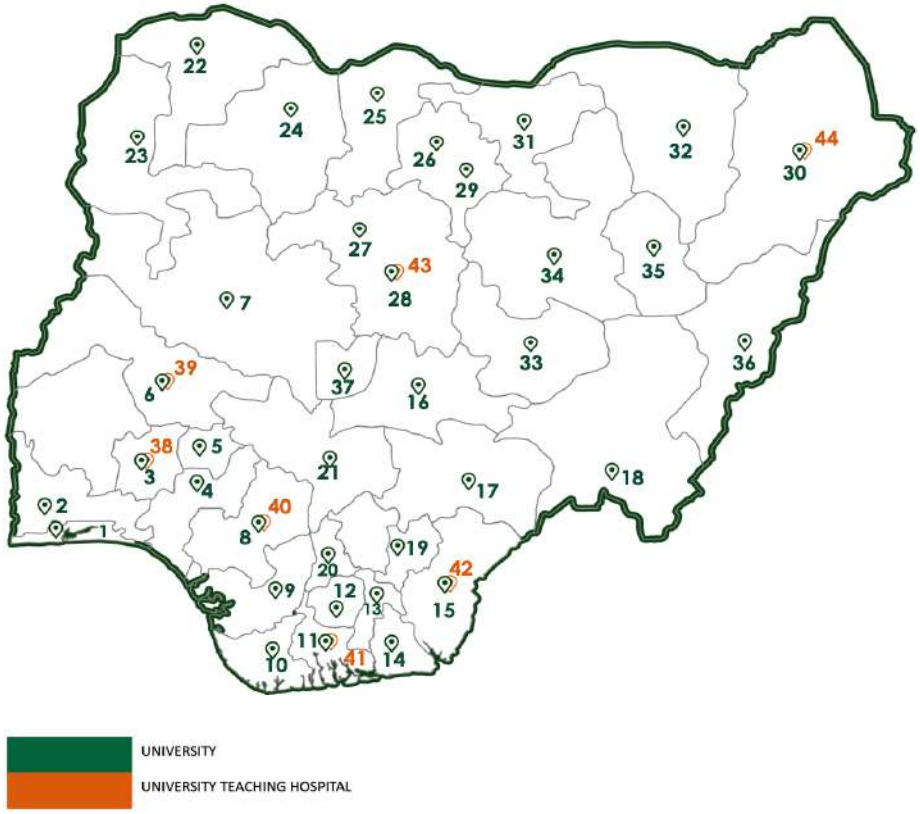
EPC contracts for:

- Solar hybrid or gas-fired power systems to operate independently of DISCO grid, with capability to be connected at a later stage
- Campus-wide distribution system upgrade as necessary
- Campus-wide street lighting
- Training center facilities dedicated to renewable energy and electrical engineering education

O&M contracts for:

- Operating and maintaining power system and street lighting for 10 years
- O&M contracts will be offered to EPC contractors upon satisfactory completion of works

Sites for the Energizing Education Program



Power System Characteristics:

- Capacity: 0.5 - 8.0 MW
- Technology: Solar-Hybrid or Gas fired with Smart Metering
- Reliability: > 99% for high-priority loads

Invitation for investments and private sector participation

Type of support	Donors	DFIs	Impact funds	Climate finance	Commercial banks/ debt financing	Private Equity/ venture capital
Projects	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies ▪ Energizing Education ▪ Technical Assistance	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies ▪ Energizing Education ▪ Technical Assistance	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies	▪ Standalone Systems ▪ Mini Grids ▪ Energizing Economies
Investment objective	▪ Provide stable electricity to off-grid households and businesses	▪ Catalyze the mini-grid and off-grid electrification sector ▪ Minimum returns	▪ Social impact ▪ Returns	▪ Invest in emissions reducing activities ▪ Sustainability and returns	▪ Interest on loans disbursed ▪ Return of principal	▪ Returns
Requirements	▪ Track record ▪ Some locall content requirements	▪ Track record ▪ Viable business plan	▪ Proven impact on the lives of customers/ community ▪ Clear path to delivering returns	▪ Sustainable path to revolutionizing clean energy in chosen space ▪ Viable business plan	▪ Secure collateral ▪ Secure future cash flows	▪ Competitive returns ▪ Comprehensive exit strategy

KEY MILESTONES

2018 Q2	**Nigerian Electrification Project (NEP)** Board Approval from the world bank
2018 Q3	**Procurement** Commence NEP procurement process for mini grids and stand alone systems
2018 Q4	**Energizing Economies** Completion/ Commissioning of power supply to 72,000 SMEs and power supply to another 150,000 SMEs will be under construction
2019 Q1	**Mini Grids and Stand alone systems** Deployment of the first 100 mini grids commences and 250k stand alone systems
2019 Q2	**Review** Conduct a comprehensive review of the successes/ challenges of implementing the off grid electrification strategy

RURAL ELECTRIFICATION AGENCY

ENERGY = EMPOWERMENT = EFFICIENCY

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the Nigeria electrification PROJECT

Minigrid Funding and Investment Roundtable

WORLD BANK GROUP

ESMAP

London and Washington
April 2018

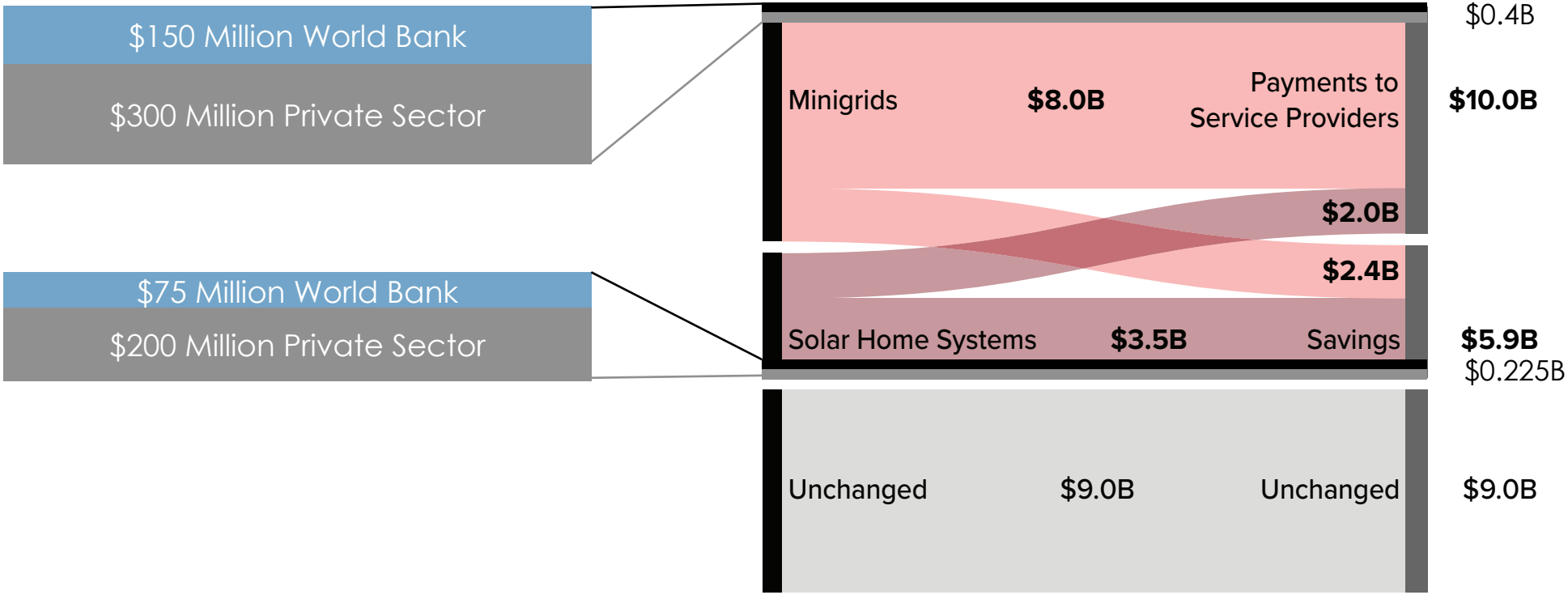
WORLD BANK PROGRAM IN THE NIGERIA ENERGY SECTOR

Project	Description	Funding
Power Sector Recovery Performance-Based Loan (PBL)	Supporting the government's PSRP by incentivising reform actions which will lead to sector financial viability. Funds will contribute to PSRP Financing Plan which will ensure GenCos are paid in full while sector viability gap is narrowed over the next 4 years	**$1 billion**
Power Sector Guarantees Program (PSGP)	Providing payment guarantees and loan guarantees to new private IPPs	**$700 million**
Nigeria Electricity Transmission Project (NETAP)	Funding the reinforcement and upgrade of network infrastructure	**$486 million**
Nigeria Electricity Distribution Improvement Project (NEDIP)	Investments in Discos that will improve technical and commercial efficiency while preparing them to receive further investments from private sector	**$500 million**
Nigeria Electrification Project (NEP)	Supporting private sector investments in solar mini grids and individual solar systems in off-grid locations. Supporting off-grid systems for universities and hospitals	**$350 million**

THE WORLD BANK IS INVESTING $350M IN OFF-GRID SOLUTIONS IN NIGERIA TO CATALYZE $1BILLION IN INVESTMENT

- $1 billion initial investment opportunity to catalyze the $10 billion market
- An initial 1000 mini grids to build a national market requiring $300 million in private sector investment
- Scaling the SHS market by an order of magnitude (10's to 100's of thousands of sales per month) requires $200 million in private sector investment
- Providing power solution for 37 universities and 7 university teaching hospitals through the 'energizing education' programme requires $150 million
- Significant opportunities for first-mover advantage in mini grids and solar home systems

This $1 billion initial investment opportunity is the catalyst for a $10 billion mini grid and SHS market



THE WORLD BANK'S INVESTMENT IN NIGERIA'S OFF-GRID ELECTRICITY MARKET IS ONE OF THE BANK'S LARGEST EVER

$350 Million World Bank Investment Leveraging an Expected $1 Billion in Investment

WB: $150 Million for mini grids. Private Sector Opportunity: $300 Million

- $70 Million: Competitive bidding for portfolios of mini grid sites
- $80 Million: Connecting new customers
- Mini grids built to grid code standard
- First-mover potential in the next 5 years: 300,000 households and 30,000 SMEs served by 1000 mini grids

WB: $75 Million for SHS. Private Sector Opportunity: $200 Million

- $15 Million: "Accelerator" grants to high-potential importer-distributors
- $60 Million: Output-based grants
- Business model neutral
- First-mover potential in the next 5 years: 1.5 million households and micro-enterprises.

WB: $105 Million for University & Hospital Power Systems. Private Sector Opportunity: $150 Million

- 37 federal universities and 7 affiliated hospitals
- EPC contracts for constructing power systems
- O&M contracts for 10 years
- Power systems designed to operate independently from the Grid

WB: $20 Million Technical Assistance

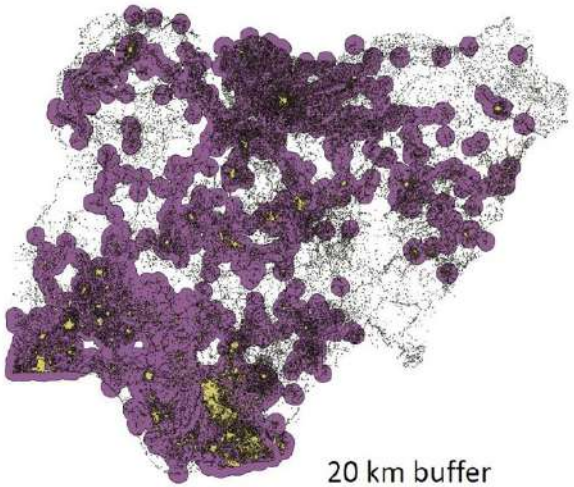
- Institutional support for REA
- Investment pipeline development
- Financing needs assessment
- Regulatory support
- Pre-investment support to mini grid developers
- Ecosystem development for SHS
- Environmental & Social Safeguards

NIGERIA ELECTRIFICATION PROJECT: COMPONENT 1

MINI GRIDS: $150M WB, LEVERAGING $300M PRIVATE SECTOR

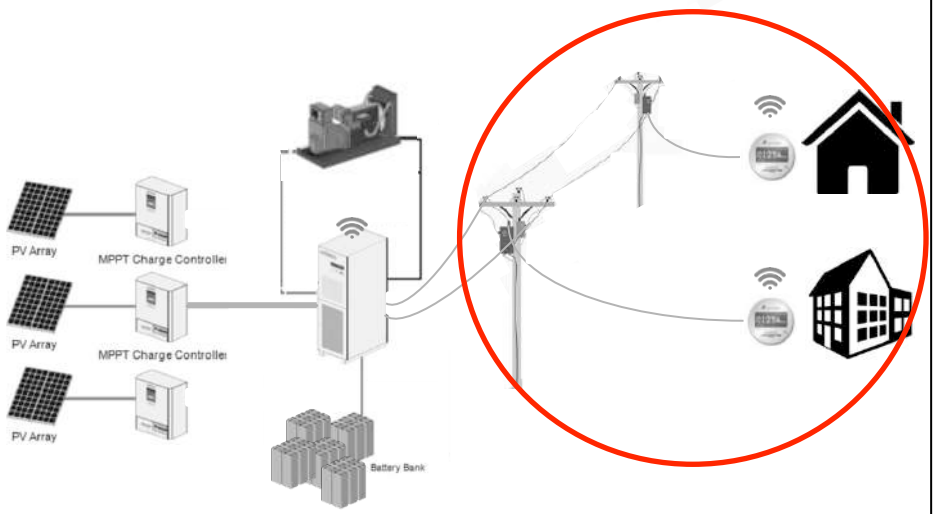
$70 Million: Competitive Bidding

- 100 pre-selected mini grid sites clustered into bid packages for auction
- Bidders compete on lowest subsidy to build, own, and operate a portfolio of mini grids
- Detailed economic and geospatial data will be made available to developers
- Standardized design: solar PV & diesel hybrid with smart meters using a prepaid system
- An additional 70+ mini grids will be auctioned off in high-risk environments (e.g., conflict areas) – these will be fully financed by the project



$80 Million: Connection Cost Subsidies

- $300+ for each new connection to a mini grid, 100% payment made after connection
- Payments made upon completed milestones: technical design; delivery of equipment to site; customer connections
- Applications assessed on a rolling basis



NIGERIA ELECTRIFICATION PROJECT: COMPONENT 2

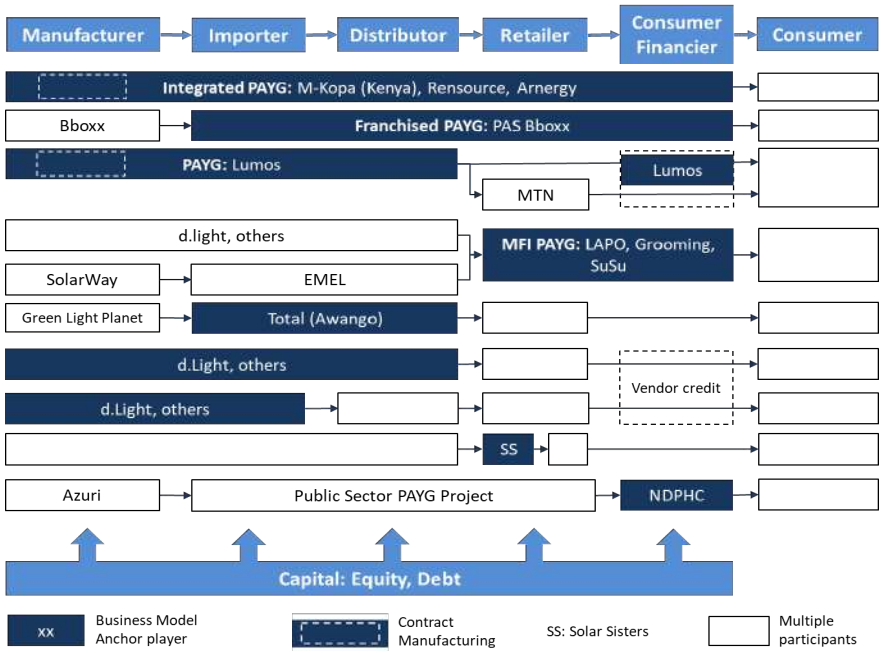
SHS: $75M WORLD BANK, LEVERAGING $200M PRIVATE SECTOR

$15 Million: Accelerator Grants

- Up-front grants to strongest and most capable SHS providers
- Pre-qualification based on evidence that applicant has ready-to-go capabilities for scaling rapidly
- Grants will crowd-in large-scale additional private sector investment and provide liquidity for working capital
- Grants disbursed in lump sums based on milestones outlined in grant proposal
- Prospective Market Players:

$60 Million: Output Based Grants

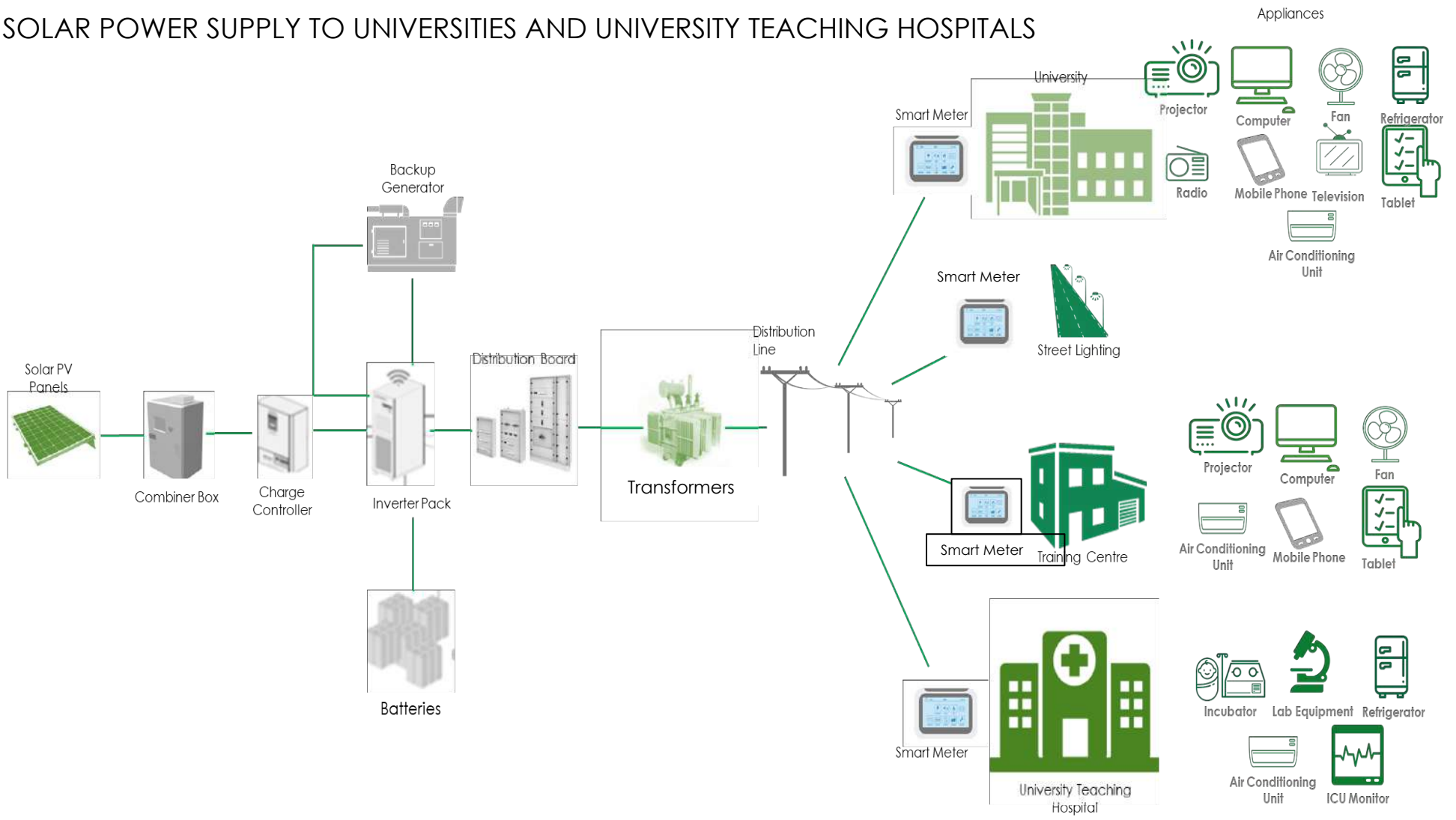
- Pre-qualification based on business capabilities and SHS technical standards
- Focus will be primarily on strong new entrants and Nigerian start-ups
- Grants set at 15-20% of the nominal retail price and paid in tranches on verified product installations
- Grant support is business model neutral



NIGERIA ELECTRIFICATION PROJECT: COMPONENT 3

"ENERGIZING EDUCATION": $105 MILLION WB INVESTMENT

SOLAR POWER SUPPLY TO UNIVERSITIES AND UNIVERSITY TEACHING HOSPITALS



NIGERIA ELECTRIFICATION PROJECT

NEXT STEPS:

2018 Q2	Preliminary implementation of Technical Assistance Component using advance funding
2018 Q3	Commence NEP procurement process for mini grids and stand alone systems
2018 Q4	Full implementation of 5-year project begins

- Private sector needs to be ready to engage in order to leverage the $225m grant funding we have made available
- Team based in DC and Abuja is available to meet to provide more details as required

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THANK YOU

RURAL ELECTRIFICATION AGENCY

ENERGY = EMPOWERMENT = EFFICIENCY

Energizing Economies Initiative (EEI)

Investor Round Table, London

April 19, 2018

POWER AFRICA

What we will cover during this session

- Overview of the Energizing Economies Initiative
- The Scale-Up Approach
- The Business Case
- Path Forward

The Energizing Economies Initiative will focus on off-grid electrification of economic clusters in Nigeria

Defining the Energizing Economies Initiative

The Energizing Economies Initiative (EEI) will support the rapid deployment of off-grid electricity solutions that will provide clean and consistent power to economic clusters in Nigeria

- Sponsored by **Federal Government of Nigeria** while **REA** is responsible for implementing and supporting initiative
- **Key focus is clusters of economic activity:**
  - Markets
  - Shopping Plazas/Complexes
  - Industrial Clusters

Expected impact of the initiative

EEI is about developing a nascent subsector

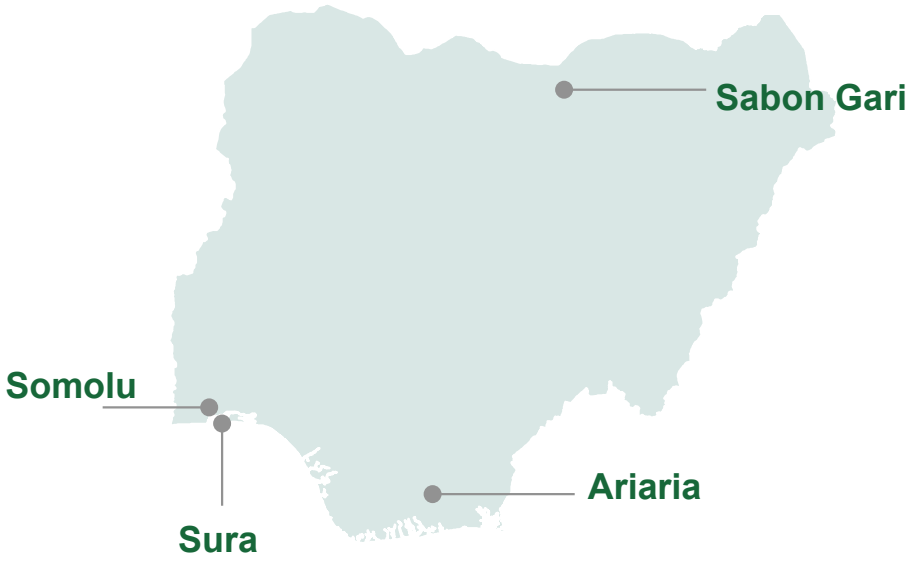
- **250-300 off-grid projects** over the next **3-5 years**
- **70% of projects** will be from renewable energy

Early stage could require intervention and capex support, but will evolve toward fully standalone business model requiring no additional support

Source: Team analysis

Our starting point: 4 pilot-projects and ~50,000 shops

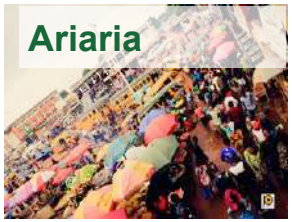
Overview



Situation

- Higher energy cost compared to renewable and other gas-fired solutions
- Noise pollution from heavy duty diesel generators and small generators
- Potential Health, Safety, and Environment (HSE) risk resulting from ad hoc installations
  - Fire caused by petrol generators at Sabon Gari market destroyed NGN 10 Bn worth of goods
- Old overhead distribution lines

Pilot project status

Site	# of shops electrified	Technology	Status
 Sabon Gari	13,600	Decentralized solar	In operation
 Somolu	4,260	Natural gas	Feasibility assessment
 Ariaria	32,000	Natural gas	Construction
 Sura	1,047	Connect to existing IPP	Being connected

Power Africa has partnered with REA and multiple stakeholders to define the path to scale off-grid solutions in Nigeria

Interviewed 30+ developers and investors

Obtain range of views on market constraints to scale

Shared views on what scale-up plan should look like

Defined pathway to scale across 3 phases

Developed a 3-phase scale-up approach over the next 3 - 5 years

Developed REA framework of systematic support for developers and investors

Structure roles for key actors

Quantified programme economics

Structured roles for key players across the scale-up phases

SOURCE: Team analysis

The scale-up model will evolve across 3 phases over the next 3 to 5 years, unlocking the market to achieve scale

	Phase I *(12 months)*	Phase II *(12 – 18 months)*	Phase III *(12 – 24 months)*
Sites developed	▪ 10-20 sites	▪ 80-100 sites	▪ 200+ sites
Key Objectives	▪ **Prove technical model** – i.e. the right technology set-up for different economic clusters across geopolitical zones ▪ **Obtain proof-points for business model** – i.e. consistent customer payments	▪ **Demonstrate commercial viability at scale** – i.e. ability to rapidly deploy a large number of projects with the support of capital on commercial terms	▪ **Continue to push the transition to commercial sources of financing** (debt and equity) on market terms ▪ **Develop pool of local developers** with strong track record of project execution

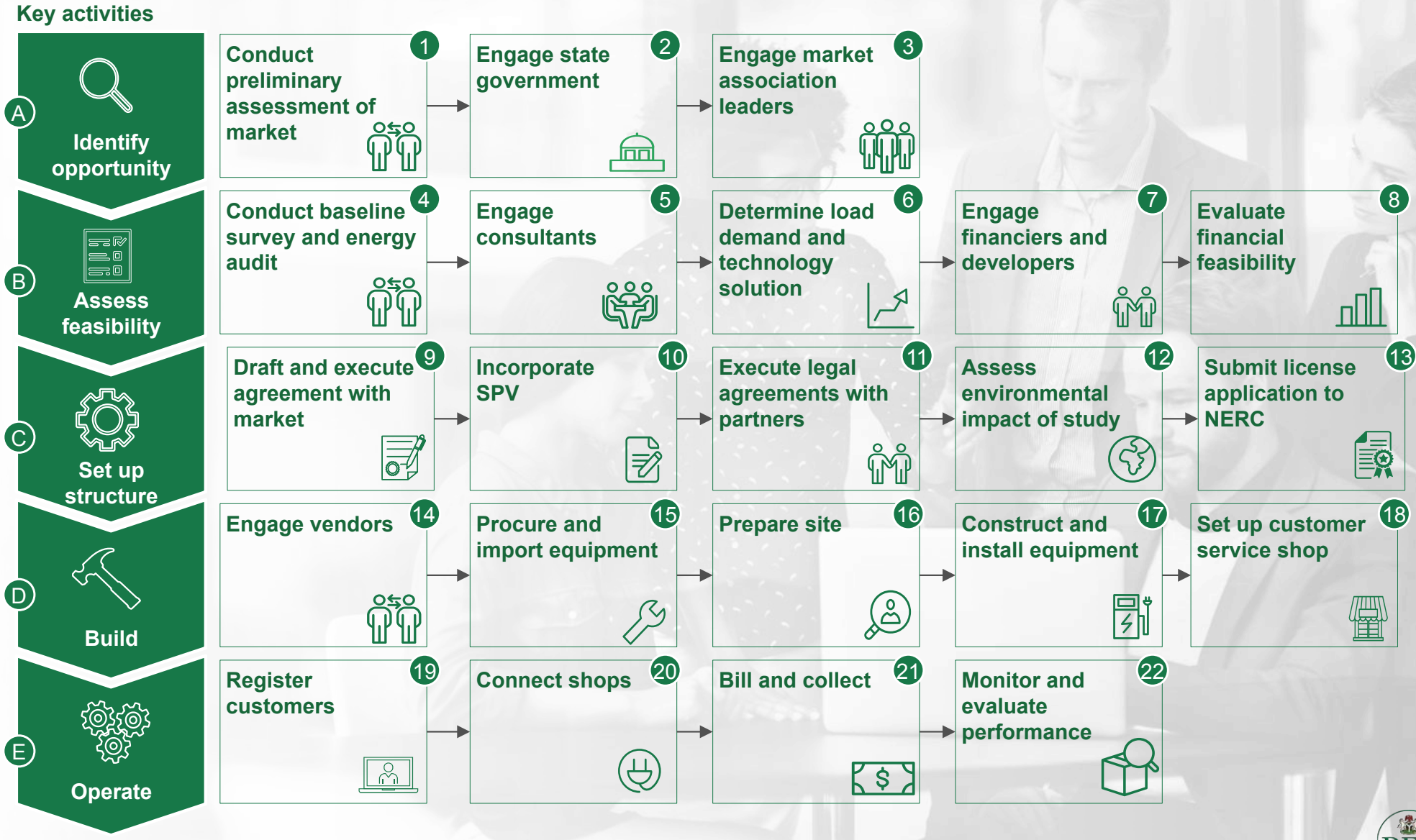
Each phase will evolve across 4 key dimensions

PRELIMINARY

Programme phases	Phase I (10-20 sites)	Phase II (80-100 sites)	Phase III (200+ sites)
1 Site sequencing	▪ **Prioritize** 'lowest hanging fruits'	▪ **Balance ease of deployment** and scale of impact	▪ **All sites** within scope
2 REA Support	▪ **Active facilitation role** across entire project lifecycle e.g. stakeholder engagement, license application, port clearance	▪ **Unlock key business environment** issues e.g. licenses, key government approvals ▪ **Facilitate access to fiscal incentives** e.g. import duty waivers, pioneer tax status	▪ **Same as Phase II, but with reduced REA involvement** ▪ **Facilitate access to fiscal incentives** e.g. import duty waivers
3 Transaction approach	▪ **Individual projects** matched to selected investors based on interest and capability	▪ **Active investor attraction** via targeted outreach to broader investor base	▪ **Competitive selection process** open to public
4 Financing	▪ **Primarily by investors** with higher-risk appetite ▪ **Project facilitation support provided by REA** to reduce CAPEX ▪ Opportunistic donor funding (if available)	▪ **Proportion of CAPEX funded** by grants or concessionary funding ▪ Non-distortionary	▪ **Commercial debt and equity funding**

Source: Team analysis

REA has developed a best practice end-to-end process for off-grid project development



Source: REA team interviews, Team analysis

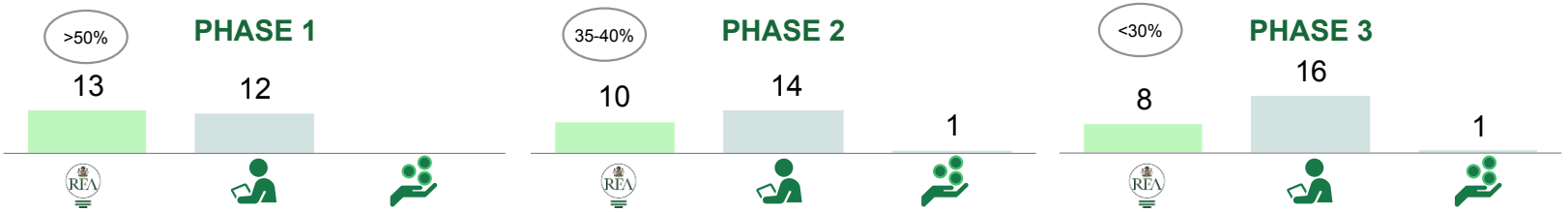
REA's support throughout the project lifecycle will transition across phases

X % of activities owned by REA

Activity with heavy REA involvement
Activity with light REA involvement
Activity with no REA involvement

Owner
Developer | REA | Investor

Level of activity ownership and involvement of parties, number of owned activities

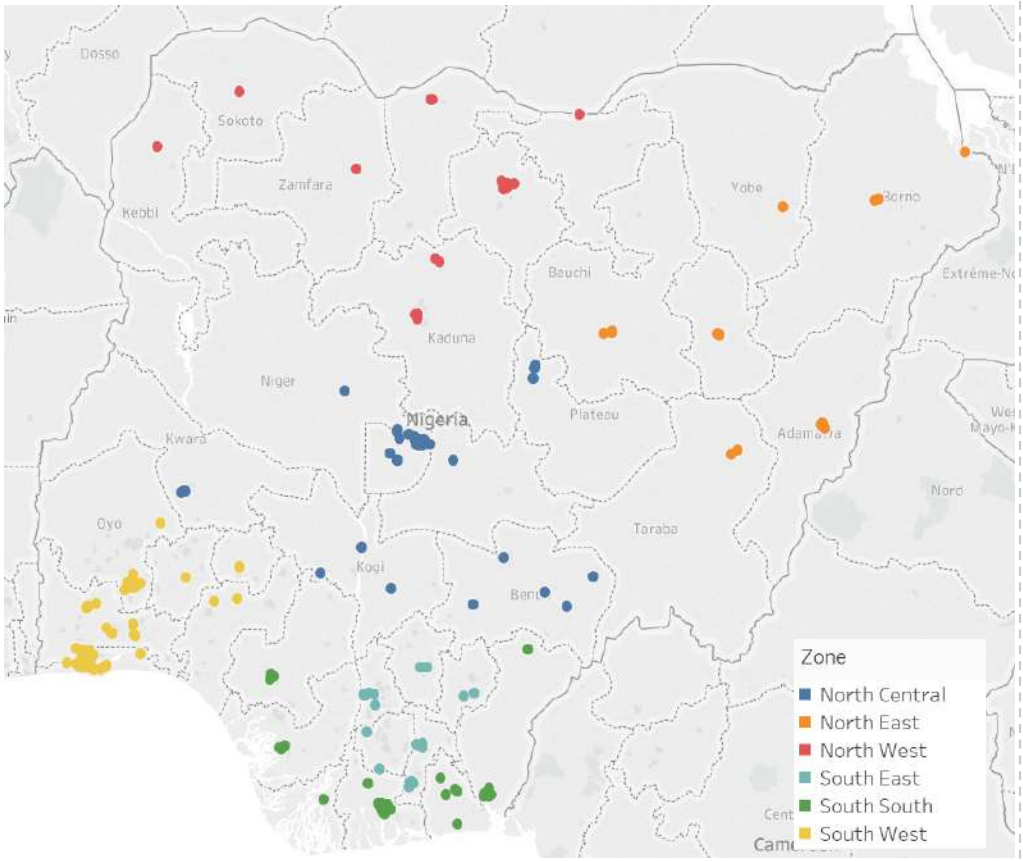


Key activities	PHASE 1	PHASE 2	PHASE 3
A Identify opportunity	REA leads extensively	REA leads extensively; facilitates introduction of developers to markets	REA leads extensively; facilitates introduction of developers to markets
B Assess feasibility	REA owns all activities; engaging consultants and financial advisors as needed	Led extensively by REA, financial feasibility assessed by investors	Investor and developer lead most activities, REA still conducts energy audit
C Set up structure	REA owns all processes for setting up structure of SPV and project	Led largely by REA, developers lead negotiation of customer agreements	Led extensively by the developer; REA provides guidelines and support as needed
D Build	Led solely by developer, REA monitors project development	Developer leads all aspects of construction and project management	Led solely by developer, REA plays no active role
E Operate	Led solely by developer, REA monitors and evaluates performance	REA not involved in operations, monitoring or evaluation	Led solely by developer, REA plays no active role

Source: Team analysis

Based on a conservative 250 projects already identified, the market opportunity is ~ USD 680M annually

Economic clusters identified are concentrated in the South South, South West & FCT



Identified 250+ markets located across the country

Market sizing	Retail markets	Complexes & Industrial clusters	Total
Markets	200	50	250
# of connections per market	15,000	2,500	17,500
Average demand, W[2]	92	700	193
Average price, USD/kWh[1]	0.50	0.50	0.50
Average trading hours & days	12 hours, 6 days a week	12 hours, 6 days a week	12 hours, 6 days a week
Estimated demand, MW	275	75	604
Annual Rev. USD mn	**515**	**164**	**679**

1 Exchange rate NGN:USD of 360

2 Estimated based on REA pilot project energy demand data

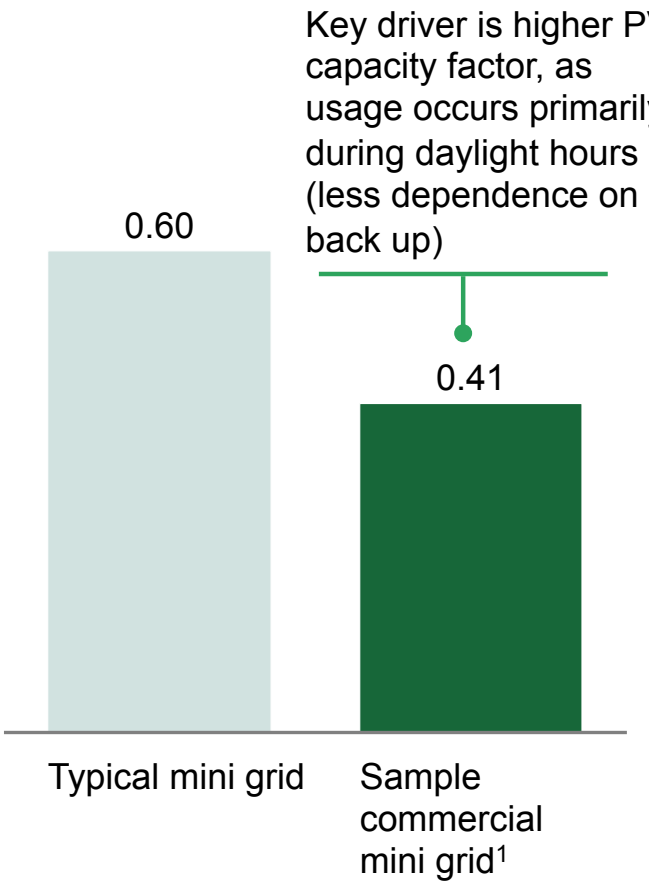
SOURCE: Geopoll Survey commissioned March 2018, Aboki FX, IEA World Energy Outlook; RMI; Expert input

The business case for off-grid projects under the Energizing Economies Initiative is compelling in steady state

X Viability / investment costs %

The LCOE of the commercial mini grid is lower than the typical mini grid

LCOE, $/kWh



The project NPV remains positive under a range of pricing and inflation assumptions

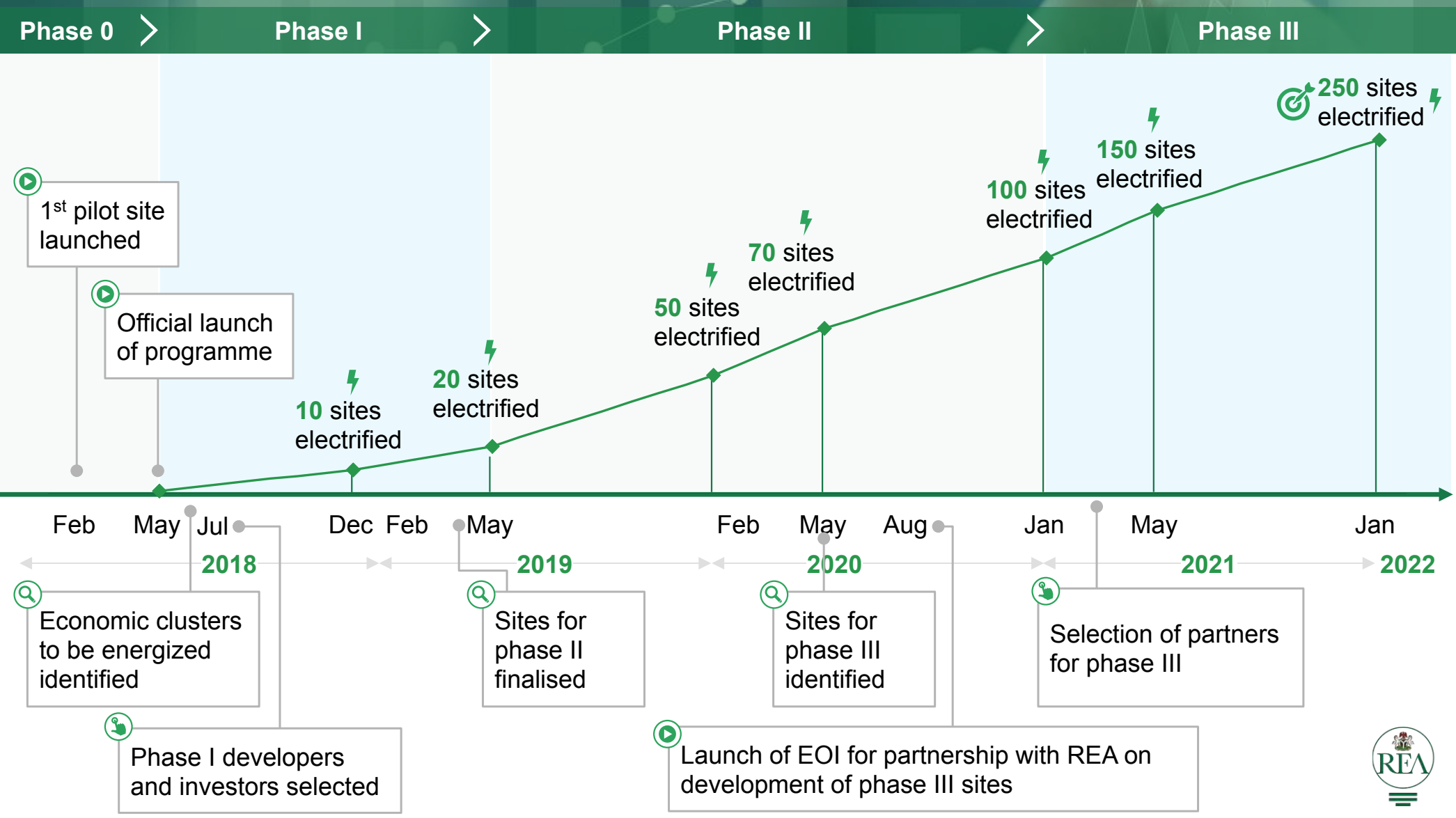
Phase 3[2] project NPVs, USD mn

	Inflation effect:	Commercial mini grid [1] N180/kWh ($0.50)	Commercial mini grid [1] N252/kWh ($0.70)
1	25% inflation pass through	6% $0.22mn	50% $1.7mn
2	50% inflation pass through	24% $0.8mn	75% $2.6mn
3	100% inflation pass through	69% $2.4mn	138% $4.8mn

1 Showcasing the PV-battery mini grid
2 Assumed that relative to phase 1, in phase 3: CAPEX reduces by 20%, upfront costs by 25%, OPEX cost by 10%, Debt interest rate by 4pp; revenue collections increases by 4%; and a debt/equity share of 50/50.

SOURCE: IEA World Energy Outlook; RMI; Expert input

EEI implementation roadmap



Building Sabon Gari Energy

An Urban Micro-utility powered by Rensource

London & Washington DC, April 2018

About Rensource

- Rensource is a leading distributed energy company in Nigeria headquarted in Lagos
- We provide access to solar based services that bridge the gap between what our clients need and what the grid provides
- We build decentralized grids in clustered environments paired with a service delivery model to optimize the end-user experience

Technology

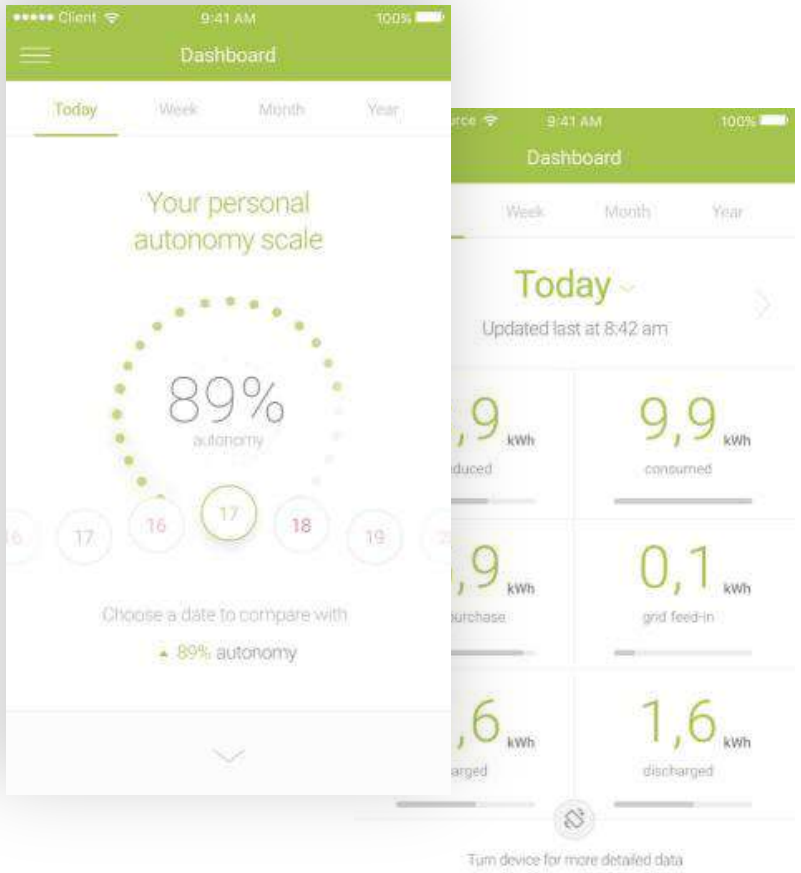
Cutting edge technology made affordable

- The Rensource HS10000 Powerbox combines everything needed for a seamless solar experience:
    - An industrial grade hybrid inverter
    - Solar charge controller
    - Long-lasting lithium based batteries
    - Remote system monitoring and control functionality
- Each system is able to power multiple shops depending on energy usage
- Every shop is fitted with a power meter which allows Rensource to monitor their usage and remotely control and limit their access to a quantum of power

Intuitive User Interface

Cutting edge technology made affordable

- Web and app based interface to
  - Monitor solar/battery energy usage
  - Determine remaining battery capacity
  - Monitor PHCN uptime / downtime
- Easy access to
  - Bill payments
  - Historical energy usage
  - Customer Service / Technical Support
  - Remotely turning appliances on/off (coming soon)



Network Operations Center

- Staffed network operations center (NOC) where engineers and technicians monitor system performance
- Preventative Diagnostics
  - Battery cell level monitoring
  - Real time uptime / downtime notifications
  - Remote fault diagnostics
- Accessible customer service hotline with escalation procedures
- Technicians can be deployed to customers as necessary

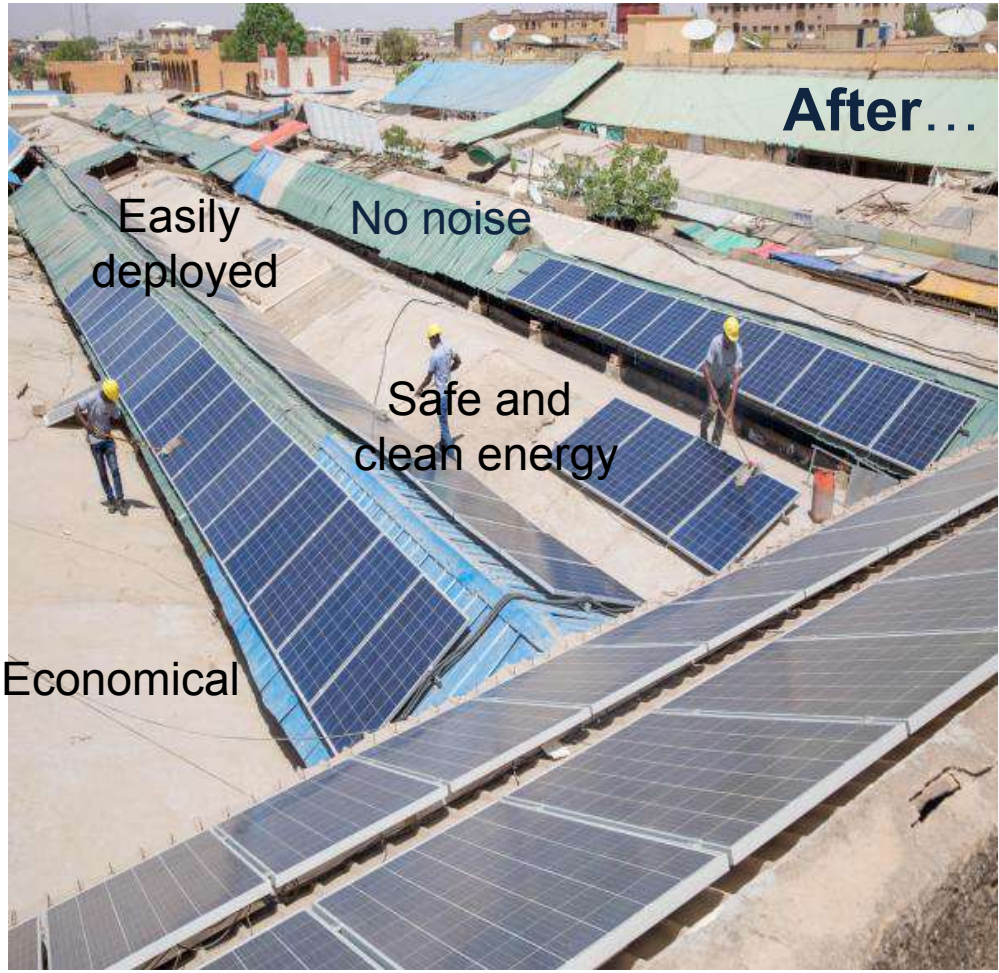
Sabon Gari Market

Electrifying the largest market for commodities and electronics in Northern Nigeria

- Sabon Gari market is located in Kano State in northern Nigeria. Kano is bound by Jigawa and Katsina States to the east and west respectively. Kano is famously regarded as the ‘Centre of Commerce’.
- Kano is the second largest industrial centre after Lagos State in northern Nigeria with textile, tanning, footwear, pharmaceuticals, ceramics, furniture and other industries. Others include soft drinks, food and beverages, dairy products, vegetable oil, animal feeds etc.
- There are approximately 11500 shops in the market and it receives foot traffic of over 1 million people monthly
- There is no grid power supply in the market
- The vast majority of shop owners power their stalls with shared 3kVa - 5kVa generators

Sabon Gari Market

Rensource will successfully replace hundreds of generators with dirty fuel, noise and emissions with solar energy which is clean, quiet and much healthier



Sabon Gari Energy – Work done so far and next steps…

rensource

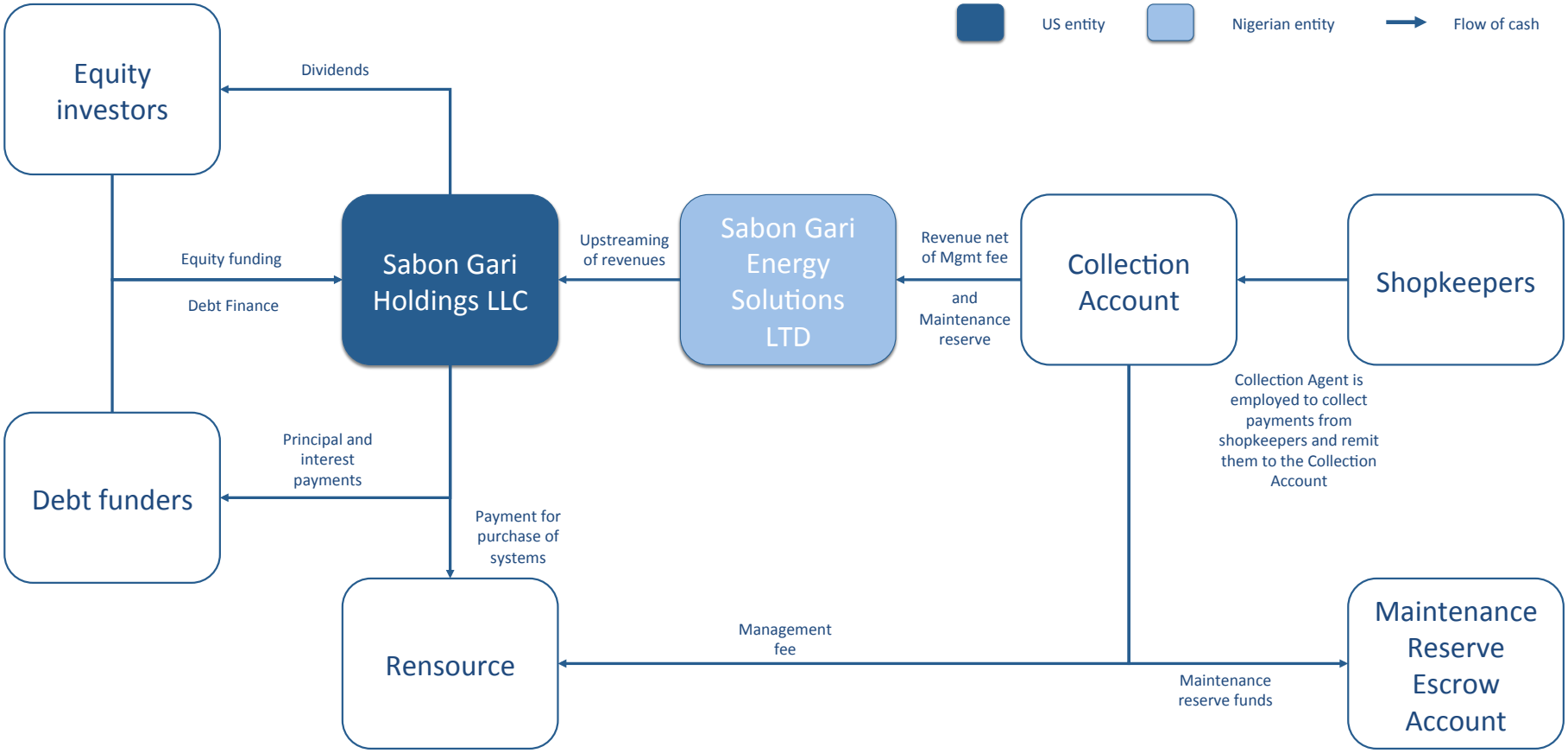
November 2017	November, 2017	December, 2017	January, 2018	January, 2018	January, 2018	February, 2018	March, 2018	Now
1	2	3	4	5	6	7	8	9
REA	***REA***	***Rensource***	***Rensource***	***REA***	***REA, SGESL & Rensource***	***SGESL***	***REA and Kano State Govt***	***SGESL***
Introductory description of Sabon Gari	Provision of detailed audit results	Analysis of data audit results, technical design and commercial proposal	Financial arrangement & Structuring of "Sabon Gari Energy"	Community relations to socialize market stakeholders to agreed solution	Agreement between relevant government agencies, Rensource and SGESL	Pilot deployment to launch initiative in Kano	Commissioning of first pilot deployments with Kano State Government	Roll-out to first 6,000 shops

May, 2018	August, 2018	August, 2018
10	11	12
REA, SGESL	***REA, SGESL***	***SGESL, Rensource***
Commissioning after deployment to first 6,000 shops	Commissioning after deployment to 12,000 shops	Long-term debt arrangement

Rensource 'powered' shops in Sabon Gari Market, Kano

Completed | **Next Steps** | **Responsible Stakeholder**

Transaction structure



Lessons Learnt to Date

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Appendix

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Excerpts from Sabon Gari, Kano

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Rensource 'powered' customer's shop in Sabon Gari Market, Kano

Rensource engineers at work in Sabon Gari Market, Kano

One of Rensource power hub in Sabon Gari Market, Kano

Verbatim feedback from customers

"The system has been functioning very well. I do not queue for fuel or go to the petrol station again except I want to buy fuel in my car. I have given out all my jerry cans"

"Rensource is guaranteed to create a lasting landmark in Nigeria, talk about working without the fear of being cut short soon by electricity companies"

"Payment is very easy and I get my token immediately I make payment"

"I always thought solar was expensive but what Rensource provided is cheap and affordable for me"

Systems Data Dashboard

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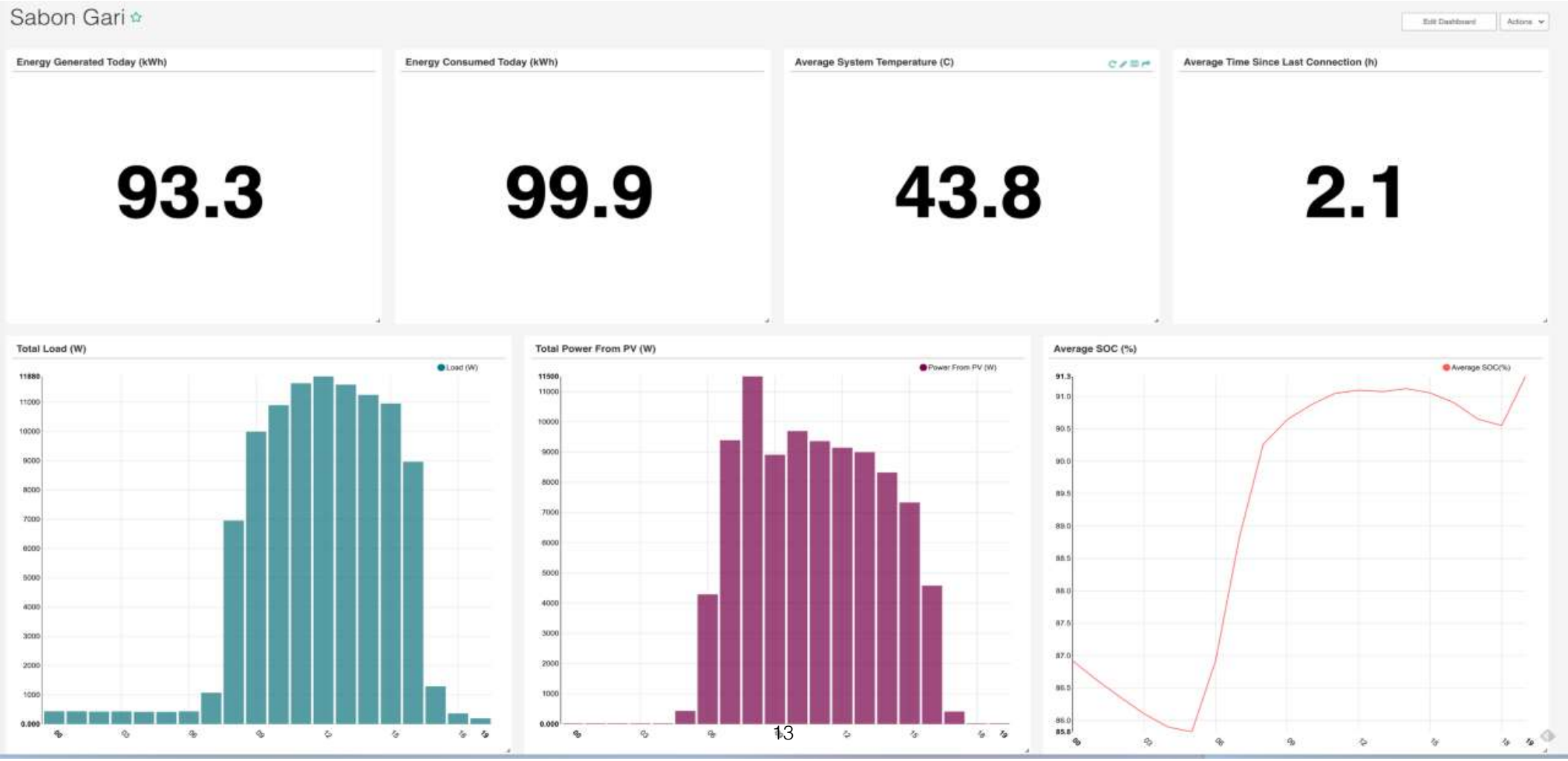

Customer Data Dashboard

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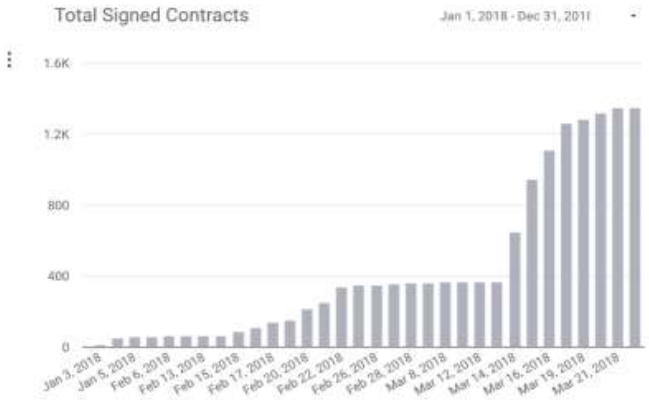
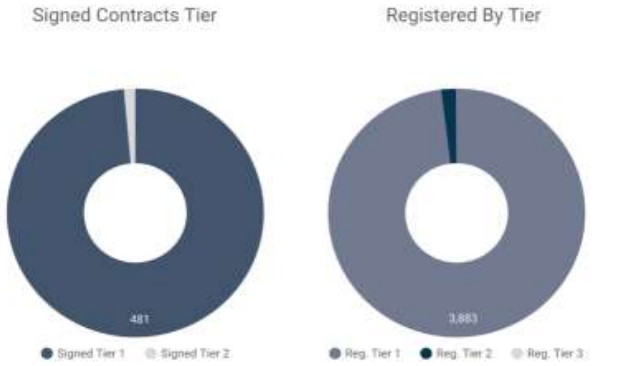
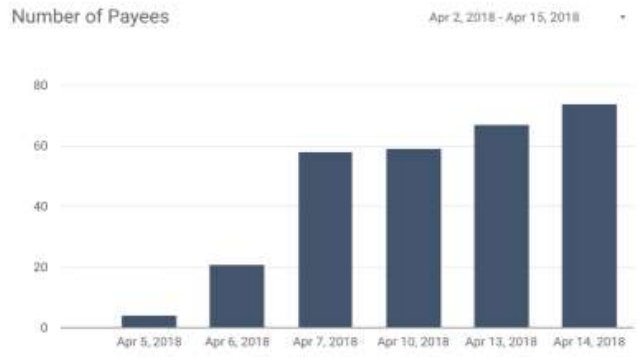
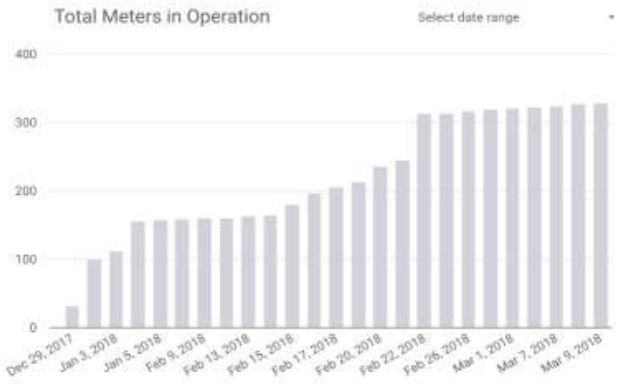






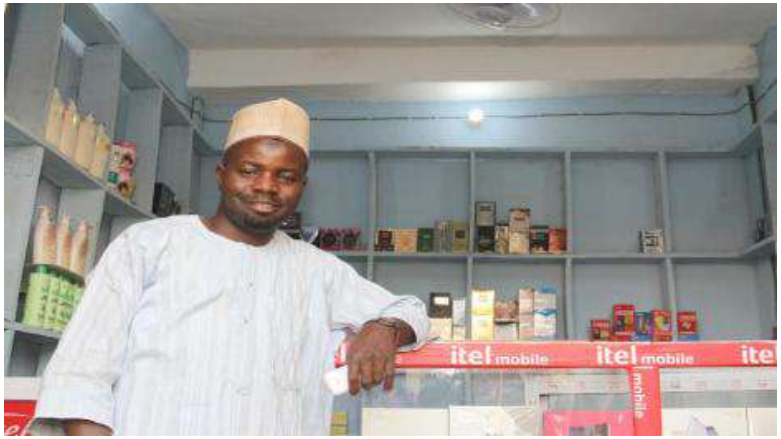


Sabon Gari Energy

rensource

The MD of Rural Electrification Agency commissions the micro utility project

Sabon Gari Energy customer service office



Recently electrified customer in the market

Nigerian Minister of Power, Works & Housing inspects the work done with the Rensource team

End

Closing thoughts

Please share with the group:

1) What are you taking away from the discussion today?
2) What kind of support can you offer to the group for moving forward?

Interested collaborators can contact us at

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