



RURAL ELECTRIFICATION AGENCY

ENERGY = EMPOWERMENT = EFFICIENCY

ENERGIZING ECONOMIES

BASELINE SURVEY
AND
ENERGY AUDIT REPORT

OCTOBER 2017
V1.0



CONTENTS

CONTENTS	II
I. INDEX OF FIGURES	VI
II. INDEX OF TABLES	IX
III. INDEX OF PICTURES	X
IV. GLOSSARY OF TERMS	XI
1. EXECUTIVE SUMMARY	2
1.1. About this Report.....	2
1.2. Project Background.....	4
1.3. Summary of the Surveys	5
1.4. Observations of Interest.....	6
1.5. Summary of Findings - Ariaria International Market	7
1.6. Summary of Findings - Sabon Gari Market	8
1.7. Summary of Findings - Somolu Printing Community	9
1.8. Summary of Findings - Sura Shopping Complex.....	10
2. INTRODUCTION	14
2.1. About REA	14
2.2. Off Grid Electrification Strategy.....	14
2.3. Document Purpose.....	15
2.4. Client Requirements	15
2.5. Report Structure	16
2.5.1. Authorship	16
2.6. Objective of Baseline Study & Energy Audit.....	16
2.7. Identifying Catchment Areas	17
2.8. Energy Solutions	19
2.9. Wider Context – Selected States	20
2.9.1. Wider Context: Abia State.....	20
2.9.2. Wider Context: Kano State	21
2.9.3. Wider Context: Lagos State.....	22
2.10. Immediate Context – Market Communities	24
2.10.1. Ariaria Market Immediate Context: Aba.....	24
2.10.2. Sabon Gari Market Immediate Context: Fagge	24
2.10.3. Somolu Printing Community Immediate Context: Somolu	24
2.10.4. Sura Shopping Complex Immediate Context: Lagos Island	24
2.11. The Sites.....	26

2.11.1.	Ariaria Market.....	27
2.11.2.	Sabon Gari Market.....	28
2.11.3.	Somolu Printing Community	29
2.11.4.	Sura Shopping Complex.....	29
2.12.	Key Stakeholders	30
2.12.1.	Market Traders Association.....	30
2.12.2.	State Governments.....	30
2.12.3.	Federal Government of Nigeria	30
3.	METHODOLOGY	32
3.1.	Theory of Change	32
3.2.	Survey Implementation.....	33
3.3.	Survey Objectives.....	36
3.4.	Fieldwork Recruitment and Training.....	36
3.5.	Information Gathering	37
3.6.	Means of Sampling	39
3.7.	Coverage Areas & Sections	39
3.8.	Data Analysis & Application	39
3.9.	Challenges and Lessons Learned.....	40
4.	ARIARIA INTERNATIONAL MARKET	43
4.1.	Introduction	43
4.2.	Background	46
4.3.	Socioeconomic Analysis	47
4.3.1.	Survey Statistics	47
4.3.2.	Traders	47
4.3.3.	Customers.....	51
4.3.4.	Conclusion	52
4.4.	Energy Audit	54
4.4.1.	Survey Statistics	54
4.4.2.	Load Analysis	55
4.5.	Recommendation.....	58
5.	SABON GARI MARKET	60
5.1.	Introduction	60
5.2.	Background	62
5.3.	Socioeconomic Analysis	63
5.3.1.	Survey Statistics	63
5.3.2.	Traders	65

5.3.3. Customers.....	69
5.4. Conclusion	71
5.5. Energy Audit	72
5.5.1. Survey Statistics	72
5.5.2. Load Analysis.....	73
5.6. Recommendation.....	75
6. SOMOLU PRINTING COMMUNITY	77
6.1. Introduction	77
6.2. Background	80
6.3. Socioeconomic Analysis	81
6.3.1. Survey Statistics	81
6.3.2. Traders	83
6.3.3. Customers.....	88
6.3.4. Residents.....	91
6.4. Conclusion	94
6.5. Energy Audit	95
6.5.1. Survey Statistics	95
6.5.2. Load Analysis.....	96
6.5. Recommendation.....	98
7. SURA SHOPPING COMPLEX.....	100
7.1. Introduction	100
7.2. Background	102
7.3. Socioeconomic Analysis	103
7.3.1. Survey Statistics	103
7.3.2. Traders	103
7.3.3. Customers.....	107
7.4. Conclusion	108
7.5. Energy Audit	110
7.5.1. Survey Statistics	110
7.5.2. Load Analysis.....	111
7.6. Recommendation.....	111
8. CONCLUSIONS & RECOMMENDATIONS.....	115
8.1. Introduction	115
8.2. Ariaria International Market.....	115
8.2.1. Recommendation.....	116
8.3. Sabon Gari Market	117

8.3.1. Recommendation.....	117
8.4. Somolu Printing Community	119
8.4.1. Recommendation.....	119
8.5. Sura Shopping Complex	120
8.5.1. Recommendation.....	120

I. INDEX OF FIGURES

Figure 1: Geographical locations of Ariaria market, Somolu printing community, Sabon Gari market and Sura shopping complex	2
Figure 2: Main Electricity Concerns Captured by Baseline Survey	6
Figure 3: Demographic Comparison of Project States	18
Figure 4: Target Locations	18
Figure 5: Concerns Expressed by Survey Respondents.....	19
Figure 6: Project States	20
Figure 7: Locations of Economic Clusters	26
Figure 8: Theory of Change	32
Figure 9: Baseline Assessment Structure & Process	33
Figure 10: Sample Information with response criteria to be collected by Project Engineers	37
Figure 11: Snapshot of Data Collection Application.....	38
Figure 12: Location of Ariaria Market, Abia State	43
Figure 13: Overview of Ariaria Market Findings.....	44
Figure 14: Structure of Ariaria Market, Abia State	46
Figure 15: Summary of survey statistics from Ariaria Market	47
Figure 16: Gender and Age distribution of traders in Ariaria Market.....	47
Figure 17: Energy source and effects of energy supply from traders in Ariaria Market	49
Figure 18: Assessment of age distribution and behaviour of customers in Ariaria Market	51
Figure 19: Geographical representation of market layout and number of shops per section in Ariaria Market	54
Figure 20: Estimated power requirements in Ariaria Market.....	55
Figure 21: Estimated power requirements by market section in Ariaria Market	56
Figure 22: Estimated power requirements, by shopping in Ariaria Market.....	56
Figure 23: Alternative sources of energy used in Ariaria Market.....	57
Figure 24: Representation of distribution network for Ariaria Market.....	58
Figure 25: Location of Sabon Gari Market	60
Figure 26: Overview of Sabon Gari Market findings	61
Figure 27: Structure of Sabon Gari Market, Kano State.....	62
Figure 28: Survey statistics from Sabon Gari Market	63

Figure 29: Gender and age distribution of traders in Sabon Gari Market.....	65
Figure 30: Energy source and effects of energy supply for traders in Sabon Gari Market	67
Figure 31: Assessment of age and impact of public lighting on customers in Sabon Gari Market	69
Figure 32: Geographical representation of layout in Sabon Gari Market	72
Figure 33: Distribution of building types in Sabon Gari Market	72
Figure 34: Estimated power requirements in Sabon Gari Market	73
Figure 35: Total estimated power requirement by sections in Sabon Gari Market.....	74
Figure 36: Alternative sources of energy used in Sabon Gari Market	74
Figure 37: Representation of distribution network for Sabon Gari Market.....	75
Figure 38: Location of Somolu Printing Community	77
Figure 39: Overview of Somolu Printing Community findings.....	78
Figure 40: Structure of Somolu Printing Community.....	80
Figure 41: Summary of survey statistics from Somolu Printing Community	81
Figure 42: Gender and age distribution of traders in Somolu Printing Community	83
Figure 43: Energy source and effects of energy supply for traders in Somolu Printing Community	86
Figure 44: Assessment of age and behaviour of customers in Somolu Printing Community	88
Figure 45: Use of alternative energy sources by residents in Somolu Printing Community	91
Figure 46: Source of noise for residents in Somolu Printing Community	91
Figure 47: Assessment of relocation possibilities amongst residents in Somolu Printing Community	92
Figure 48: Geographical representation of market layout in Somolu Printing Community	95
Figure 49: Number of shops by zone in Somolu Printing Community.....	96
Figure 50: Estimated power requirement in Somolu Printing Community	96
Figure 51: Total estimated power requirement by zone in Somolu Printing Community	97
Figure 52: Alternative sources of energy used in Somolu Printing Community	97
Figure 53: Representation of distribution network for Somolu Printing Community	98
Figure 54: Location of Sura Shopping Complex	100
Figure 55: Overview of Sura Shopping Complex findings	101

Figure 56: Structure of Sura Shopping Complex.....	102
Figure 57: Summary of survey statistics from Sura Shopping Complex.....	103
Figure 58: Gender and age distribution of traders in Sura Shopping Complex.....	103
Figure 59: Energy source and effects of energy supply for traders in Sura Shopping Complex	105
Figure 60: Assessment of age and behaviour of customers in Sura Shopping Complex	107
Figure 61: Geographical representation of market layout and number of shops enumerated in Sura Shopping Complex.....	110
Figure 62: Estimated power requirements in Sura Shopping Complex	111
Figure 63: Alternative sources of energy used in Sura Shopping Complex	111
Figure 64: Representation of distribution network in Sura Shopping Complex	112

II. INDEX OF TABLES

Table 1: Energy Requirements and recommended Power Solutions for each Economic Cluster	5
Table 2: Major themes assessed in baseline assessments and energy audits.....	35
Table 3: Job description of evaluation team	36
Table 4: Gender distribution of survey participants by business type in Ariaria Market	48
Table 5: Traders' safety concerns by gender in Ariaria Market	52
Table 6: Proposed System Overview for Ariaria Market.....	58
Table 7: Gender distribution of survey participants by business type in Sabon Gari Market	65
Table 8: Most common times of day for each purchase type in Sabon Gari Market .	69
Table 9: Customer safety concerns by gender in Sabon Gari Market.....	71
Table 10: Proposed system overview for Sabon Gari Market	75
Table 11: Gender distribution of survey participants by business type in Somolu Printing Community	84
Table 12: Most common times of day for each purchase type by customers in Somolu Printing Community	89
Table 13: Safety concerns by gender in Somolu Printing Community	92
Table 14: Proposed system overview for Somolu Printing Community	98
Table 15: Gender distribution of survey participants by business type in Sura Shopping Complex	104
Table 16: Proposed system overview for Sura Shopping Complex	112
Table 17: Recommended systems for Ariaria Market	116
Table 18: Recommended system for Sabon Gari Market	118
Table 19: Recommended system for Somolu Printing Community	119
Table 20: Recommended system for Sura Shopping Complex	120

III. INDEX OF PICTURES

Picture 1: Ariaria Market, Abia State.....	XII
Picture 2: Sabon Gari Market, Kano State	3
Picture 3: Market Stalls, Ariaria Market, Abia State.....	12
Picture 4: Somolu, Lagos State at Night.....	23
Picture 5: Field Engineer during Enumeration Exercise	34
Picture 6: Field Engineer Conducting Interviews	41
Picture 7: Activity in Ariaria Market, Abia State	45
Picture 8: Artisan at work, Ariaria Market, Abia State	53
Picture 9: Stall in Sabon Gari Market, Kano State	64
Picture 10: Generators used to Power Shops in Sabon Gari Market, Kano State	68
Picture 11: Men at Work. Somolu Printing Community, Lagos State	79
Picture 12: Printing Press. Somolu Printing Community, Lagos State	82
Picture 13: Somolu Printing Community, Lagos State	85
Picture 14: Generator powering shops in Somolu Printing Community, Lagos State...	87
Picture 15: Market Activity in Somolu Printing Community, Lagos State	90
Picture 16: Oil Spills around Generator. Somolu Printing Community, Lagos State	93
Picture 17: Entrance to Sura Shopping Complex, Lagos State	106
Picture 18: Sura Shopping Complex, Lagos State.....	109
Picture 19: Field Engineers. Sabon Gari Market, Kano State.....	114

IV. GLOSSARY OF TERMS

Acronym	Definition
AC	Alternating Current
AMATA	Sabon Gari Market Amalgamated Traders Welfare Association
APP	Application
ASSPPON	Association of Professional Printers of Nigeria
CNG	Compressed Natural Gas
DC	Direct Current
DisCo	Distribution Company
ERGP	Economic and Recovery Growth Plan
FCT	Federal Capital Territory
FGN	Federal Government of Nigeria
GDP	Gross Domestic Product
GPS	Global Positioning System
IPP	Independent Power Plant
KM	Kilometre
KVA	Kilo-Volt-Ampere
KW	Kilowatt
LGA	Local Government Area
LNG	Liquefied Natural Gas
FMoPWH	Federal Ministry of Power, Works and Housing
MMscf	Million Standard Cubic Feet
MSME	Micro, Small, and Medium Enterprises
MW	Megawatt
NERC	Nigerian Electricity Regulatory Commission
PSRP	Power Sector Recovery Programme
REA	Rural Electrification Agency
RESIP	Rural Electrification Strategy and Implementation Plan
RoW	Right of Way
SHS	Solar Home System
SME	Small and Medium Enterprises
Sq.Km	Square Kilometre



Picture 1: Ariaria Market, Abia State

EXECUTIVE SUMMARY



RURAL ELECTRIFICATION AGENCY

1. EXECUTIVE SUMMARY

1.1. About this Report

This report presents the findings of the baseline survey and energy audits carried out across four Nigerian economic clusters, namely; Ariaria Market in Abia State, Sabon Gari Market in Kano State, Somolu Printing Community, and Sura Shopping Complex in Lagos State. The report highlights two key activities integral to the success and sustainability of the electrification projects; **baseline surveys** and **energy audits**. The baseline surveys are intended to establish reference points for the measurement of impact of the direct energy interventions on the relevant beneficiaries and stakeholders, while the energy audits are essential to determine the energy demand for each market in order to provide a feasible power solution for each economic cluster.

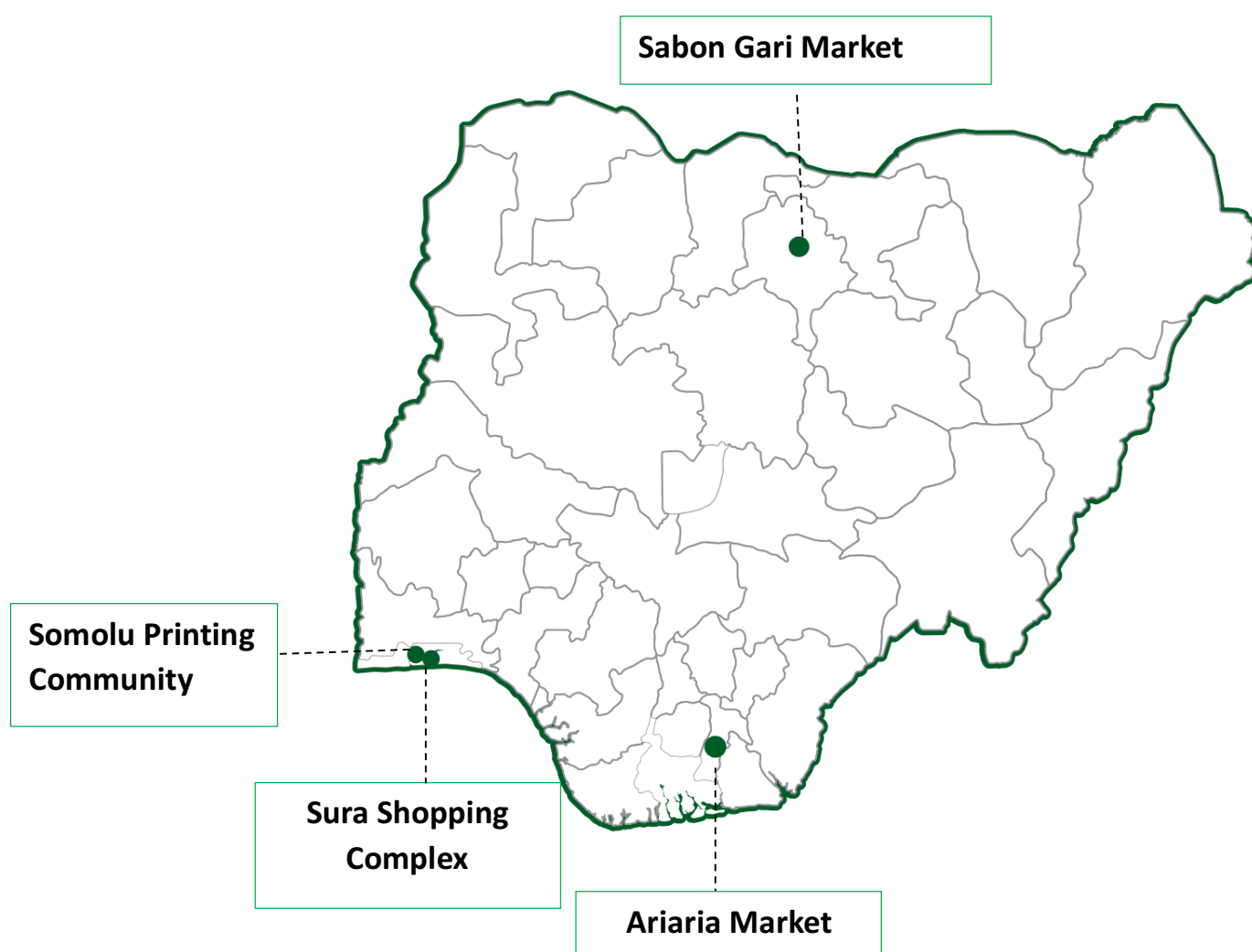


Figure 1: Geographical locations of Ariaria market, Somolu printing community, Sabon Gari market and Sura shopping complex



Picture 2: Sabon Gari Market, Kano State

1.2. Project Background

The Rural Electrification Agency (REA) has developed an **Off-Grid Electrification Strategy** with the primary objective of increasing electricity access to rural and underserved clusters.

Part of this strategy is to fast track development initiatives towards achieving the overall objective of The Federal Government of Nigeria's Economic and Recovery Growth Plan (ERGP) as well as the Power Sector Recovery Programme (PSRP).

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 objective of the **Off-Grid Electrification Strategy** is designed to complement the national grid supply by developing a decentralised approach to power generation, distribution and metering to underserved and unserved areas that are:

- Economically Viable
- Demand-driven
- Market-oriented
- Private sector focused

There are five initiatives that form the Off-Grid Strategy. These include:

1. Solar Home Systems (SHS)
2. Mini Grids
3. Energizing Education
4. Energizing Economies
5. Nigerian Energy Database

1.3. Summary of the Surveys

The surveys were carried out in September 2017 and involved interviewers with 3 broad categories of respondents; Traders, Customers and Residents, thus enabling a rounded view of current performance from key actors within these categories. Overall, the intervention of alternative energy is set to provide sustainable energy to over **50,900 shops with a customer base of over 2 million Nigerians.**

The socioeconomic surveys used a random sampling across all cluster sections to assess the current state of affairs in the markets from a variety of users of the space. This approach required a further survey at completion in order to get a better picture of the impact of the changes made at the target sites on the environment and economic outcomes. It is of critical importance that subsequent surveys assess existing economic performance data as illustrated in profit and loss statements for a credible quantitative basis on economic outcomes.

Census surveys were carried out for the Energy Audits, as all shops within the project scope were enumerated. The enumeration was carried out in this manner in order to accurately capture generation, consumption and energy demand data. The analysis of captured data allows for reliable recommendations for the most suitable energy solution for each of the economic clusters.

The recommended energy solution for each economic cluster is as follows:

Name	Energy Requirement	Recommended Solution
<i>Ariaria Market</i>	2.06MW – current demand 6.67MW – estimated total demand for entire market	5MW CNG Plant & 2MW Backup Generator – Phase 1
<i>Sabon Gari Market</i>	1.38MW – current demand 3.29MW – estimated total demand for entire market	High Capacity, Small and Medium Solar Home systems
<i>Somolu Printing Community</i>	4.73MW – Printers located in zone 2 and 4 32MW – current demand for zones 1 to 6	5MW Natural Gas - Phase 1
<i>Sura Shopping Complex</i>	0.83MW – current demand 1.5MW – estimated total demand for entire complex	Connection to existing Power Plant

Table 1: Energy Requirements and recommended Power Solutions for each Economic Cluster

1.4. Observations of Interest

Traders in the markets surveyed strongly expressed a willingness to pay for reliable energy due to the high cost of self-generation. Other observations included concerns centred on the negative health impacts caused by noise and air pollution resulting from self-generation. Traders however expressed concerns that reliable supply might increase the overall rent of their stores.

Customers strongly expressed interest in spending more time in the market, participating in night markets if the market is properly lighted.

Residents of the communities around the markets raised concerns about the noise and air pollution related to self-generation, particularly in Somolu Printing Community

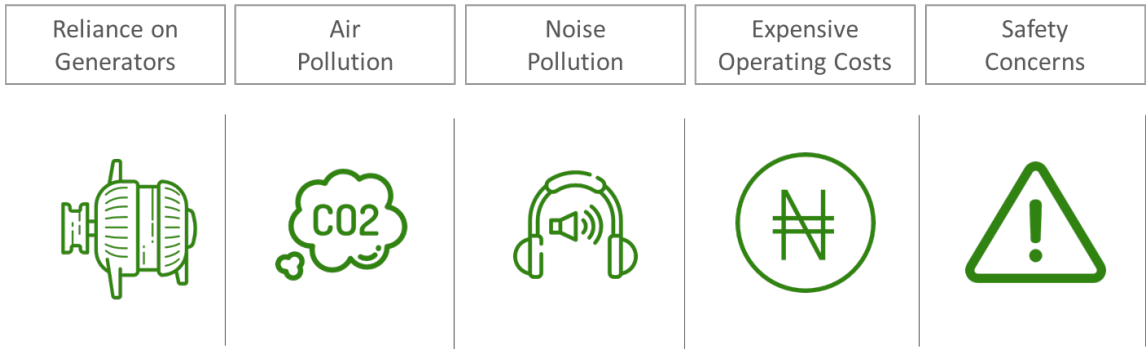


Figure 2: Main Electricity Concerns Captured by Baseline Survey

The **total energy demand** for all 50,900 shops was 36.27MW, with Somolu Printing Community having the highest demand of 32MW and Sura Shopping Complex having the lowest demand with 0.83MW.

1.5. Summary of Findings - Ariaria International Market



59% of traders would expand their shops given reliable power supply



80% Traders Use alternative to DISCO power



66% of respondents believe street lighting will be useful



HARASSMENT IS THE MAIN SAFETY CONCERN IN THE MARKET



84% enumeration rate



2.06MW CURRENT Estimated Load requirement



31,993 Shops located within the market



0.96MW Estimated Load requirement **LIGHTING**

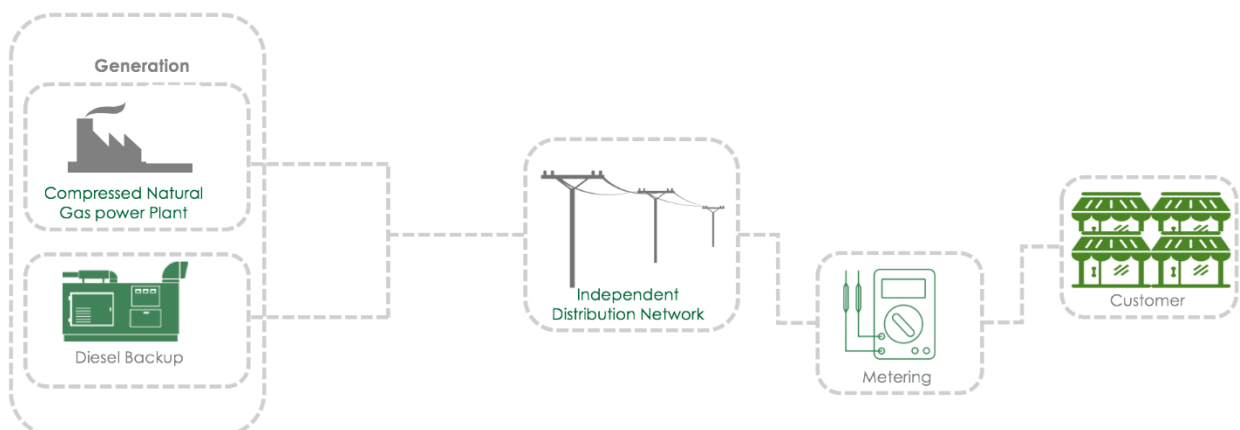


0.86MW Estimated Load requirement **COOLING**

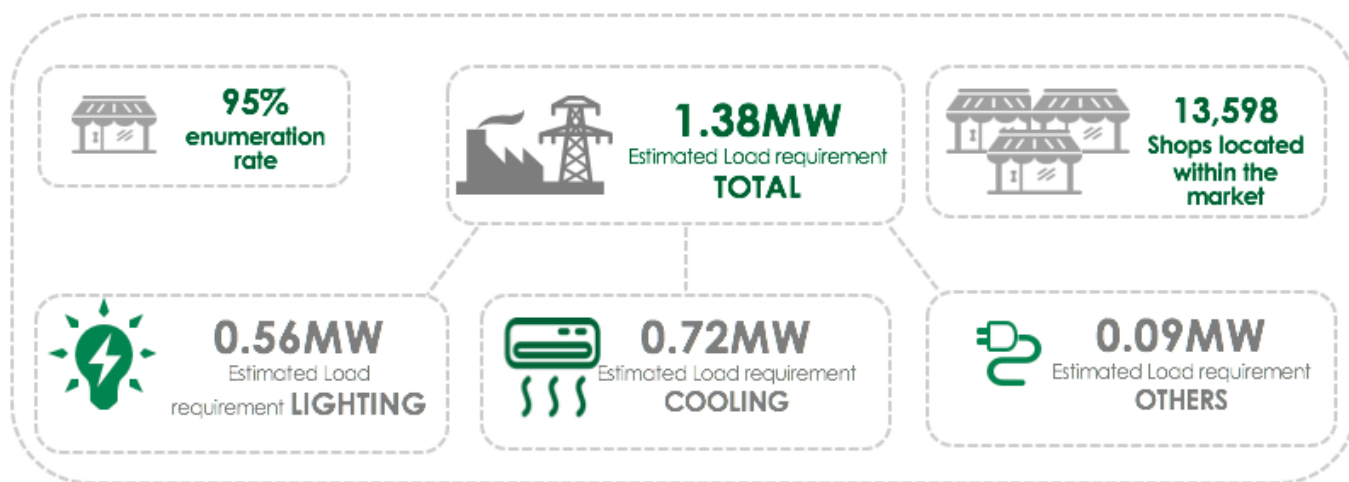
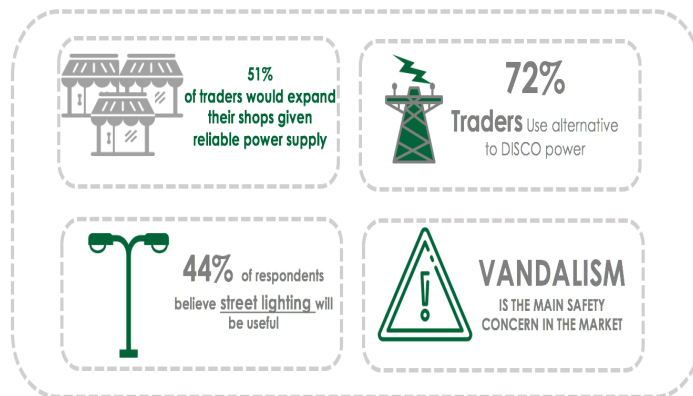


0.25MW Estimated Load requirement **OTHER APPLIANCES**

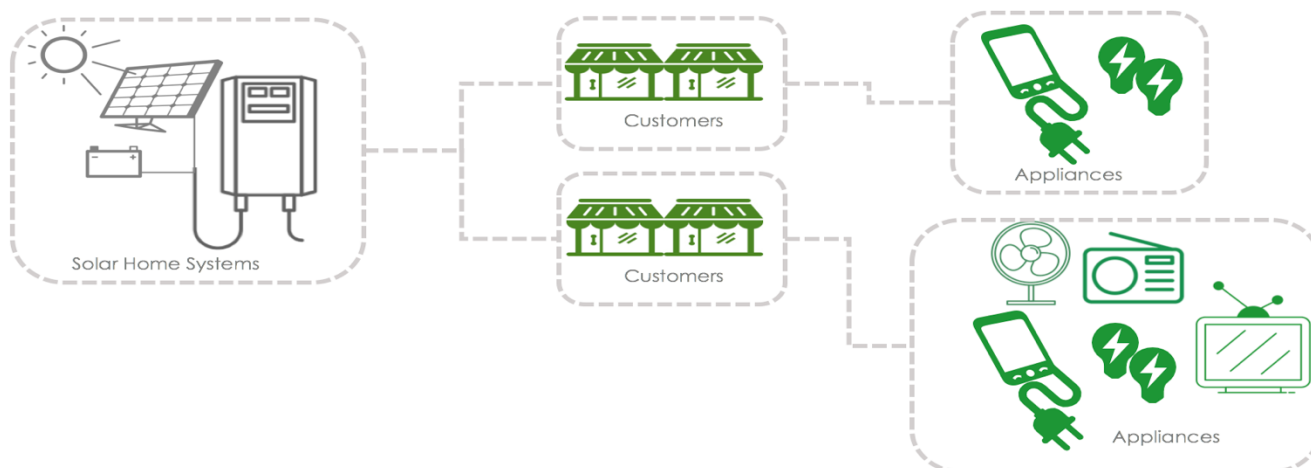
PROPOSED SOLUTION



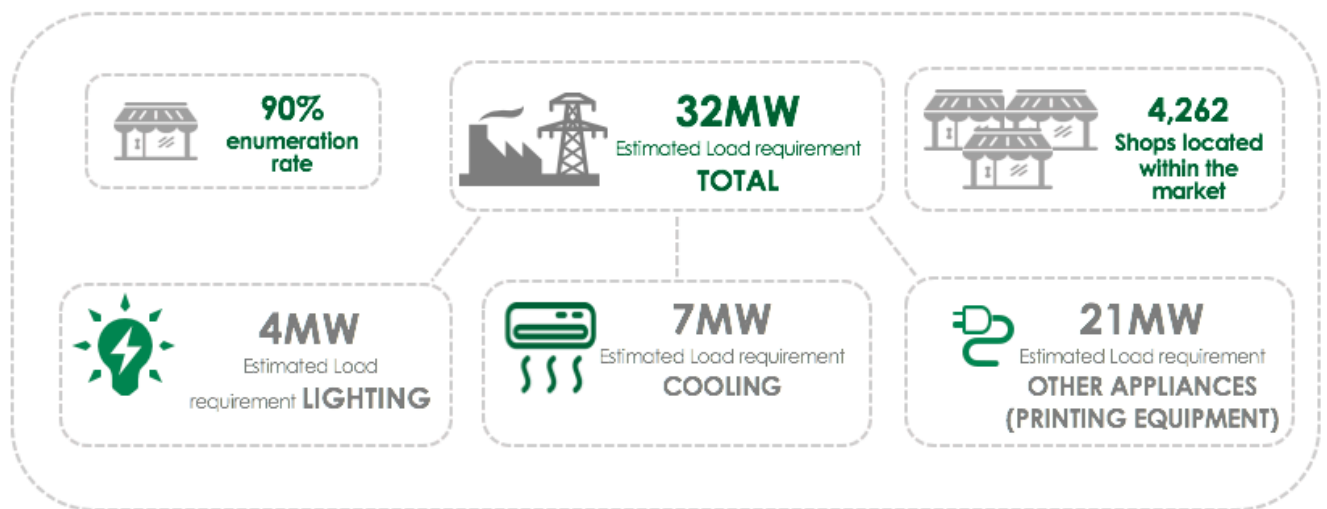
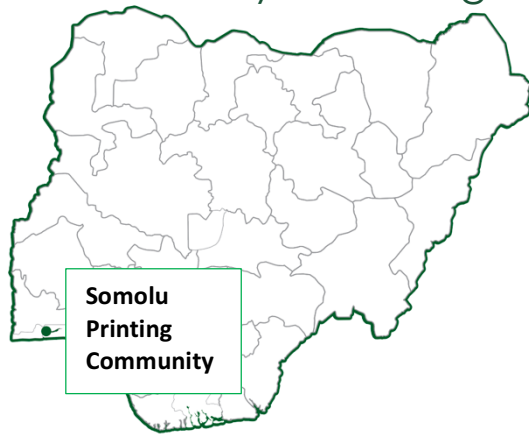
1.6. Summary of Findings - Sabon Gari Market



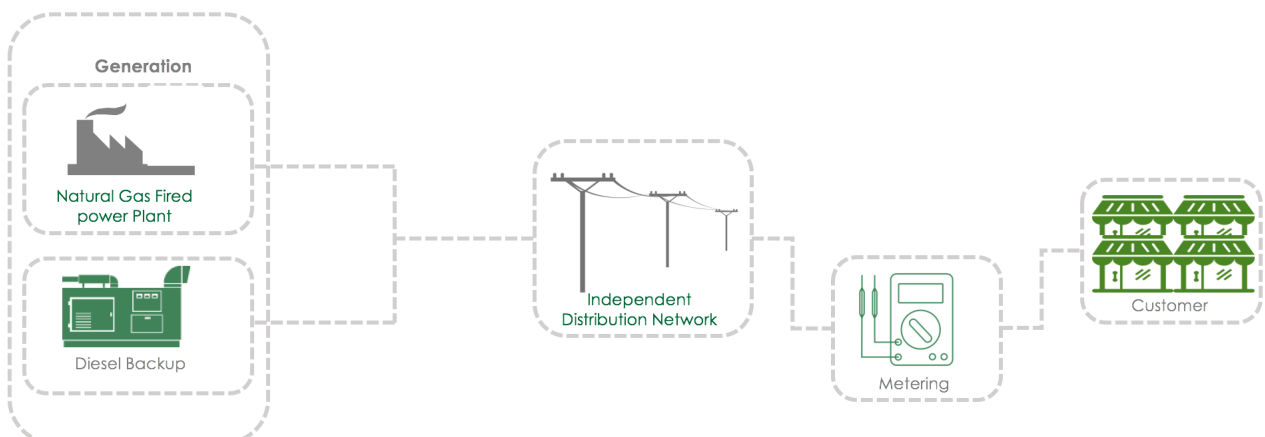
PROPOSED SOLUTION



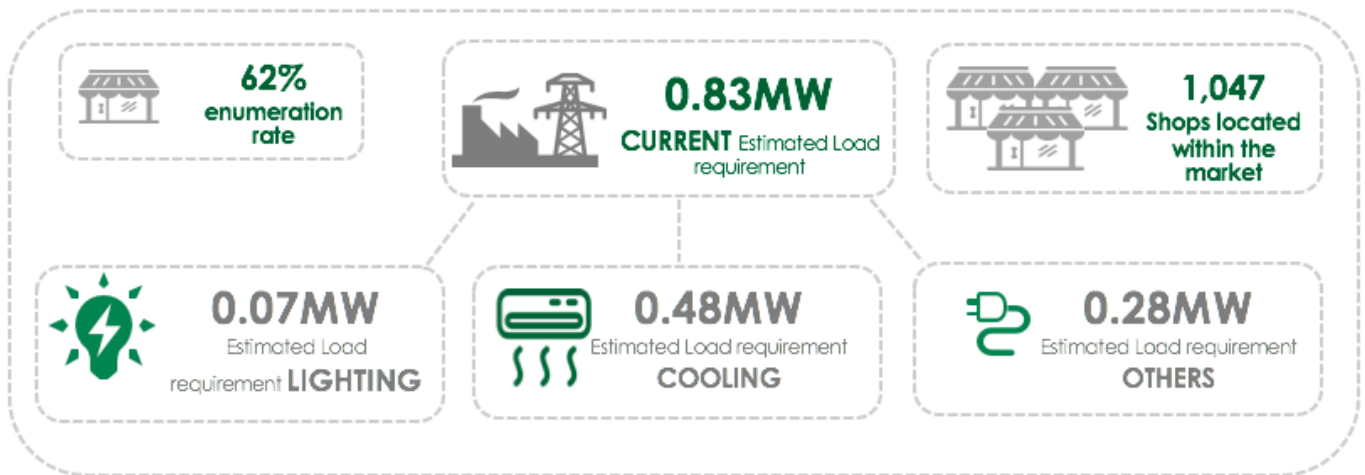
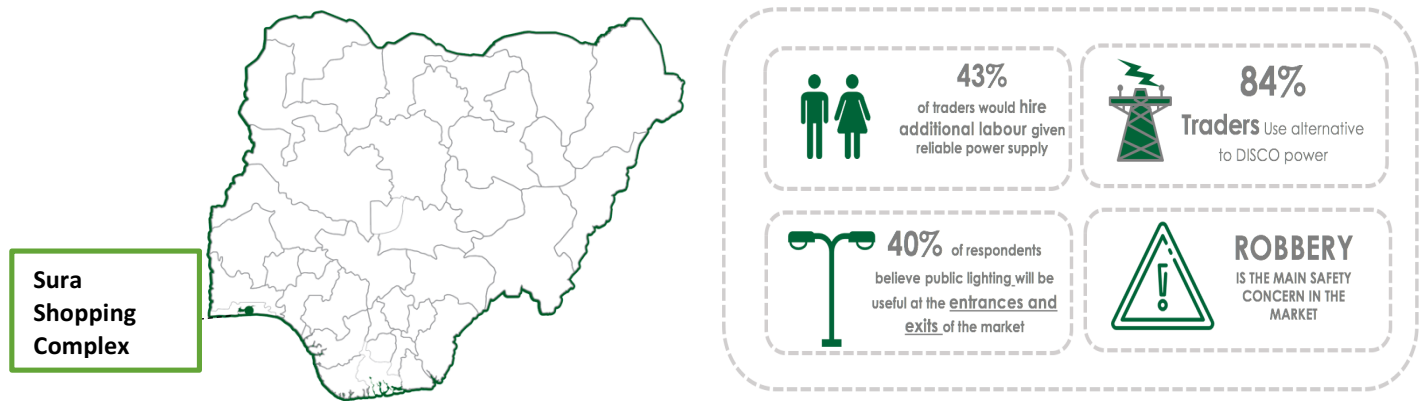
1.7. Summary of Findings - Somolu Printing Community



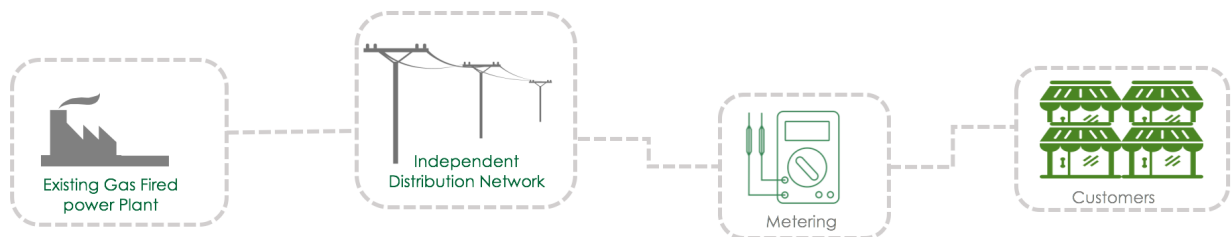
PROPOSED SOLUTION



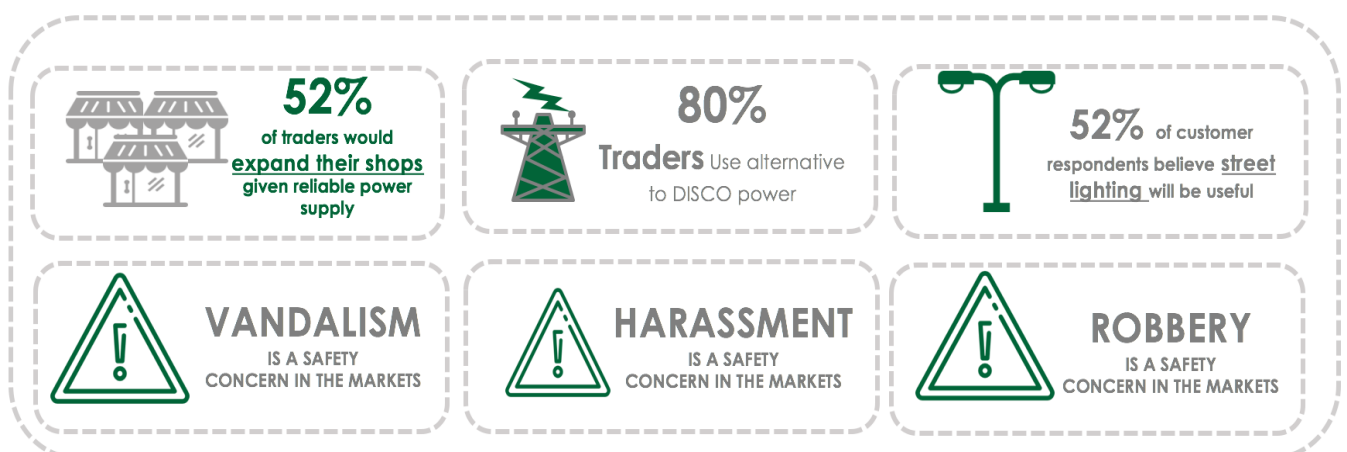
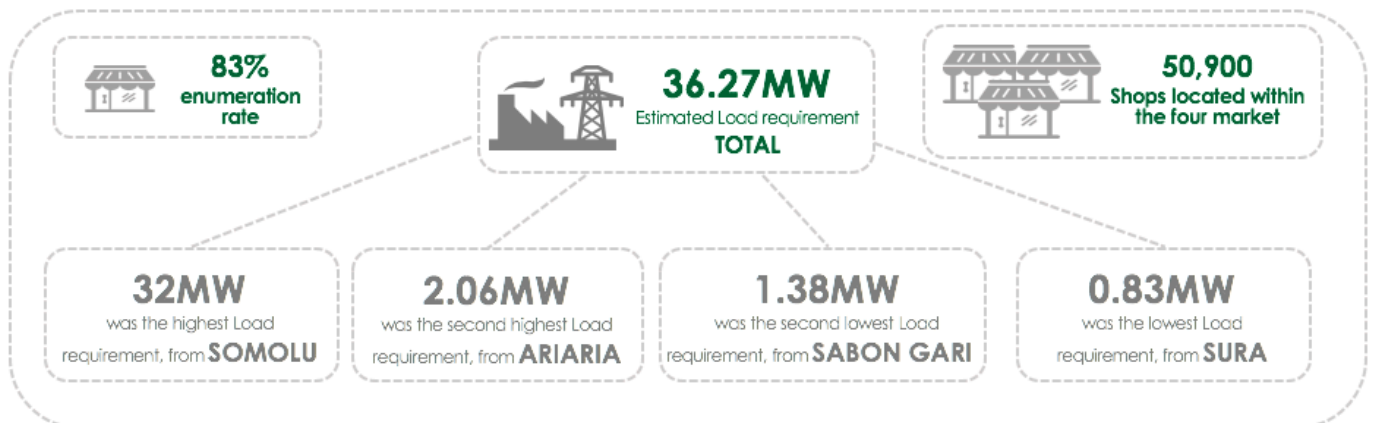
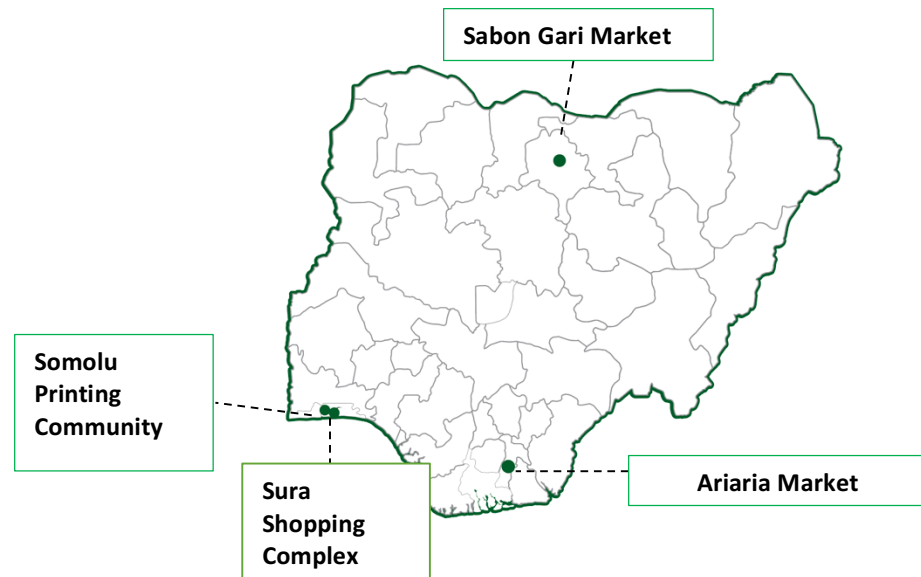
1.8. Summary of Findings - Sura Shopping Complex



PROPOSED SOLUTION



1.9. Summary of Findings – All Markets





Picture 3: Market Stalls, Ariaria Market, Abia State

INTRODUCTION



RURAL ELECTRIFICATION AGENCY

2. INTRODUCTION

2.1. About REA

The Rural Electrification Agency (REA), is a Federal Government agency under the Ministry of Power, Works and Housing. The Agency has the primary objective of increasing electricity access to rural and underserved communities.

2.2. Off Grid Electrification Strategy

The objective of the **Off-Grid Electrification Strategy** is to compliment the national grid supply by developing a decentralized approach for power generation, distribution and metering to underserved and unserved areas.

The Rural Electrification Agency (REA) aims to promote decentralized power generation, distribution and metering that is demand-driven, encourages economic viability, market-oriented and private sector focused.

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).

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.**

This **Off-Grid Electrification Strategy** focuses on five main areas:

Solar Home Systems

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

Mini-Grids

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

Energizing Education

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

Energizing Economies

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

Energy Database

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

2.3. Document Purpose

The purpose of this document is to present the findings of the Baseline Studies and Energy Audits conducted in 4 economic clusters across 3 States, namely: **Ariaria Market (Abia State), Sabon Gari market (Kano State), Somolu Printing Community (Lagos State), and Sura Shopping Complex (Lagos State)**. This is an initial exercise aimed at effectively measuring data prior to sustainable power interventions as well as measuring energy requirements at these sites under the **Energizing Economies** initiative. This report provides an overview of the study area and wider context, as well as a detailed account of the research and survey findings of all sites.

2.4. Client Requirements

This baseline survey has been developed to support future benefits and impact assessments of the capital investment made by the sponsoring organizations in the improvement of power supply to the identified catchment areas.

The report's key purpose therefore is to establish a qualitative and quantitative baseline, for future reference by the joint sponsoring organizations.

The Rural Electrification Agency (REA) has developed a set of strategic priorities that guide the development of off-grid electrification projects. These include:

- **Encouraging social and economic inclusion.**
- **Stimulating economic growth and increased business profitability.**
- **Utilizing energy and material resources efficiently.**
- **Improving safety and security.**
- **Enhancing the night time economy.**

As a consequence of the Energizing Economies initiative, the REA is keen to assess the impact of power supply improvements on the social and economic life of selected economic clusters. These impacts are measured and objectives achieved by increasing trade volumes, allowing greater participation of vulnerable and less active groups, and most notably, extending the operating hours and productivity at the markets.

2.5. Report Structure

This report is organized in 8 sections, with the first 2 sections introducing the project and explaining the survey in detail. Section 1 summarises the report providing a synopsis of the overall content of the report including findings from the baseline studies and energy audits conducted. Section 2 sets out the background of the survey and energy audits, outlining objectives, off-grid electrification strategy, and wider context of the project areas. Section 3 details the methodology, describing the key tools and techniques employed, as well as survey targets and delivery. Sections 4 – 8 detail the markets including main findings and analysis. A summary and critical overview of the baseline survey is provided in the conclusion, while the energy audits are concluded by Recommendations for appropriate energy solution.

2.5.1. Authorship

This report has been prepared by the Rural Electrification Agency (REA).

2.6. Objective of Baseline Study & Energy Audit

As part of its aim to understand the widespread benefits of the initial phase of the programme on primary stakeholder, REA has commissioned a study to achieve the following objectives:

- Establish qualitative and quantitative baseline data reflecting economic activity and the experience of traders, customers and residents of the area.
- Ascertain the current impact of problematic power supply on economic clusters.
- Understand the behaviour and concerns of those affected by little or no power supply.
- Provide a baseline to measure the success and impact of the Energizing Economies project.
- Provide insights into potential ways in which the progress and benefit of the alternative energy intervention solutions may be monitored and measured in its impact.
- Identify potential issues that the alternative energy intervention will need to tackle in order to achieve its desired purpose.
- Determine the actual energy demand of each customer.
- Determine the generation, distribution and metering required to provide sustainable power to all the economic clusters.

2.7. Identifying Catchment Areas

Key indicators used for the selection of the catchment areas include:

- **Population:** The number of people within these communities and other specific demographics were considered in selecting the catchment areas.
- **Trade Impact:** Using specific trade metrics, i.e., export potential, internally generated revenue amongst others; these markets have been found to fulfil all the trade metrics.
- **Local Content Potential:** In line with the “**Made-in Nigeria**” Framework, these catchment areas manufacture or retail Nigerian made finished goods.
- **Employment Sustainability:** MSMEs are fast becoming employment growth drivers as they employ both skilled and unskilled labour.
- **Access to sustainable fuel:** These locations meet the criteria for availability of gas pipelines or are within reasonable proximity to virtual pipelines.
- **Willingness to pay:** Feasibility studies conducted in these communities have shown that business owners spend a lot monthly on power. The roll out of off - grid solutions will translate to significant cost savings on electricity supply.

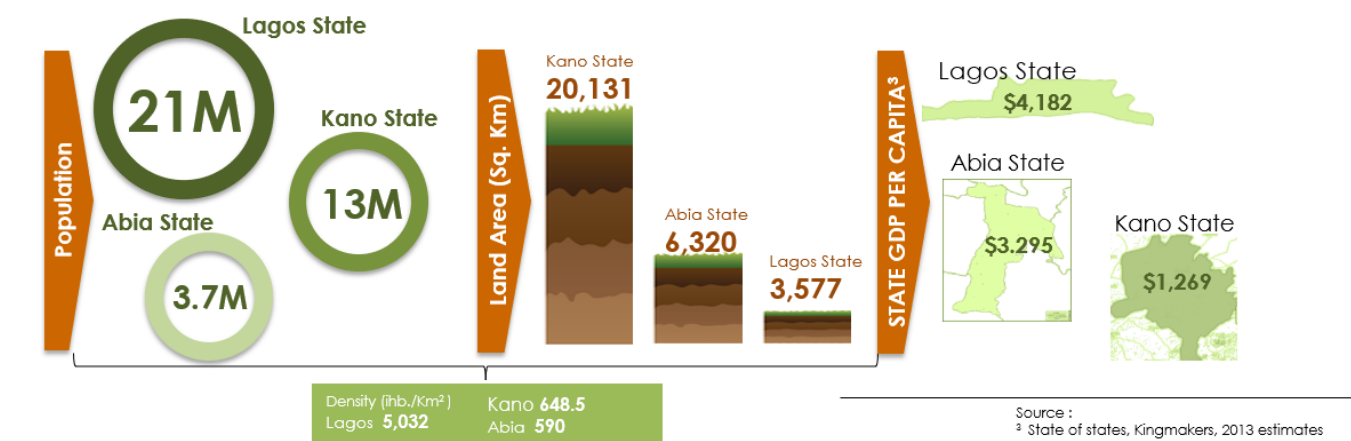


Figure 3: Demographic Comparison of Project States

Using these indicators, REA has identified and selected catchment areas in the North West, South-Eastern and South-Western parts of Nigeria for immediate intervention. These catchment areas include:

- Somolu Printing Community, Lagos State
- Ariaria Market Community, Abia State
- Muhammadu Abubakar Rimi (Sabon Gari) Market, Kano State
- Sura Shopping Complex, Lagos State



Figure 4: Target Locations

These economic clusters have been selected primarily for their high level of commercial activities and propensity to increase local content as it relates to “**Made in Nigeria**” goods, as well as heavy reliance on electricity for running their day-to-day businesses.

The agency has carried out extensive audit of the power requirements for 4 markets across 3 States (Abia State, Kano State, Lagos State) in Nigeria. The audit covering a total of 50,900 shops across these markets was driven by the commitment of the agency and the Federal Government of Nigeria to Promote efficient, clean and sustainable power to catchment areas that have high growth impact on the economy.

2.8. Energy Solutions

The purpose of the baseline intervention is to assess the ideal energy intervention for each site. Based on the availability of fuel (e.g. gas), solar irradiance, availability of distribution infrastructure, the energy solution will uniquely address the specific needs of each catchment areas. Each solution will be independent from the national grid, and will provide energy to the target community only.

Proposed deployment will be as follows:

- Ariaria Market Community: 5MW Gas fired power plant running on Compressed Natural Gas (CNG).
- Somolu Printing Community in Lagos State: 5MW Natural Gas fired power plant.
- Sabon Gari Market in Kano State: 1MW decentralised solar solution using high capacity solar home systems.
- Sura Shopping Complex: connection to power supply from existing power plant located within Lagos Island.

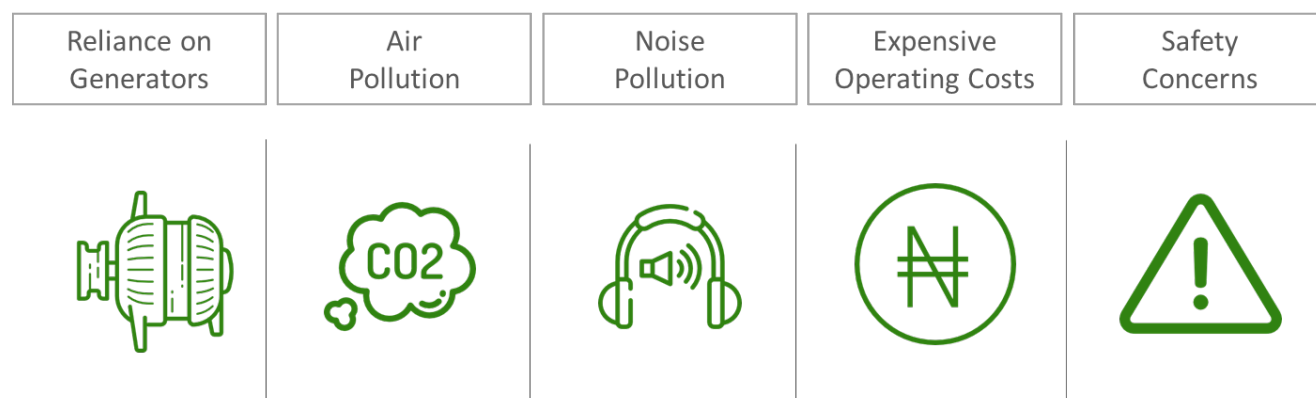


Figure 5: Concerns Expressed by Survey Respondents

2.9. Wider Context – Selected States

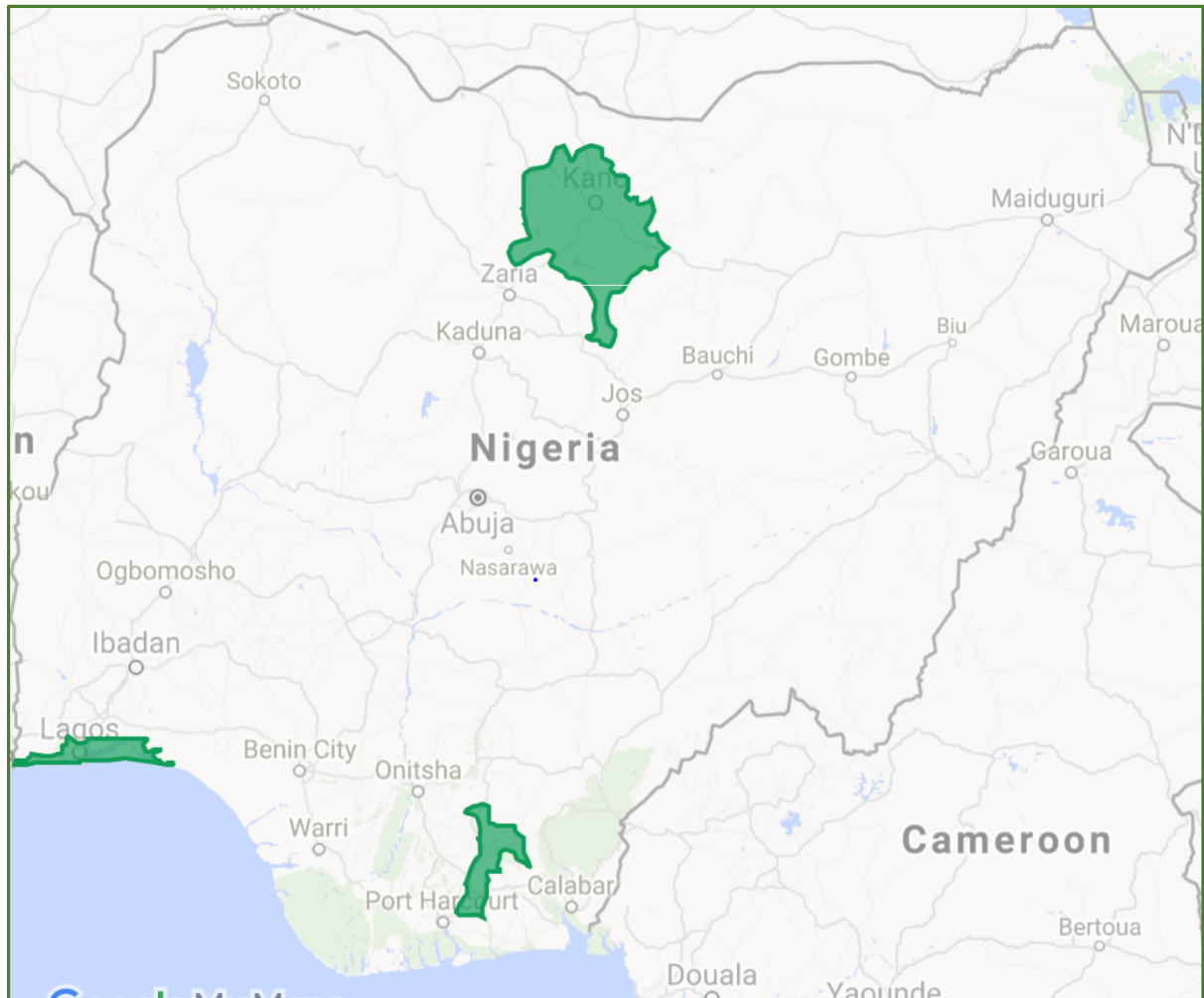


Figure 6: Project States

2.9.1. Wider Context: Abia State

Geographical context: Abia

Abia State, which occupies about 6,320 square kilometres, is bounded on the north and northeast by the states of Anambra, Enugu, and Ebonyi. To the west of Abia is Imo State, to the east and southeast are Cross River State and Akwa Ibom State, and to the south is Rivers State. The southern part of the State lies within the riverine part of Nigeria. It is low-lying tropical rain forest with some oil-palm brush. The southern portion gets heavy rainfall of about 2,400 millimetres (94 in) per year especially

intense between the months of April through October. The rest of the State is moderately high plain and wooded savannah.

Urban context: Abia

Abia State has a population of about 3,727,347¹. Out of this figure, 1,900,947 are males and 1,826,400 are females. Abia State has two main urban centres, namely: Umuahia and Aba. Umuahia, the state capital, has become the administrative, educational and cultural centre of the state. In addition, the city is located at the centre of an extensive agricultural region which covers most of the central part of Abia State. It is also strategically located along a well-established north-south trading and transportation route.

Administrative Structure: Abia

The State Government is led by a democratically-elected Governor who works closely with an elected State House Assembly.

The capital city is Umuahia. There are Seventeen (17) local government areas (LGAs). The executive is made up of democratically elected officials and consists of the governor, his deputy, and appointed commissioners.

Economy: Abia

Crude oil and gas production is a prominent activity, as it contributes to 39% of the GDP. Representing 27% of the GDP, agriculture, which employs 70% of the state workforce, is the second economic sector of Abia. With its adequate seasonal rainfall, Abia has much arable land that produces yams, maize, potatoes, rice, cashews, plantains and cassava. Abia also has large crude oil deposits. The manufacturing sector only accounts for 2% of the GDP.

2.9.2. Wider Context: Kano State

Geographical context: Kano

Kano lies on 12°00'N 8°31'E coordinate in North West, Nigeria. It is situated in the Sahelian geographic region, south of the Sahara. The total area of Metropolitan Kano is now 499 square kilometres (193 square miles).

Urban context: Kano

With an estimated population of about 13 million, Kano is Nigeria's second most

populous state with a density of 37,000/sq. meters. The energy demand is very high with inadequate supply that has affected the economy as elsewhere in the country. In March 26, 2016, the Sabon Gari market which is one of the market covered by this report had a fire incident due to poorly planned electrical infrastructure.

¹ Source: National Population Commission and National Bureau of Statistics Estimates

Administrative Structure: Kano

Kano has six districts: The Old City, Bompai, Fagge, Sabon Gari, Syrian Quarter, and Nassarawa. The executive is made up of democratically elected officials and consists of the Governor, his deputy, and appointed commissioners.

Economy: Kano

The State of Kano is the biggest industrial centre in Northern Nigeria and the second

biggest in whole of Nigeria. The state has more than four hundred private SMEs, which produce diverse products like agricultural implements, tanned leather, pharmaceutical products, dairy products, bicycles and textile materials. Kano's government provided big industrial areas like Challawa Industrial Area, Sharada industrial areas and Tokarawa Industrial layout for enhancing industrial progress.

2.9.3. Wider Context: Lagos State

Geographical Context: Lagos

Lagos State is the smallest state in area of all Nigeria's 36 states and FCT. It covers an area of 3,577km, straddling approximately 180 km of Atlantic coastline, comprises of a series of islands, peninsulas and sand bars that run east-west.

Urban Context: Lagos

With an estimated population of about 21 million, Lagos is Africa's most densely populated city, averaging at 4,713 people per km with concentrations reaching up to 12,000 in certain neighbourhoods. The city is connected by a network of expressways.

Administrative Structure: Lagos

Lagos consists of five, largely geographical divisions – namely: Ikorodu, Lagos, Epe, Badagry, Ikeja. The executive is made up of democratically elected officials and consists of the governor, his deputy, and appointed commissioners.

Economy: Lagos

Lagos is the Nigeria's major commercial centre, contributing to about a quarter of Nigeria's gross domestic product (GDP) as well as 70% of its industrial investments, 90% of foreign trade flows, 40% of non-oil revenues and employing half of Nigeria's skilled workers.



Picture 4: Somolu, Lagos State at Night

2.10. Immediate Context – Market Communities

2.10.1. Ariaria Market Immediate Context: Aba

With a population of over 534,000 people, Aba is a city divided into two local Government areas, Aba North and Aba South. However, the market itself cuts across three local government areas, Aba North, Aba South and Osisioma Ngwa. Aba is the commercial centre of Abia State. Surrounded by oil wells which separate it from the city of Port Harcourt, a 30-kilometre pipeline powers Aba with gas from the Imo River natural gas repository. Its major economic contributions are Textiles and Palm Oil along with pharmaceuticals, plastics, cement, and cosmetics, this has made the Ariaria International Market one of the largest markets in west Africa. There is also a brewery, a glass company and distillery within the city.

2.10.2. Sabon Gari Market Immediate Context: Fagge

The largest market in the state – the Sabon Gari market (also known as Abubakar Rimi Market) is located in Fagge. Fagge is a town in Kano as well as a Local Government Area in Kano State, within the greater Kano area. It has a large commercialized agricultural landholding with associated buildings and other facilities. It is the commercial nerve centre of Kano State.

2.10.3. Somolu Printing Community Immediate Context: Somolu

Somolu is a Local Government in the Mainland area of Lagos State with an estimated population of 537,200. Somolu is a residential suburb of Lagos, which hosts the largest population of printers in Nigeria and is responsible for printing the majority of the posters, signs and exercise books used in Nigeria. The town's local activities include works in leather handicrafts and printing.

2.10.4. Sura Shopping Complex Immediate Context: Lagos Island

Lagos Island is the principal and central local government area in Lagos, Lagos State with a population of 209,437. The LGA only covers the western half of Lagos Island; the eastern half is under the jurisdiction of the LGA of Eti-Osa. Lagos Island is connected to the mainland by three large bridges. Forming the main commercial district of Lagos, Lagos Island plays host to the main government buildings, numerous markets and offices. Most Nigerian banks' head offices are located on Lagos Island. Other medium and large-scale businesses such as real estate consultancy firms, electrical appliances manufacturers and retail stores



Aerial View of Ariaria Market, Abia



Aerial View of Sabon Gari Market, Kano



Aerial view of Somolu, Lagos



Aerial View of Sura Shopping Complex, Lagos

2.11. The Sites

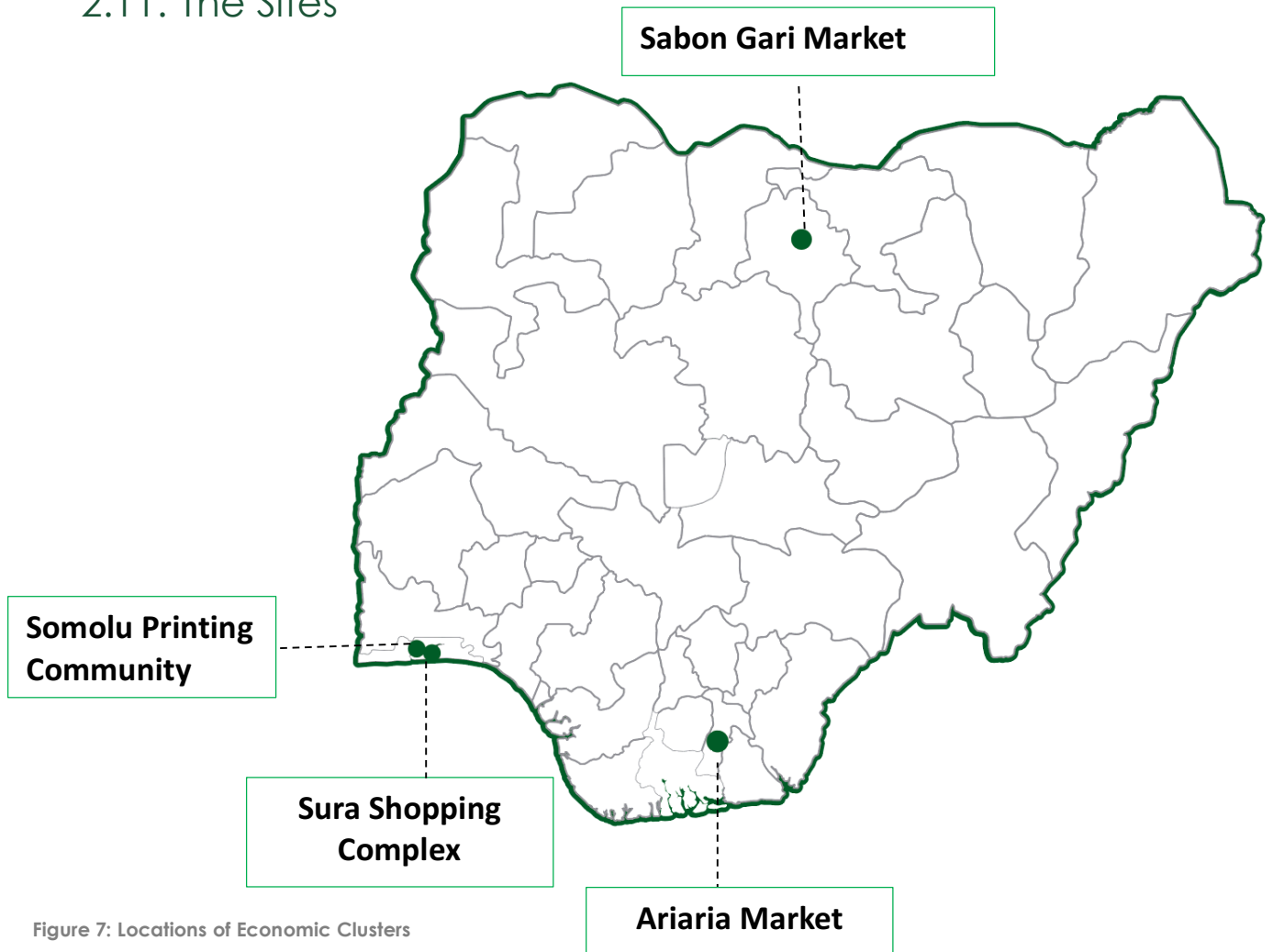



Figure 7: Locations of Economic Clusters

2.11.1. Ariaria Market

The Ariaria International Market is an open-air market located in Aba, a city in Abia State. The market has 11 sections of typically a story building and over 31,000 shops with trading activities ranging from clothing and shoes production, printing and fabrication of tool and mechanical parts. The market receives visitors daily in thousands as its accessible from most parts of the city. The market cuts across three local government areas, the Aba North, Aba South and Osisioma Ngwa.



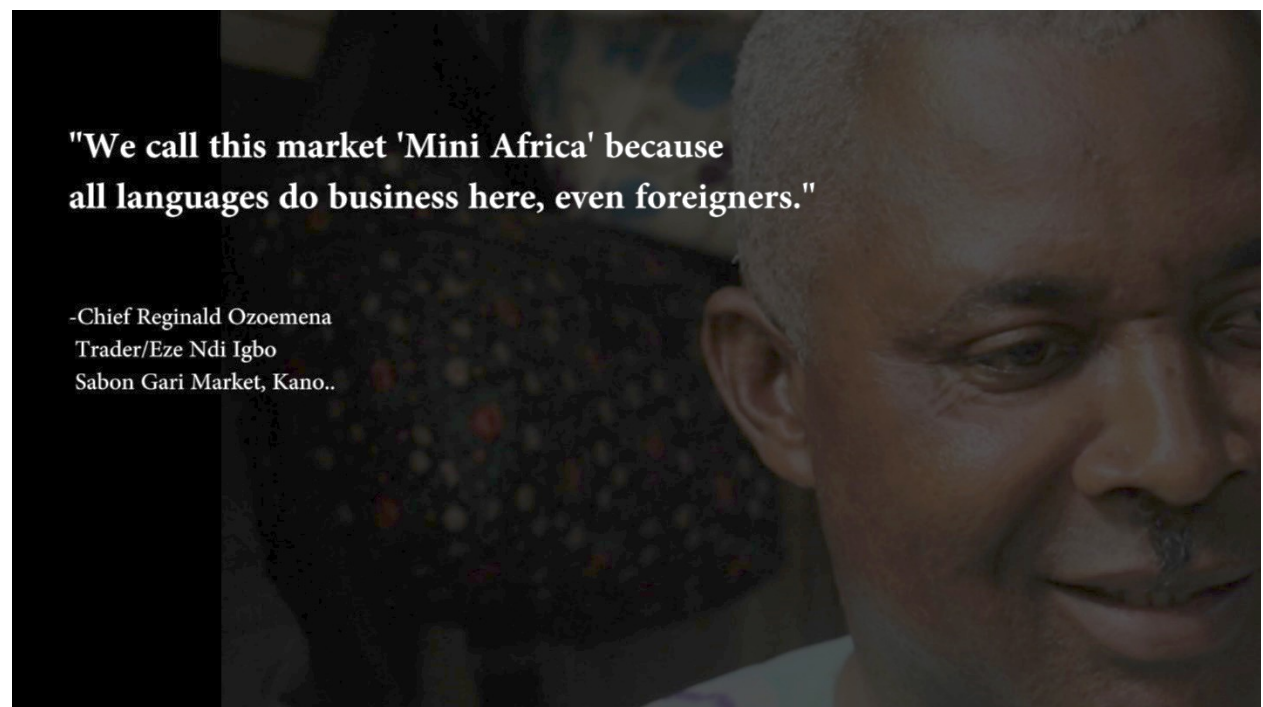
**"My dream is for this business to grow
in a big way, giving me, my children
and workers international recognition."**

-Adaku Enyioha
Hair Stylist
Ariaria Int'l Market, Aba.

2.11.2. Sabon Gari Market

The Sabon Gari Market also known as Mohammed Abubakar Rimi Market is located in the city of Kano. Kano being a city of high agricultural significance to the country's economy has Sabon Gari which is relatively the biggest market in the north with over twelve thousand shops, engaging in commercial activities involving large scale purchase of agricultural produce like maize, wheat, groundnuts, livestock and dairy products.

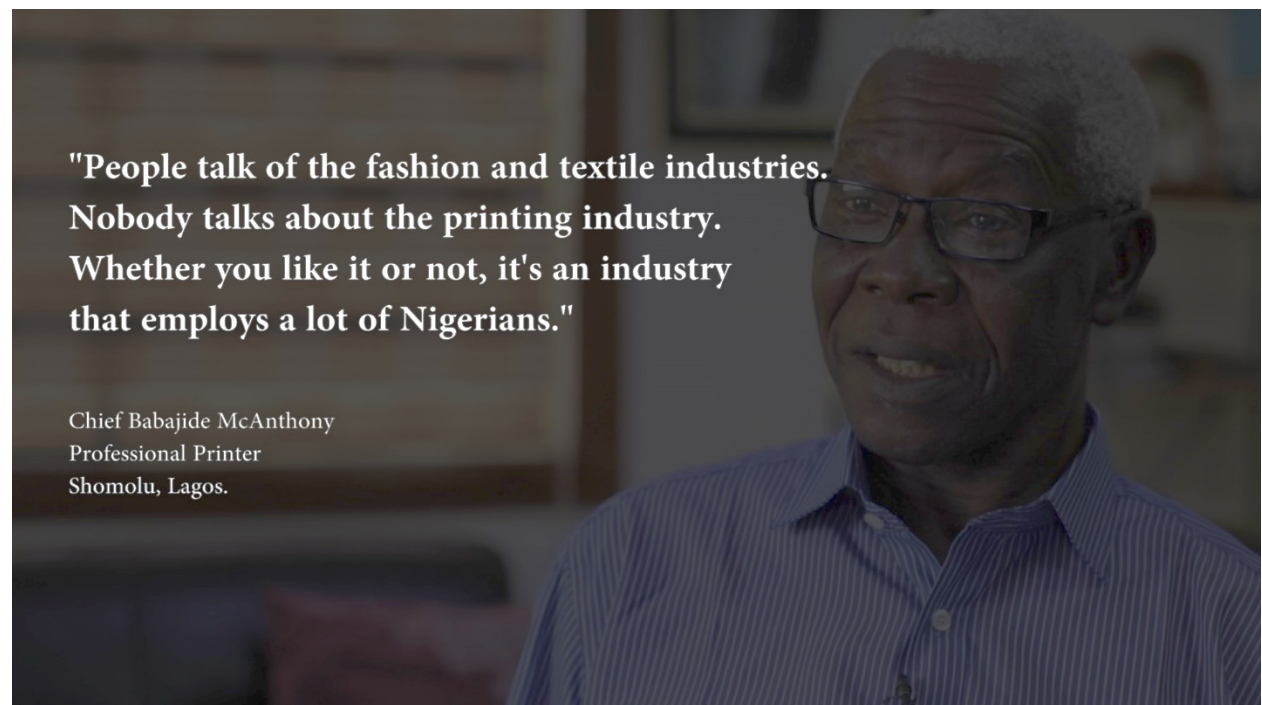
In 2016, the market experienced fire outbreaks due to electrical faults resulting from unregulated generating sets which disrupted economic activities and led to huge losses in assets.



2.11.3. Somolu Printing Community

Somolu Local Government Area of Lagos State hosts Somolu printing community. It is the largest hub of commercial printing in Nigeria with thousands of commercial printing presses both small and medium scale dotting the length and breadth of the business community.

By concentration of people involved in printing activities per area, Somolu may emerge as the community with largest concentration of printers in the world.



2.11.4. Sura Shopping Complex

The Sura Shopping Complex is located in Lagos. It is an Ultra-modern shopping market built to improve the marketing experience from the old Sura Market adjacent to it. The Shopping Complex covers a land area of about 42,000sqm, with 1,047 shops for used mainly for commercial purposes.

The Shopping complex is only 2KM from an existing Power Plant located within Lagos Island. Therefore, the proposed solution is for the excess capacity at the Island Power Plant to power the shopping complex.

2.12. Key Stakeholders

2.12.1. Market Traders Association

Each of the Economic Clusters have their respective Markets Traders' Associations:

- **Ariaria is managed by Ariaria International Market Traders' Association (AIMATA)**
- **Sabon Gari is managed by Amalgamated Traders' Welfare Association (AMATA),**
- **Sura shopping complex is managed by the Association of Shop owners in Sura Complex Lagos (ASOSCL)**
- **Somolu printers are under the Association of Professional Printers of Nigeria (ASSPPON)**

Each of these authorities is regarded as community leaders. Their primary task involves registration of traders, collection of dues pertaining to tariffs, urban services and rent, as well as delivery of certain government funded programs.

2.12.2. State Governments

Each of the economic clusters are governed by the respective state

- Aba State Government
- Kano State Government
- Lagos State Government

The State governments consist of the Governor's office, the Ministries and Parastatals responsible for providing land, Right of Way (RoW) and other necessary permits required.

2.12.3. Federal Government of Nigeria

REA is responsible for the project development and monitoring the Energising Economies initiative on behalf of the FGN.

METHODOLOGY



RURAL ELECTRIFICATION AGENCY

3. METHODOLOGY

3.1. Theory of Change

The theory of change for this project refers to the identified and anticipated outcomes expected from the implementation of this project.

Although the GDP growth for the Wholesale and Retail sector contracted in Q4 2016, only a year prior, the Retail sector was contributing as high as 4.69% to the Nigerian Gross Domestic Product, this shows a high potential within this sector and the technical service sector.

The rationale of the Off-Grid electrification strategy is to initiate efficient, clean and sustainable power to catchment areas that have high growth impact on the economy. It is believed that providing reliable power to economic clusters will have the following positive changes on the affected markets:

- Improve economic opportunities by ensuring that the energy that industries and businesses require to function is safe, reliable and predictable, improving the bottom line by improving production and sales
- Provide an incentive and working model for private investors in the energy industry on innovative power solutions.
- Provide street lighting to encourage longer and safer business hours in well-lit business spaces.

These economic clusters have been selected primarily for their high level of commercial activities and propensity to increase local content as it relates to '**Made in Nigeria**' goods, as well as heavy reliance on electricity for running their day-to-day businesses.

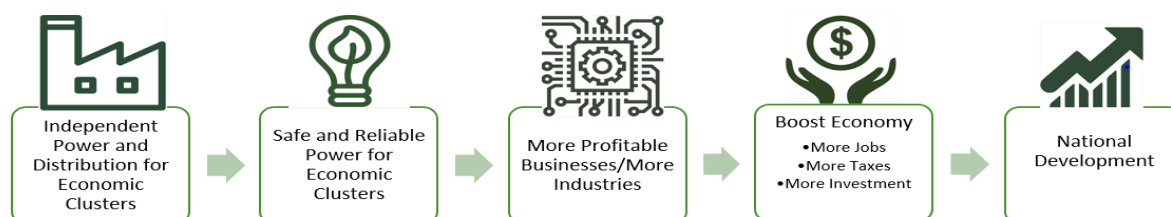


Figure 8: Theory of Change

3.2. Survey Implementation

Energy Audits and **Socioeconomic Assessments** were carried out concurrently at each identified catchment area in order to set a baseline level of consumption and quality of life for each of the areas with which to assess the accuracy of the theory of change above.

Information was gathered on the following topics:

1. Load requirements
2. Safety assessments
3. Expenditure on grid electricity
4. Expenditure on alternatives to grid electricity
5. Projected impact of electricity reliability on economic activity
6. Quality of life as a result of power supply (or lack thereof)

These surveys were implemented using both paper and mobile phone applications. While it was intended to be solely mobile based for ease of data collection and analysis, insufficient mobile phones and some customer's reluctance to auditors using mobile phones to capture data this resulted in paper based approach in some locations.

BASELINE ASSESSMENT STRUCTURE AND PROCESS







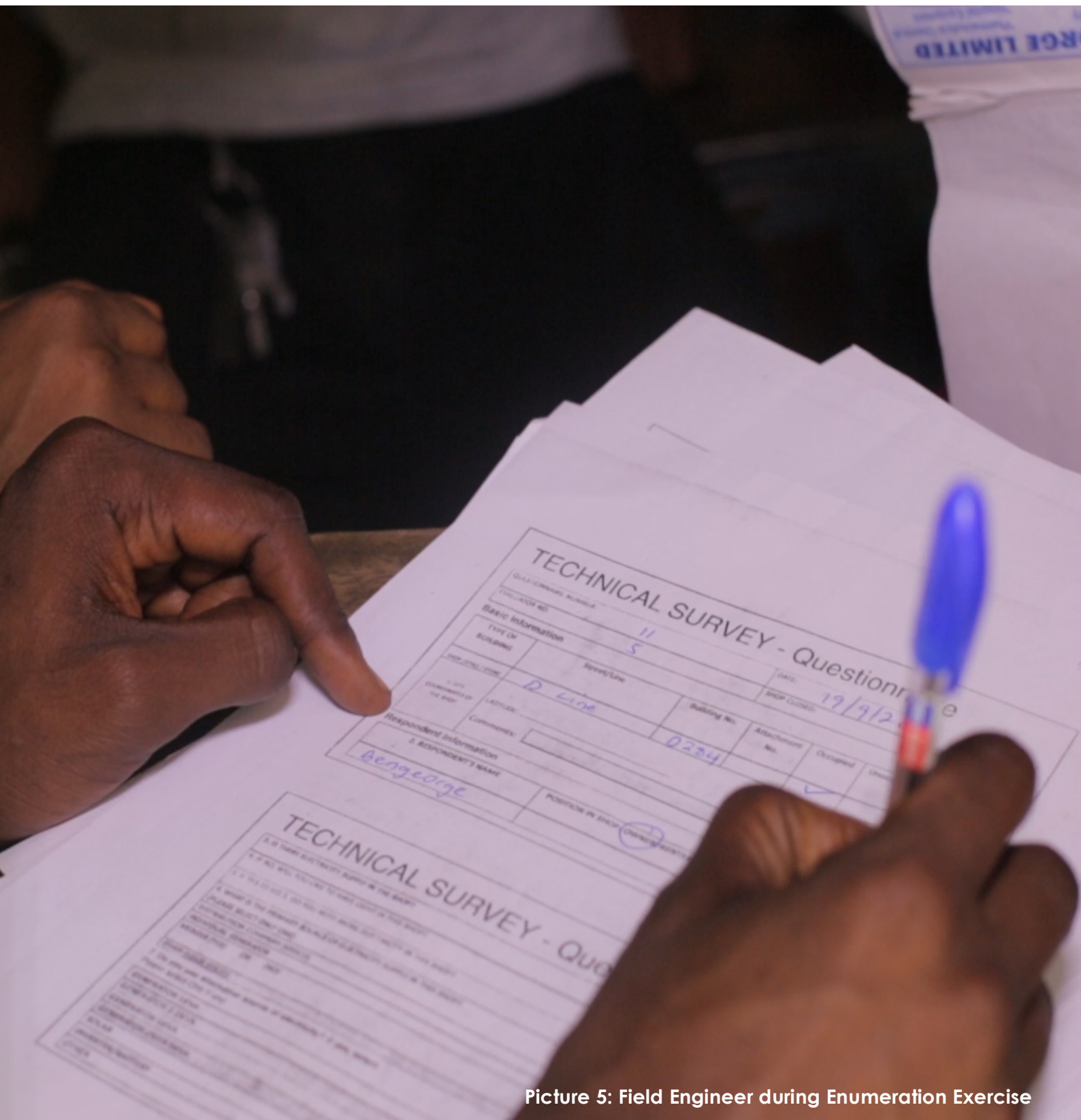
	Verification approach	<ul style="list-style-type: none">Comprehensive energy consumption assessment of shops in the catchment area in order to assess the load required for a successful Independent Power Project
	Data capture methodology	<p>3 components:</p> <ul style="list-style-type: none">Store by Store SurveysVisual observationDigital recording (photo, GPS)
	Training methodology	<ul style="list-style-type: none">Training of Load and Baseline Assessors focused on:<ul style="list-style-type: none">1 classroom training1 practical dry run exercise
	Team distribution	<ul style="list-style-type: none">Team represented by hired Assessors and Catchment Area Project Managers
	Style of questionnaire	<ul style="list-style-type: none">Simple and comprehensive using the Google AppPhysical questionnaires and calculation sheets for load assessments
	Stakeholder management	<ul style="list-style-type: none">Each location met with market leaders and the trade community to request support and cooperation for the project

Figure 9: Baseline Assessment Structure & Process



Picture 5: Field Engineer during Enumeration Exercise

Subject Area	Description
Facility content	<ul style="list-style-type: none"> • Current commercial use by commodity market types. • Layout of the market indicating shops and commodity market sections. • Ownership, rental and taxation of market physical assets.
Energy Requirements	<ul style="list-style-type: none"> • Lighting and equipment load • Cooling load • Estimated power requirements • Energy Costs in terms of average spend on electricity bills and average spend on self-generation.
Current business activity	<ul style="list-style-type: none"> • Current business hour (according to zones and commodity groups). • Catchment of market users/customers. • Typical turnover per month per trader (expenditure & profits). • Variations in day and night activities (type, layout & concentration of market activities).
Safety and security	<ul style="list-style-type: none"> • Perceptions of security by market users (i.e. traders, customers and local residents). • Crime trends and rates for the area.
Night time activity	<ul style="list-style-type: none"> • Commodity groups most likely to thrive during extended market working hours. • Key areas most likely to benefit from lighting as a safety and security feature.

Table 2: Major themes assessed in baseline assessments and energy audits

3.3. Survey Objectives

Performing a Baseline Survey allows REA to objectively measure the impact of its interventions and by so doing clearly attribute improvements in rural communities to its projects, by assessing the status of the project surrounding prior to the intervention.

Monitoring and evaluation is essential to maintain or improve the quality of REA interventions and to understand whether these interventions have achieved the planned goals.

The energy audit/ load analysis component of the survey was intended to ensure that the energy solution recommended for each location is the most cost effective ideal solution for that catchment area.

3.4. Fieldwork Recruitment and Training

The roles identified for conducting physical energy demand assessments and baseline studies are outlined below:

Role	Project Manager	Supervisor	Field Engineer
Requirements	Managed professional team on field visits to multiple locations	Managed team of 10 in high pressure environment	Possesses people management skills
Responsibilities	<ul style="list-style-type: none">- Responsible for end to end work plan and project success- Report progress updates and results to REA	<ul style="list-style-type: none">- Allocates tasks to Field Engineers- Monitors survey progress- Ensures efficiency of survey and quality of data collected- Disperses daily resources to Field Engineers	<ul style="list-style-type: none">- Conducts energy demand and baseline surveys- Submits physical verification data to central server

Table 3: Job description of evaluation team

Field engineers were recruited and trained according to the requirements and methodology of the survey mobile application, laying emphasis on research ethics, due diligence, courtesy, and recommendations on how to tailor these to different groups of respondents. The primary purpose was to familiarise the engineers with the survey aims, interview techniques and survey tools. The training ensured that field engineers were comfortable interacting with respondents, calculating appliance and lighting load, and assessing power infrastructure. Supervisors were trained to perform data quality checks and ensure that all the data was uploaded correctly on the mobile application. Once the main components of the training were understood, a dry run was carried on a section of the clusters affording the opportunity for planning.

Baseline Survey- Institution Questionnaire		
	Question Project	Options Somolu, Aba, Kano (Select One)
Background		
S/N		
1	Name	Free Form
2	Age	9-17, 18-25, 26-40, 40 - 55, 55+
3	Gender	Male, Female
4	Phone Number	Number Validation (String)
5	Facility Name	Igbobi College, Igbogbi Hospital
6	Facility Type	School, Hospital
7	Stakeholder Description	Student, Academic Staff, Non Academic Staff, Patient
Activities		
8	How many hours a day do you have access to grid power on average in the facility?	1-3, 4-6, 8-12, 12+
9	Does access to electricity hinder your quality of work?	Yes, No
10	When does the facility open?	5 - 7 am 8- 10 am, 24hrs
11	When does the facility close?	5 - 7 pm 8- 10 pm, 24hrs
12	Is your facility well lit during work hours?	Yes, No
13	How do you rate this facility compared to others of the same type?	Excellent, Fair, Poor
14	Would you recommend your facility to others?	Yes, No
Health & Environmental		
15	How would you rate the noise level in the facility?	1-5 (5 being the highest)
16	What is the main source of noise?	Generator, Traffic, Trade, Music
17	Does access to electricity affect running water supply?	
Expenses - Facility Admin Only		
18	Monthly electricity expense (PHCN)	Number Validation
19	Do you use other sources of power?	Yes, No
20	If yes, what kind (select all that apply)	Generator, Kerosine Lamp, Rechargeable Lamp, Solar, Inverter, Torchlight
21	How much do you pay for generator expenses (diesel, petrol, etc) a month	Number Validation
22	If given access to uninterrupted power, how will it impact this facility? (select all that apply)	Longer hours, better refrigeration/storage, more multimedia use
Safety & Security		
23	Are there functioning security lights on your facility?	Yes, No
24	How safe do you feel in this facility after dark?	Very Safe, Fairly Safe, Unsafe, Not Applicable

Figure 10: Sample Information with response criteria to be collected by Project Engineers

3.5. Information Gathering

Two main research techniques were employed over the course of the survey. Each mode of engagement had a particular set of aims involving specific stakeholder(s) in order to obtain information as effectively as possible. The manner of employment of each technique is detailed below:

- **Stakeholder Engagement:** This focused on meeting with the market associations to discuss the purpose of the project and to ensure buy in during the purpose of surveying, audit and project development
- **Data Collection:** The Baseline Surveys were conducted on a random sample of market traders, customers and residents where applicable. However, the Energy Audits consisted of enumeration of all shops within the specified locations. To ensure data consistency and reliability during data collection, an application was designed with the required data points and response fields to collect information for both the baseline survey and the energy audit. The application had the capacity to collect photographs, and vital energy consumption information by the project engineers. A paper version of the data collection application was also generated as backup in the event of difficulties using the application.

Figure 11: Snapshot of Data Collection Application

3.6. Means of Sampling

Selection of participants for the questionnaire- based survey was achieved through a combined non-probability means of sampling. The selection of respondents was based on:

- **Targeting:** pre-determined allocations to achieve representative coverage.
- **Convenience:** relative ease of access of willing participants.
- Discretionary selection of candidates capable of answering set questions.
- **Snowballing:** referrals from other respondents.

3.7. Coverage Areas & Sections

Coverage areas were specified to structure sampling across the distinct spatial segments of the study area to ensure representative reporting. These were identified and grouped into sections according to estimated power requirements and results of the energy audits.

3.8. Data Analysis & Application

Once data collection was finalized, a system of collating data elements within a coded spreadsheet was adopted to prepare completed questionnaires for processing. This technique enabled the systematic recording of all responses specific to each participating group within a single database, aiding cross analysis amongst similar stakeholders across the four market sites. Frequencies, percentages and averages were calculated using Microsoft Excel. Google Data studio and Microsoft Power BI Desktop was used for annotation, commentary statistic and graphical representation.

Manual crosschecking and extraction was used in processing the qualitative entries captured in the logbooks. Besides corroborate findings of specific interviews, information gathered from logbooks afforded assessment of respondents' attitude and relevant insights not readily captured by the set questions. As a tool, these entries were also valuable in capturing the experience of researchers and review of the survey delivery as a whole.

3.9. Challenges and Lessons Learned

Difficulties deterring the achievement of the survey objectives include:

- **Respondents' misinterpretation of the questions or unawareness.**

This was mitigated through improvements in stakeholder consultation with market associations who helped to explain the purpose of the survey to the participants

- **Hampered access to the site and/or information relevant for study.**

Priority surveys subjects and areas were identified in order to ensure that resources were expended where they were most needed. If a less important question was extremely difficult to gather information for, it was left out.

- **Local networker's lack of cooperation or incompetence.**

Training efforts were focused on mitigating this issue to ensure that the team taking the surveys were well versed in the ideal approach and minimize negative interactions.

- **Political unrest and curfews affected survey in some areas.**

This was mitigated by ensuring survey takers were out of the area during unsafe times of day, and all security advice was followed.



Picture 6: Field Engineer Conducting Interviews

ARIARIA MARKET



RURAL ELECTRIFICATION AGENCY

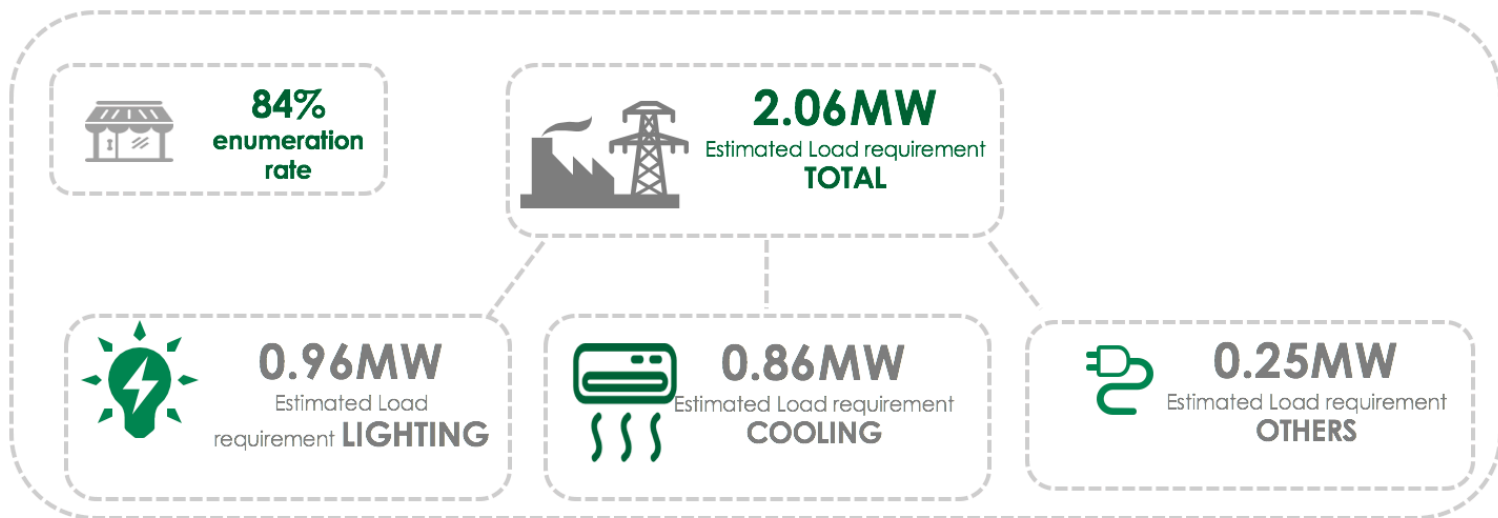
4. ARIARIA INTERNATIONAL MARKET

4.1. Introduction

Ariaria International Market is located in the city of Aba, in Abia State. The energy audit was conducted for 31,993 shops and the baseline survey was carried out on 556 traders and 66 customers. The data was compiled and analysed using the data analytical software to compile charts and graphs that clearly depict the activity in the market and potential impact of future projects.



Figure 12: Location of Ariaria Market, Abia State



PROPOSED SOLUTION

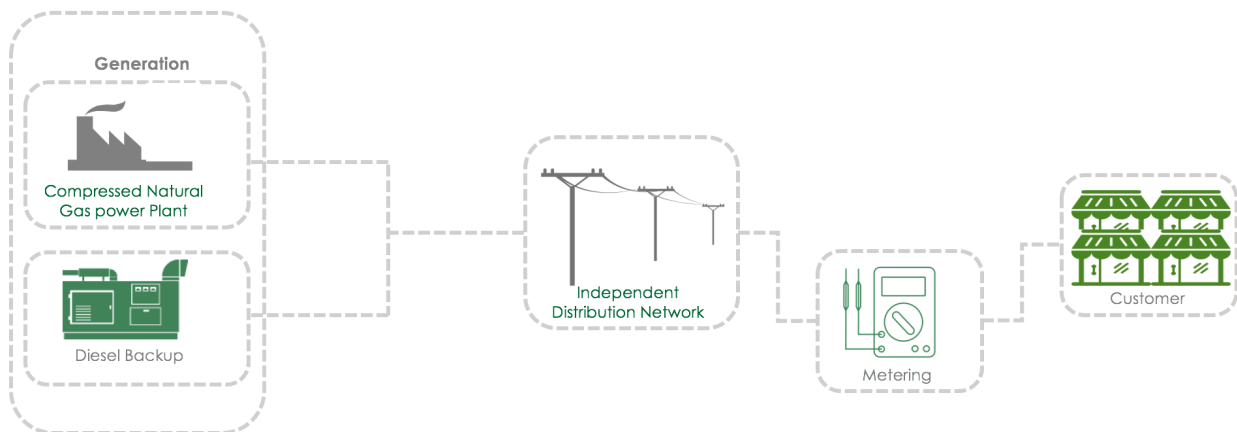


Figure 13: Overview of Ariaria Market Findings



Picture 7: Activity in Ariaria Market, Abia State

4.2. Background

The city of Aba is noted within Nigeria and worldwide for its huge commercial activities. One of its most popular markets is the Ariaria Market that attracts customers from all over the southern part of the country and beyond. Yet some of the basic infrastructure required to drive and support the thousands of entrepreneurial Nigerians found in Ariaria Market are non-existent.

The Federal Government Nigeria (FGN) is committed to improving the infrastructure of the Ariaria market and wants to ensure that the Ariaria International Market in Aba, Abia State, enjoys round the clock electricity.

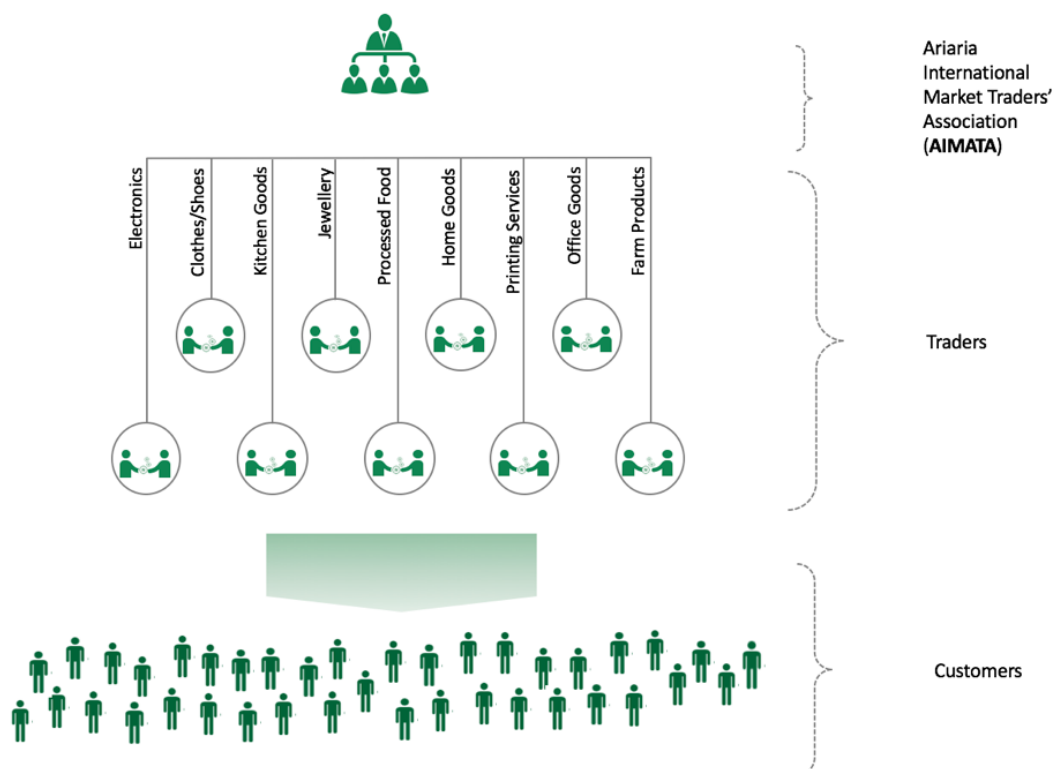


Figure 14: Structure of Ariaria Market, Abia State

4.3. Socioeconomic Analysis

4.3.1. Survey Statistics

The FGN intervened by sending a team from the Rural Electrification Agency (REA) to visit the market for a baseline study and survey to collect the data necessary to determine the feasibility of this project in the market area.

The following presentation highlights the data collected after deployment of a survey of the market and makes critical analysis between some of the key metrics. A total of 622 people, both customers and traders were surveyed.

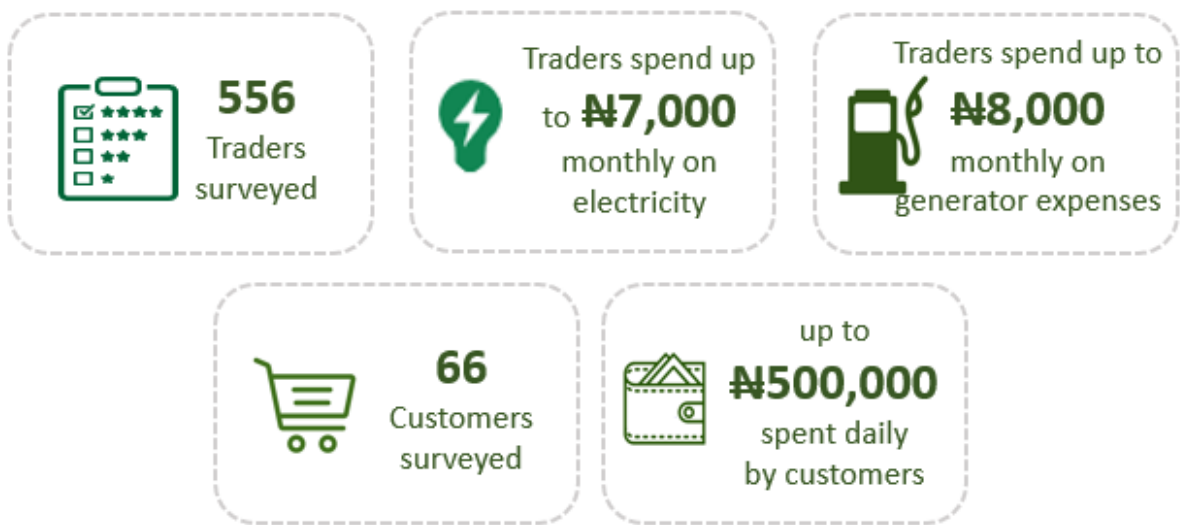


Figure 15: Summary of survey statistics from Ariaria Market

4.3.2. Traders

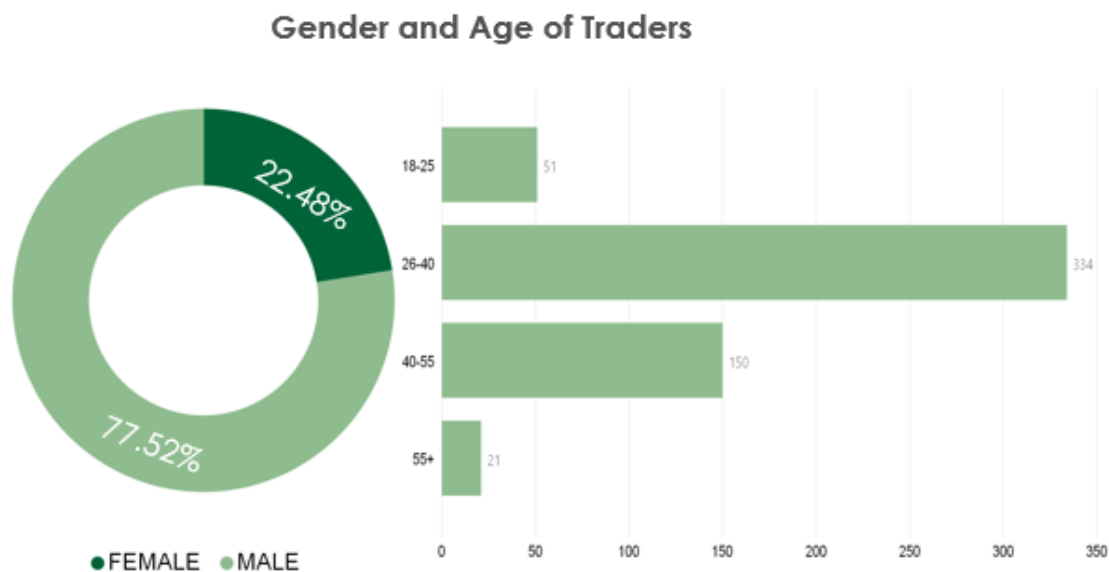


Figure 16: Gender and Age distribution of traders in Ariaria Market

556 traders across the market area were surveyed, 78% of whom were male and majority of whom were within the 26-40 age range. Traders most commonly expressed concerns around expenses related to self-generation, and raised issues of health and safety due to air and noise pollution in the community during general interviews.

Business Type	Male	Female	Total
<i>Clothes/Shoes</i>	76.82%	23.18%	100%
<i>Electronics</i>	88.89%	11.11%	100%
<i>Farm Produce</i>	80%	20%	100%
<i>Home Goods/Clothes/Shoes</i>	92.59%	7.41%	100%
<i>Home Goods/Office Goods</i>	100%	0%	100%
<i>Jewellery</i>	72.73%	27.27%	100%
<i>Jewellery/Clothes/Shoes</i>	0%	100%	100%
<i>Jewellery/Home Goods</i>	100%	0%	100%
<i>Kitchen Goods</i>	71.43%	28.57%	100%
<i>Kitchen Goods/Home Goods</i>	100%	0%	100%
<i>Office Goods</i>	75%	25%	100%
<i>Other Goods</i>	70.34%	29.66%	100%
<i>Printing Services</i>	100%	0%	100%
<i>Processed Foods</i>	62.50%	37.50%	100%
<i>Processed Foods/Farm Product</i>	100%	0%	100%

Table 4: Gender distribution of survey participants by business type in Ariaria Market

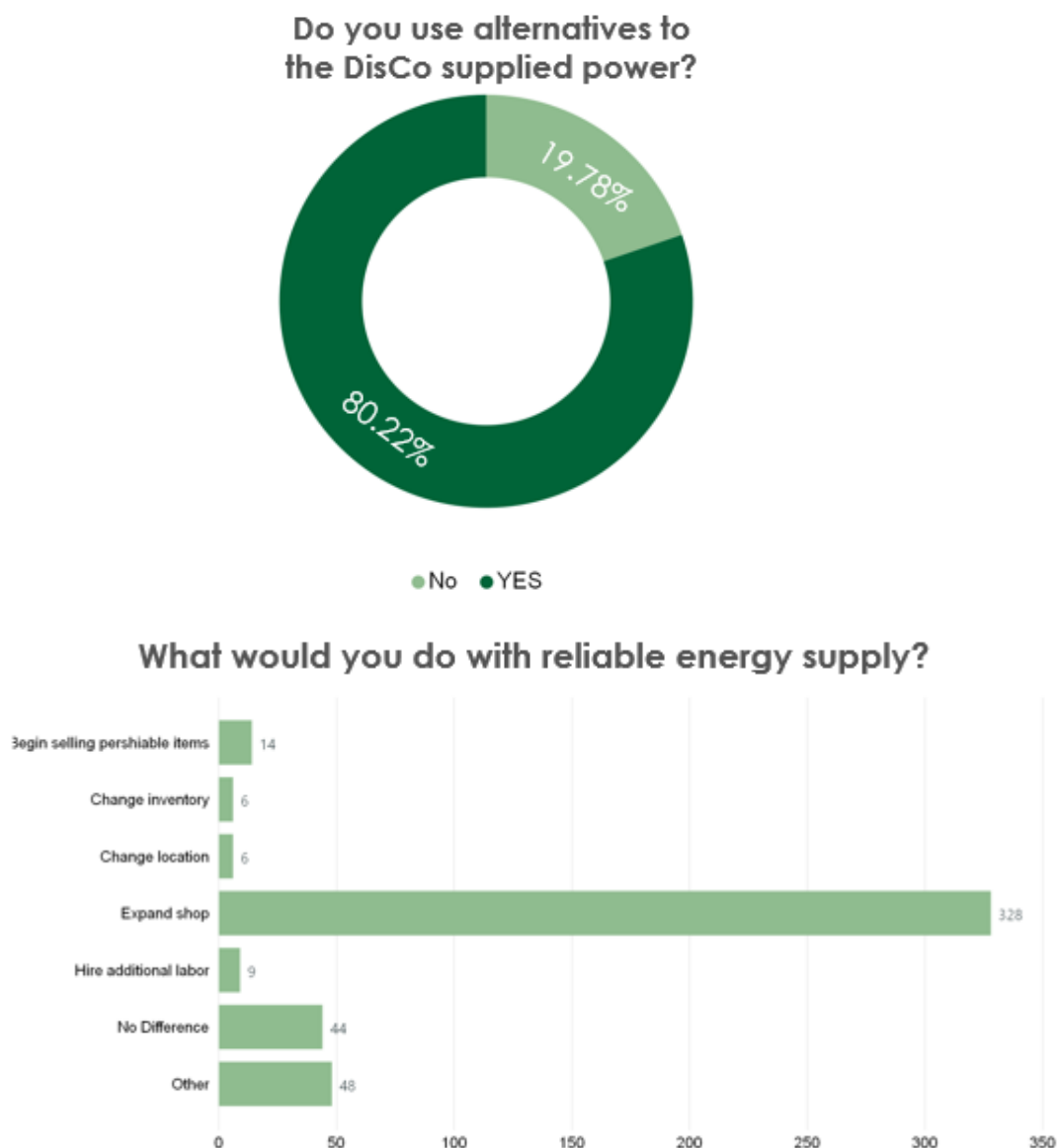



Figure 17: Energy source and effects of energy supply from traders in Ariaria Market

At Ariaria market, 72.09% traders said that reliable energy supply will lead to the expansion of their shops. While 10% of the respondents in the market said that reliable energy supply will make no difference in their business and the remaining 18.91% said it will lead to increment of labour, selling perishable goods, etc. As discovered earlier, a large number of shops across the market are being powered by generators. The average trader is spending daily is estimated daily at N723 on self-generation and provides a guide for possible tariff structures. The Figure above proves that majority of traders are spending a lot more on generator expenses. Not only are these expenses volatile, they also erode the shop owners profit margin, and they have other expenses to consider.

A photograph of a man with a beard and mustache, wearing a grey polo shirt with a green collar, speaking. The background is dark and out of focus. A quote is overlaid on the right side of the image.

**"If we have constant power, we can get
more machines and equipment.
Outsourcing our jobs eats into our profit."**

Chigozie Uzoma
Professional Shoe Maker
Ariaria Int'l Market, Aba.

4.3.3. Customers

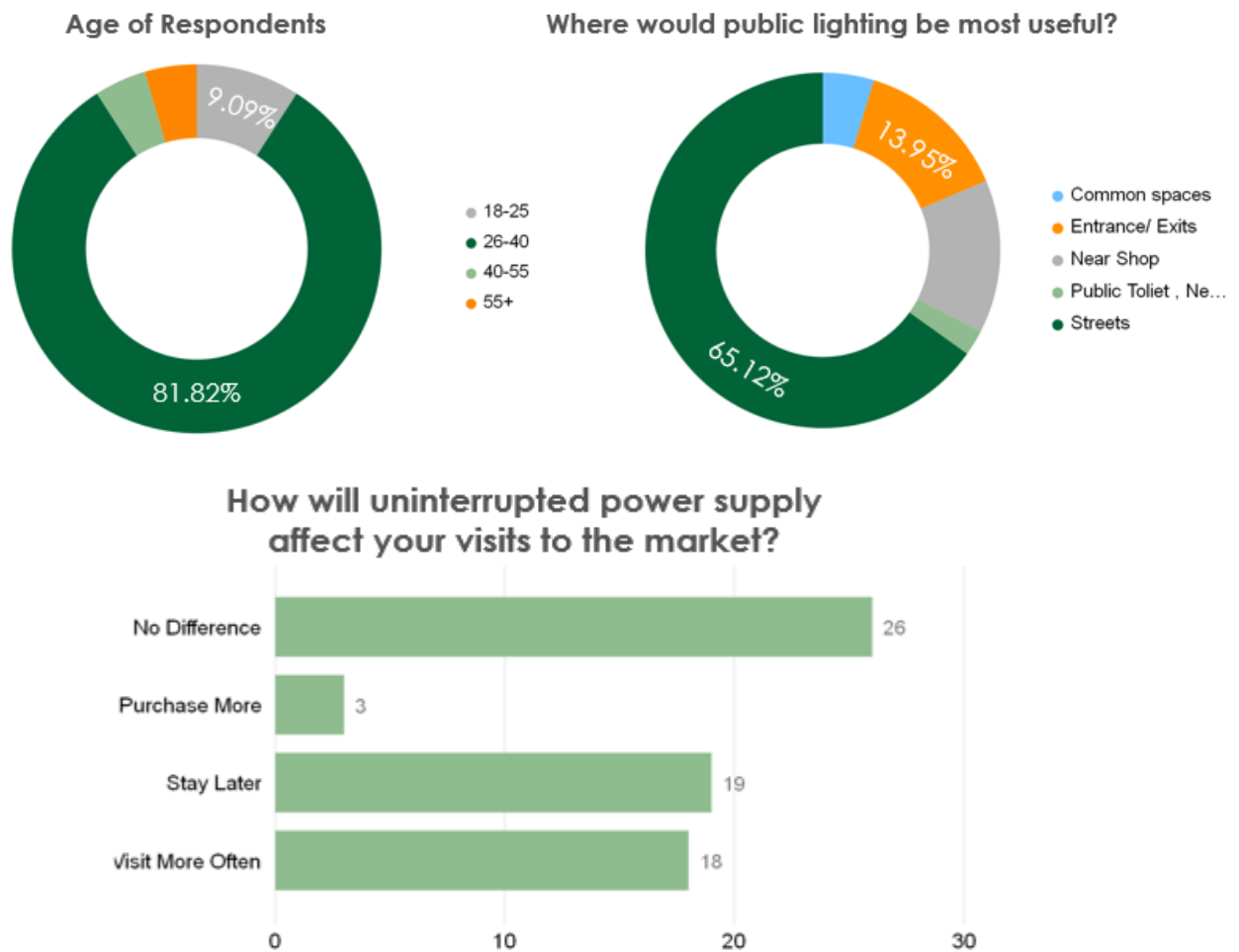


Figure 18: Assessment of age distribution and behaviour of customers in Ariaria Market

The majority of customers surveyed in the market were between the ages of 26 – 40, followed by the age range 18 -25 (9.1%), and male, indicating that this is a young, active demographic.

A significant portion of customers (27%) would visit the market a lot more often were there to be a reliable power supply to the area. This is despite the fact that most customers are already visiting the market on a weekly basis. It is quite apparent that uninterrupted electricity can only improve the experiences of customers and traders alike.

Safety Concerns	MALE	FEMALE
<i>Vandalism</i>	16.94%	15.20%
<i>Harassment</i>	57.77%	53.60%
<i>Robbery(Personal)</i>	10.44%	16%
<i>Rape</i>	0.4%	3.20%
<i>Not Applicable</i>	3.25%	2.40%
<i>Robbery (Shop)</i>	11.14%	9.60%
Total	100%	100%

Table 5: Traders' safety concerns by gender in Ariaria Market

The table above shows that the most common safety concern expressed by customers is harassment, as about half of all respondents, both male and female, expressed this concern.

4.3.4. Conclusion

The dominant age group in both male and female respondent is 20-30. The survey indicated that reliable energy supply plays a significant role in the life of both traders and customers. The responses from the survey shows that the provision of streetlights to the market at night would increase the number of hours that the market is open and also provide safety within the market at night. Survey finding indicates that crime is not a major concern in the market place. Though 3% of the total population indicated fear of criminal activities like vandalism, sexual harassment and robbery. In conclusion, constant power supply will reduce expenses on petrol and diesel.



Picture 8: Artisan at work, Ariaria Market, Abia State

4.4. Energy Audit

4.4.1. Survey Statistics

A total of 31,993 shops were identified in the market. Data was obtained from 26,750 of those shops. This translates to an approx. 83.6% enumeration rate. As mentioned above, the shops were spread out across 11 sections, with most of the shops located in Section 9 of the market.

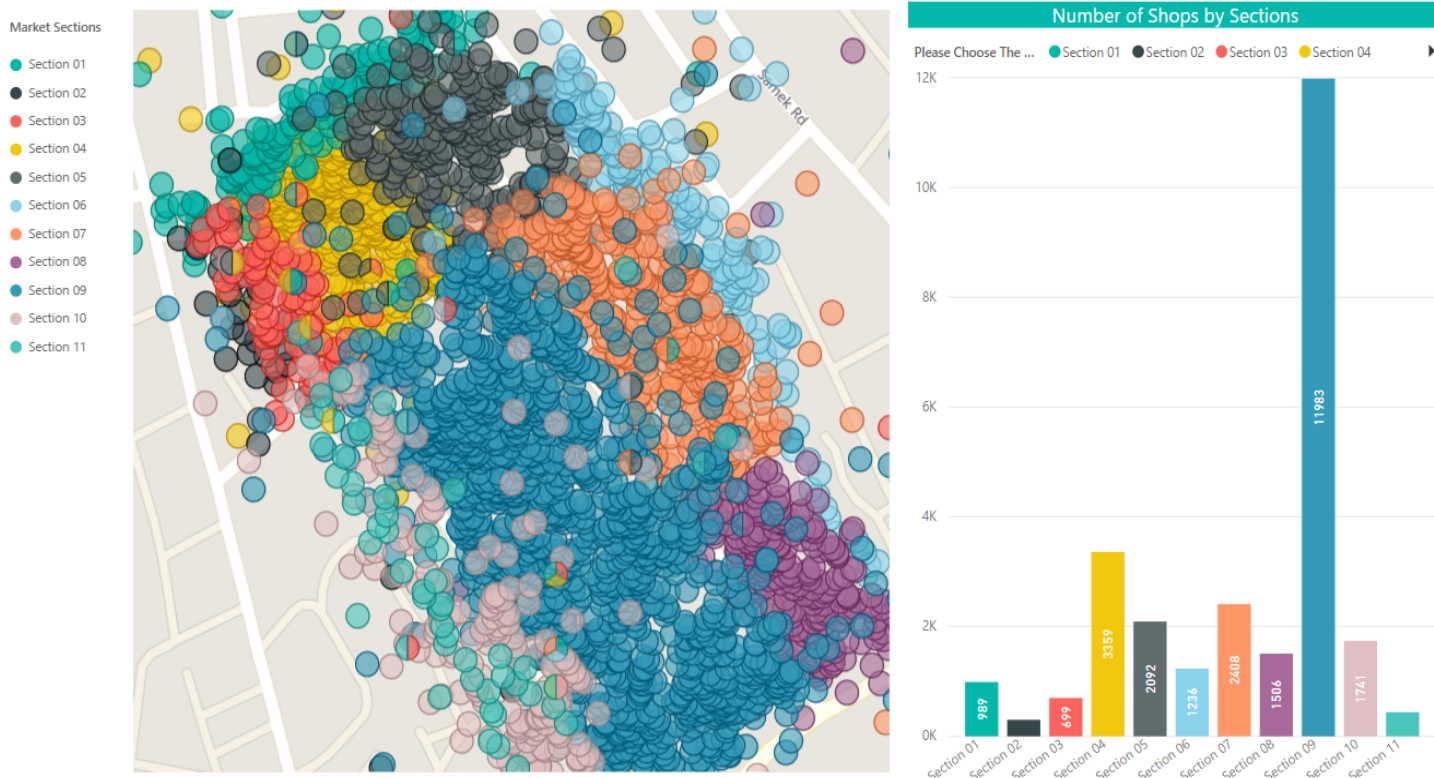


Figure 19: Geographical representation of market layout and number of shops per section in Ariaria Market

4.4.2. Load Analysis

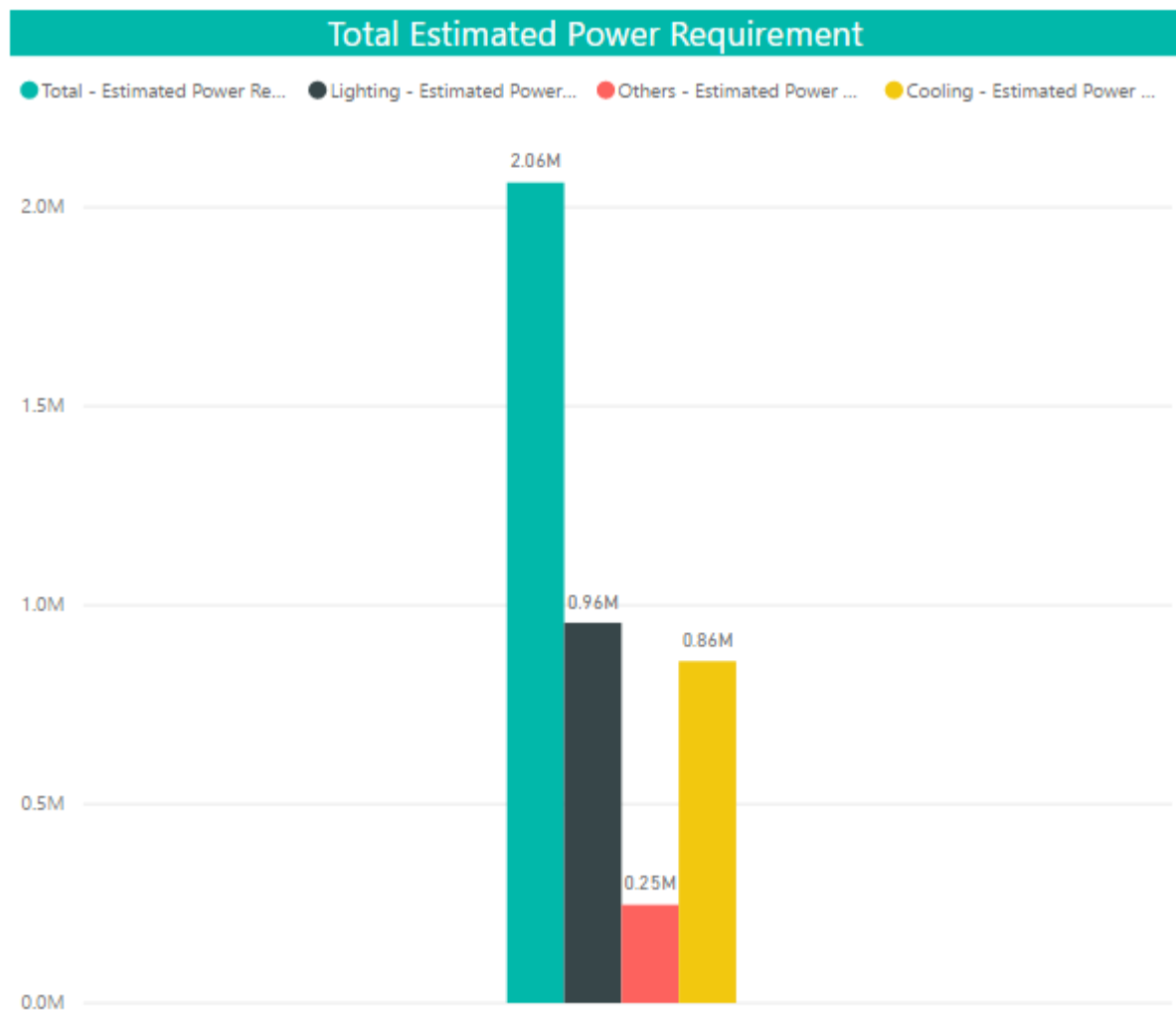


Figure 20: Estimated power requirements in Ariaria Market

8,150 shops are currently using power out of 26,750 shops surveyed; signalling a power usage of 30.4%, with the rest not using any power at all. The power requirements of the market were shown to be 2.06MW; 46.6% of that is required for lighting and another 41.7% for cooling.

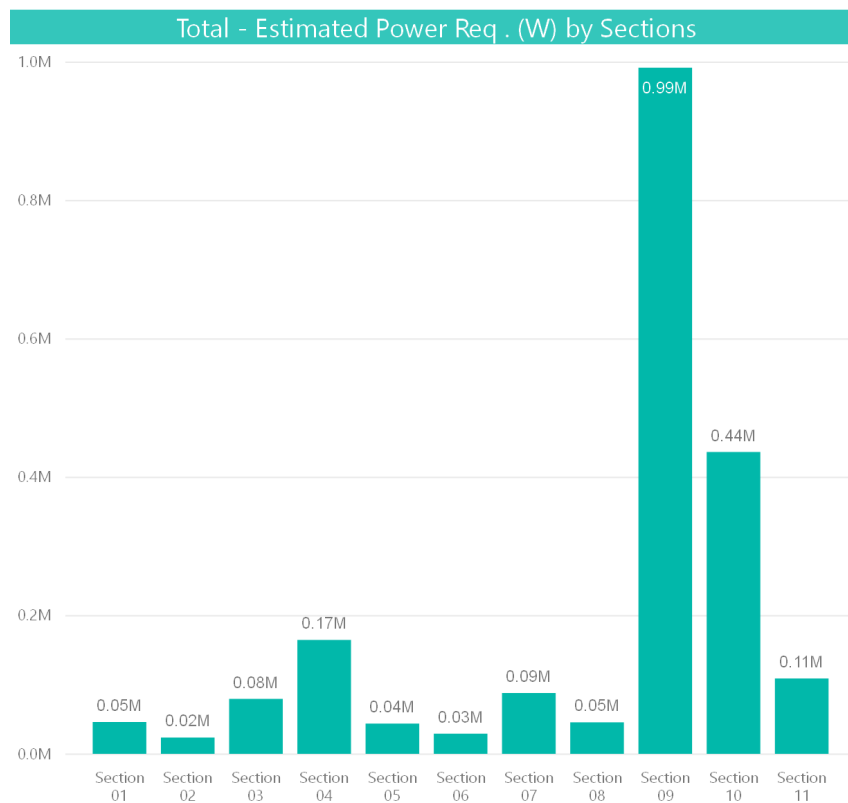


Figure 21: Estimated power requirements by market section in Ariaria Market

In order to power the entire market area, a plant size of about 6.6MW would be required. However, the power required is not distributed evenly amongst the 11 sections and Phase 1 will only require 5MW. As shown above, Section 9&10 jointly require about 70% of the total estimated power requirement of the market. The majority of the power required is also from shops located on the ground floor.

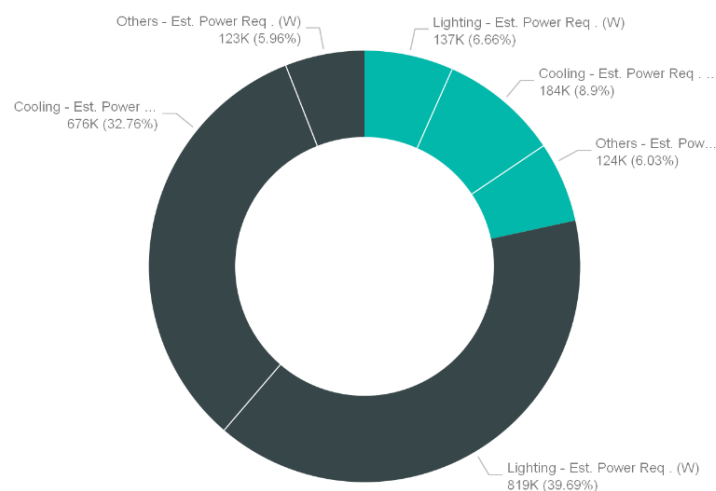


Figure 22: Estimated power requirements, by shop level in Ariaria Market

The data showed that 61.3% of market shops surveyed were using one form of self-generation or the other. Majority of these shops use some form of a generator to power their shops. The percentage of various Generator sizes used in the market can be seen below.

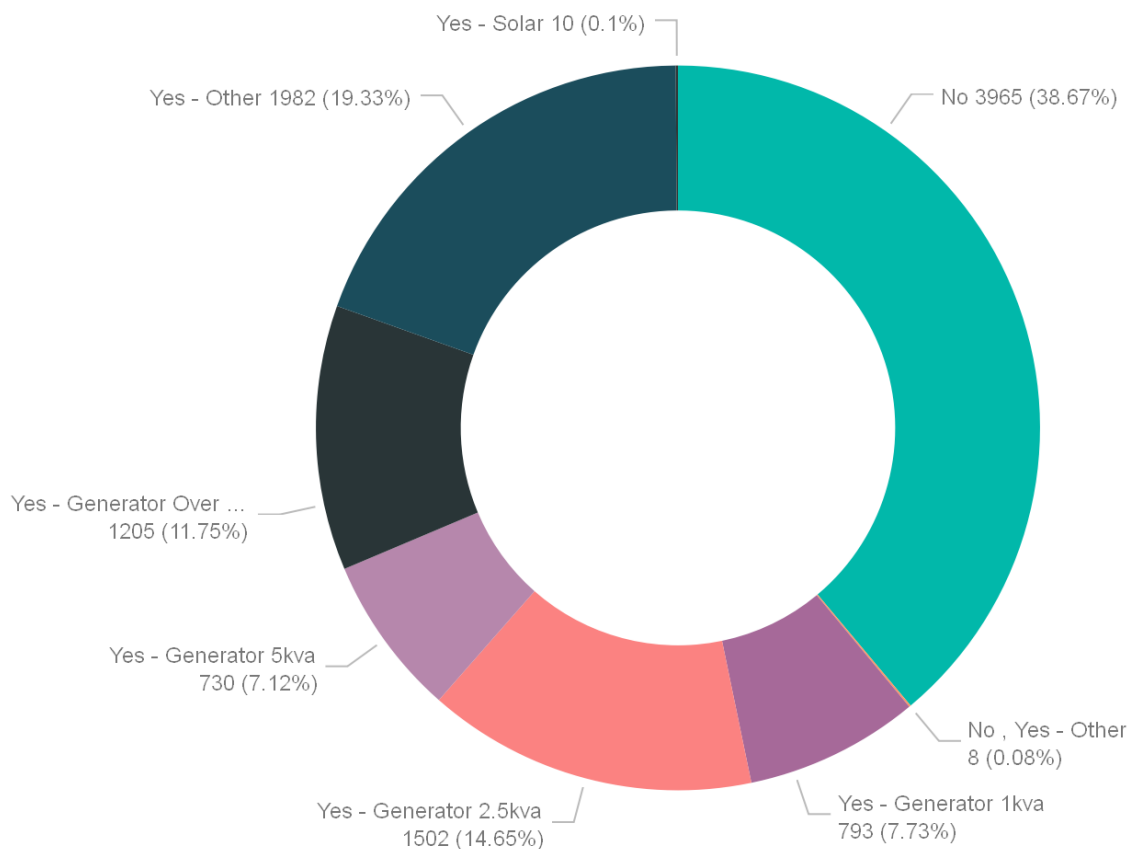


Figure 23: Alternative sources of energy used in Ariaria Market

4.5. Recommendation

Based on the results from the Energy Audit the system recommendation for Ariria Market is to implement a Compressed Natural Gas (CNG) Power Plant to meet the current and forecasted demand.

Electricity Demand	2.06MW – current demand
	6.67MW – estimated total demand for entire market
Type of Configuration	Compressed Natural Gas Plant
Proposed System Size	5MW (Phase 1)
	2MW Diesel Backup (Phase 1)

Table 6: Proposed System Overview for Ariaria Market

In order to ensure consumers are only billed for the energy consumed, all consumers (shops) should be individually metered. This will also foster trust between the power generator and consumers.

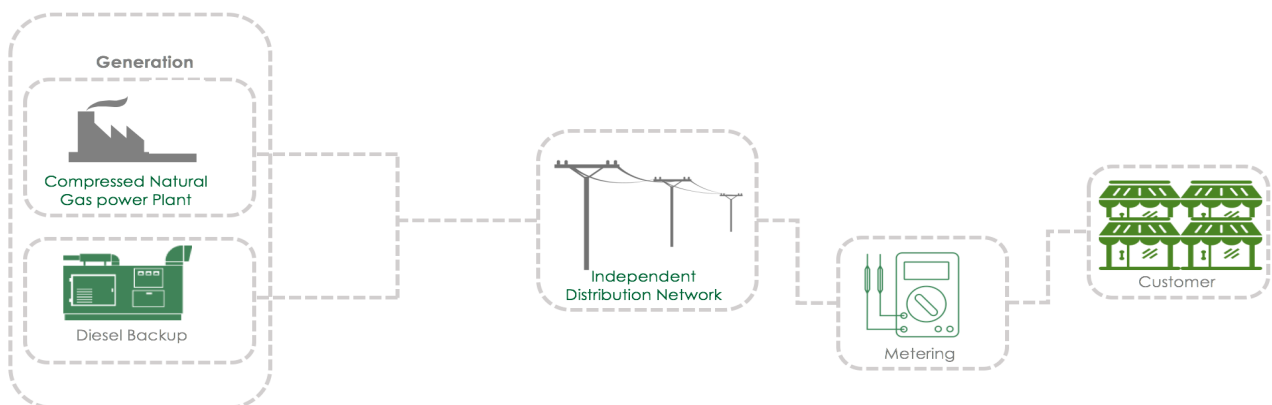


Figure 24: Representation of distribution network for Ariaria Market

SABON GARI MARKET



RURAL ELECTRIFICATION AGENCY

5. SABON GARI MARKET

5.1. Introduction

Kano City is one of the oldest and largest urban settlements in Nigeria and West Africa, renowned for its commercial activities. Sabon Gari Market is a popular and one of the large markets which attracts customers from all over the Northern part of Nigeria.

Kano State has a population of 13 million people, a land area of 20,131sq.km and population density of 648.5 sq.km is named as the second largest industrial centre after Lagos. Kano State has a high concentration of textile, tanning, footwear, pharmaceuticals, ceramics, furniture, dairy products, animal feeds and agro-allied industries.



Figure 25: Location of Sabon Gari Market

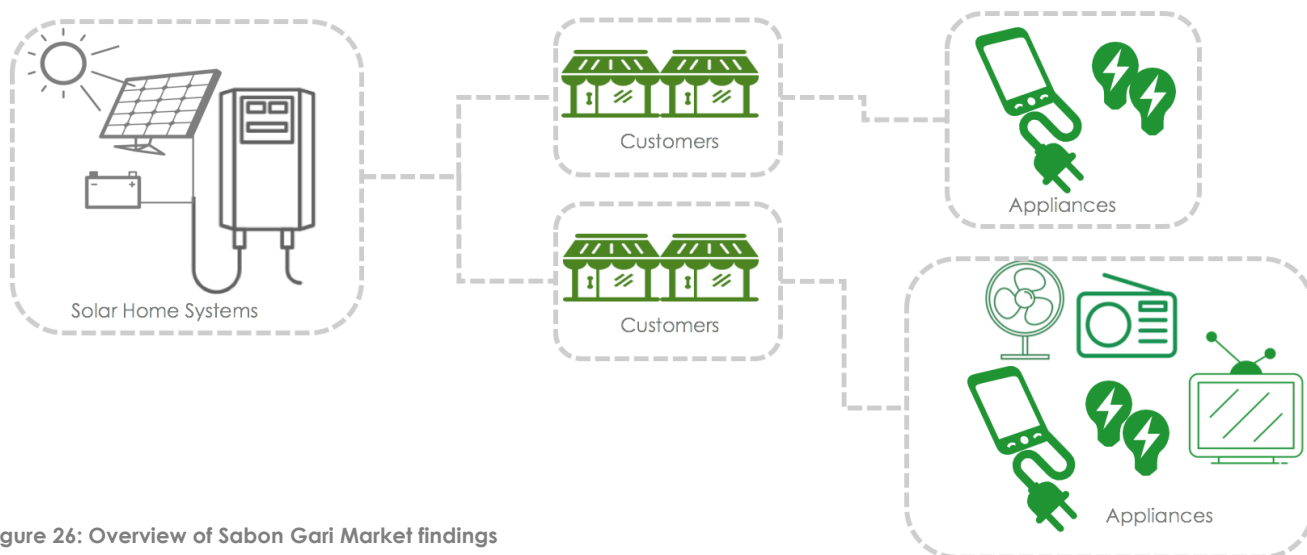
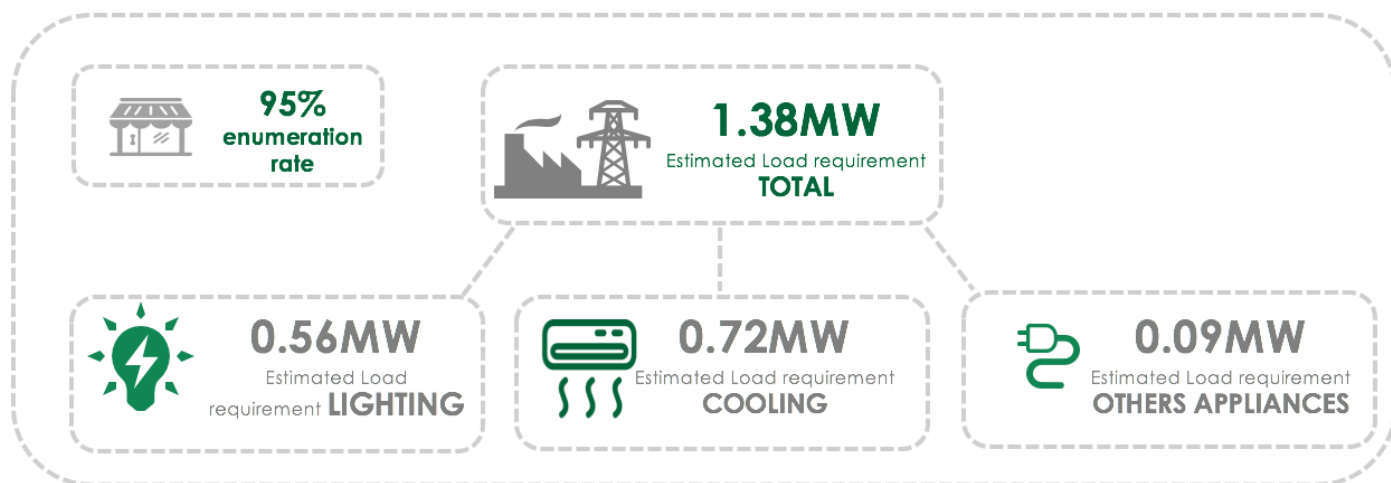


Figure 26: Overview of Sabon Gari Market findings

5.2. Background

The Sabon Gari market built in 1914, is a one-stop, all-inclusive market for commodities located right in the heart of the city and covers an area of approx. 22 hectares with over 13,000 shops. The market is bounded by Kantin Kwari textile market, Abattoir markets, Singa whole sale market among others

Notable landmarks within the market include; the Massallacin Abacha Mosque, newly-built fire station, car and motorcycle parks, police station, ongoing fly-over bridge on Murtala Mohammed Way.

The market is broken into multiple clusters under a management board called **Muhammadu Abubakar Rimi (Sabon Gari) Company Limited**. The market also has traders' association known as **Sabon Gari Market Amalgamated Traders Welfare Association (AMATA)**.

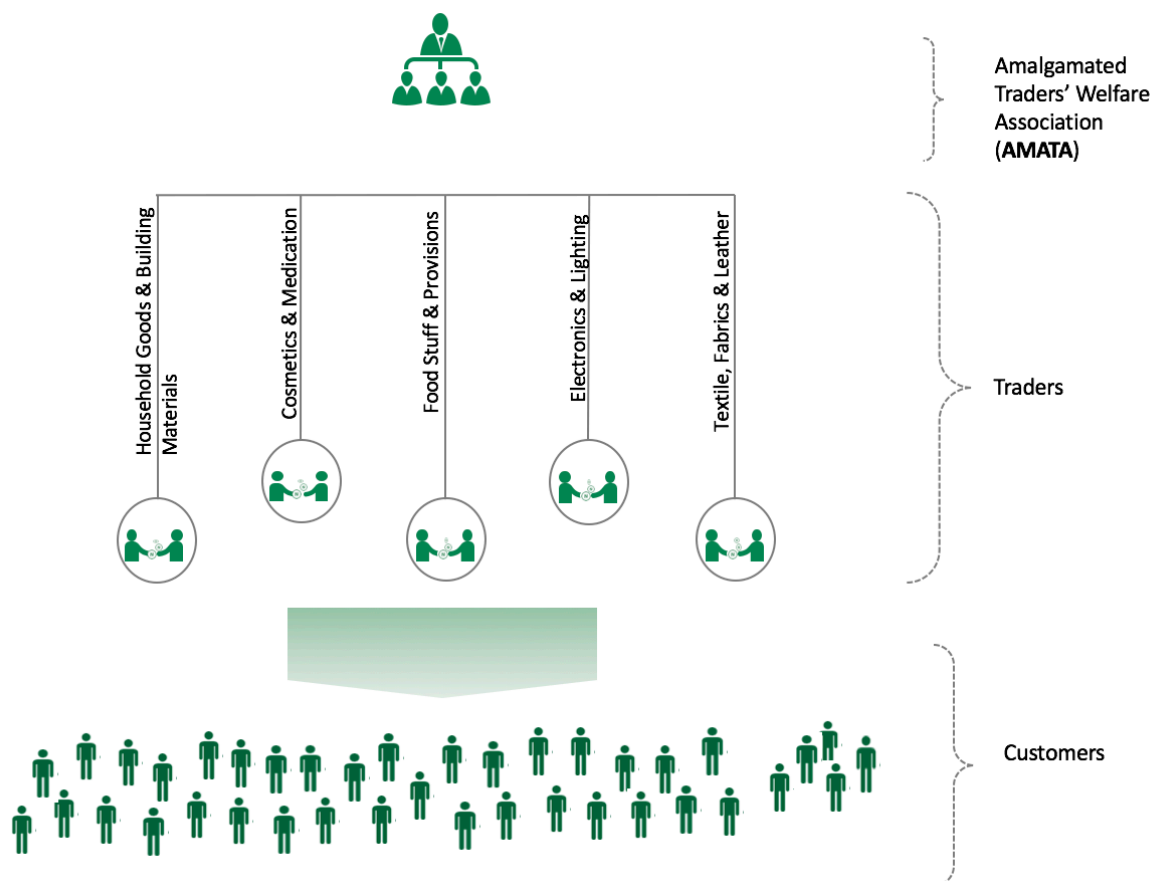


Figure 27: Structure of Sabon Gari Market, Kano State

5.3. Socioeconomic Analysis

5.3.1. Survey Statistics

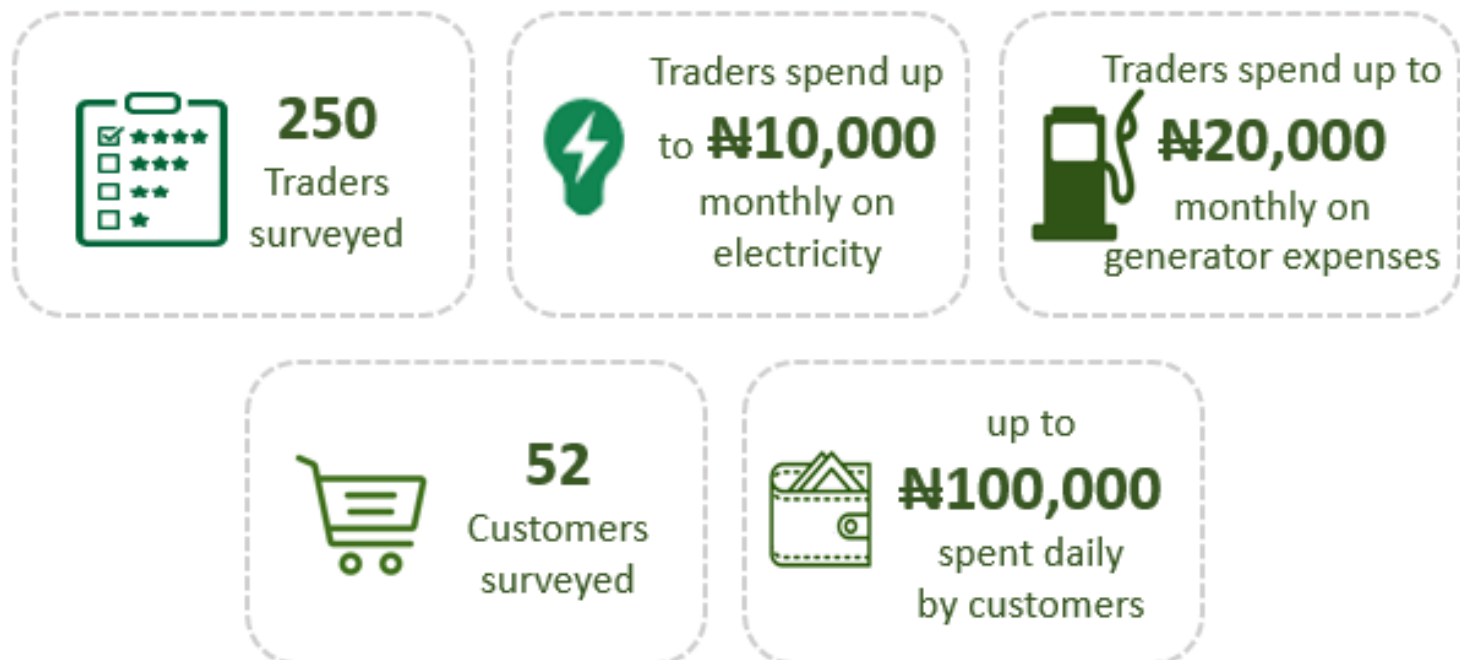


Figure 28: Survey statistics from Sabon Gari Market

Picture 9: Stall in Sabon Gari Market, Kano State



5.3.2. Traders




Figure 29: Gender and age distribution of traders in Sabon Gari Market

250 traders across the market area were surveyed. There are a range of commodities being sold in the market: Textiles, Fabrics & Leather, Cosmetics & Medication, Electronics & Lightings, Food Stuff & Provisions as well as Household Goods. A majority of the respondents were male and within the ages of 30-40. During interviews, it was discovered that close to 70% of the shops in the marketplace spend nothing on electricity and roughly 29% do not even have access to electricity at all.

Business Type	Male	Female	Total
<i>Cosmetics & Medications</i>	0%	100%	100%
<i>Electronics & Lighting</i>	12%	88%	100%
<i>Food Stuff & Provisions</i>	0%	100%	100%
<i>Household Goods & Building Materials</i>	0%	100%	100%
<i>Textiles, Fabrics & Leather</i>	12%	88%	100%

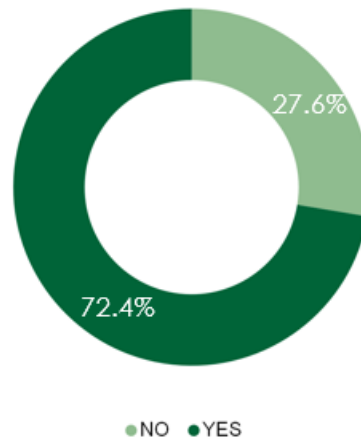
Table 7: Gender distribution of survey participants by business type in Sabon Gari Market

A portrait of a young Black woman with curly hair, looking slightly to the side. The background is blurred, showing what appears to be a market setting with various items.

**"Buying fuel everyday was so frustrating.
During fuel scarcity, we have to fan our customers
just to make them comfortable."**

-Ozioma Anele
Trader
Sabon Gari Market, Kano..

Do you use alternatives to the DisCo supplied power?



What would you do with reliable energy supply?

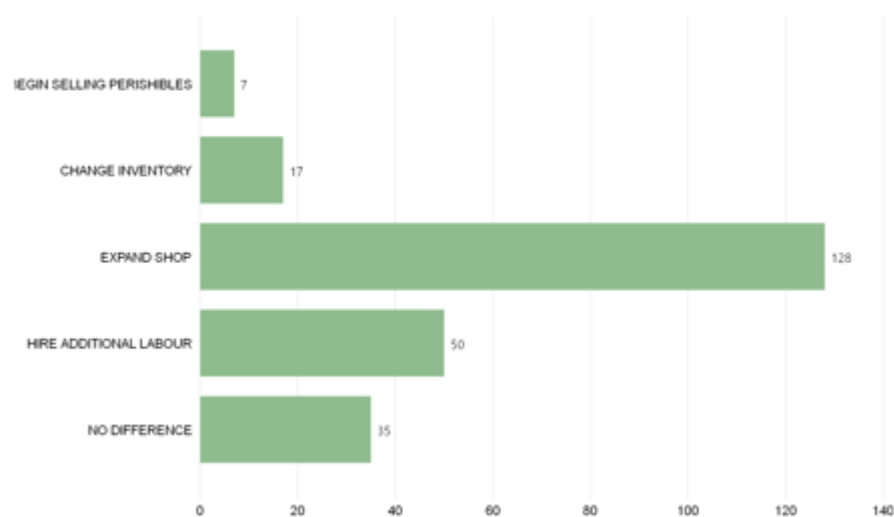


Figure 30: Energy source and effects of energy supply for traders in Sabon Gari Market

Research indicates that most shops are powered by alternative sources of power. Close to 98% of the respondents rely on some form of generator for their power supply. Not only are these expenses volatile, they erode the shop owners' profit margin, amongst other expenses. Statistics shows that the current demographic would appreciate the benefits of constant power, as only about 15% of people believe there would be no difference to their business if they were to be supplied uninterrupted electricity.



Picture 10: Generators used to Power Shops in Sabon Gari Market, Kano State

5.3.3. Customers

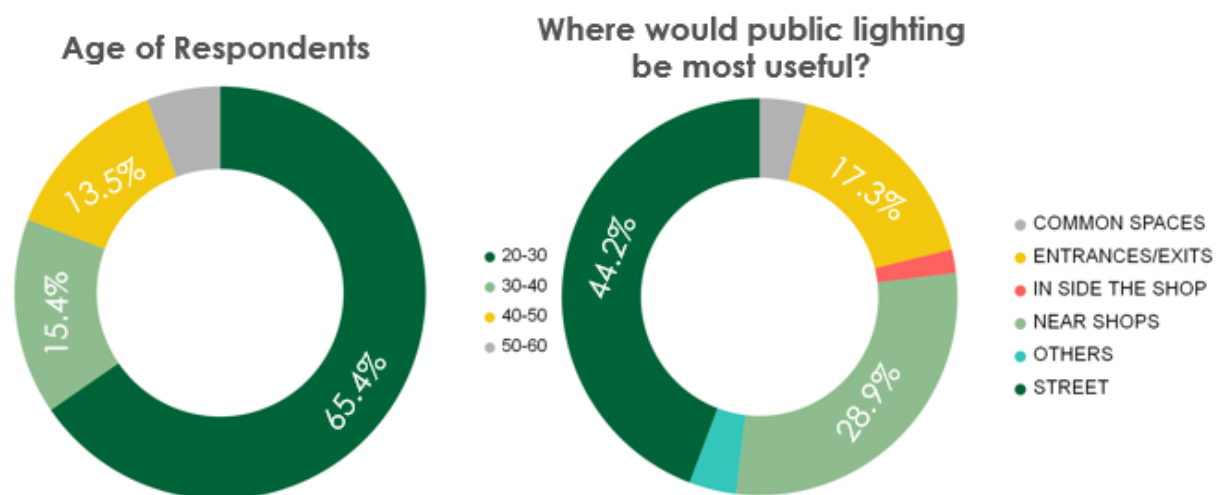
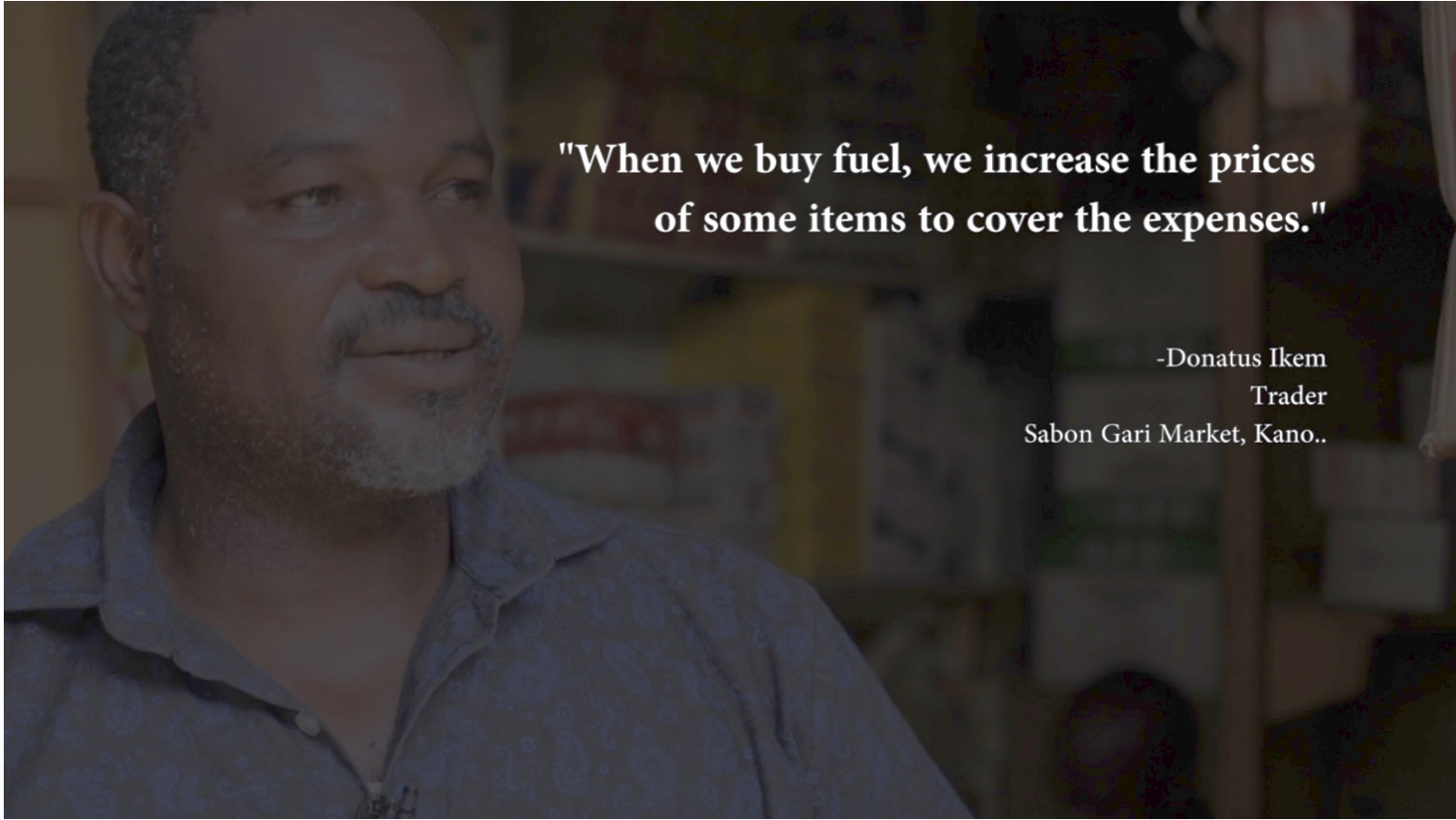


Figure 31: Assessment of age and impact of public lighting on customers in Sabon Gari Market

The lack of street lighting in the area may also contribute to the fears of traders and customers in the marketplace. The occupants have signalled that strategic placement of street lighting in and around the marketplace will alleviate some of these fears as well as provide a safer environment for customers and shop owners alike; it could also allow for extended shopping times which could improve the profitability and revenue generation from the market.

Items Purchased	9AM-12PM	12PM-3PM	3PM-6PM	All Day	Total
Building Materials	50%	0%	0%	50%	100%
Cosmetics	13%	50%	37%	0%	100%
Electronics	20%	60%	0%	20%	100%
Food Stuff	23%	54%	15%	8%	100%
Gold	0%	100%	0%	0%	100%
Provisions	13%	40%	20%	27%	100%
Textiles/Fabrics	57%	14%	14%	15%	100%

Table 8: Most common times of day for each purchase type in Sabon Gari Market

A portrait of Donatus Ikem, a trader, with a quote about fuel prices. The image is a close-up of a man with a grey beard and mustache, wearing a blue patterned shirt. He is looking slightly to the right. The background is blurred, showing shelves with various items. The quote is overlaid on the right side of the image.

**"When we buy fuel, we increase the prices
of some items to cover the expenses."**

-Donatus Ikem
Trader
Sabon Gari Market, Kano..

Safety Concerns	MALE	FEMALE
<i>Vandalism</i>	71%	41%
<i>Harassment</i>	24%	31%
<i>Robbery(Personal)</i>	5%	28%
Total	100%	100%

Table 9: Customer safety concerns by gender in Sabon Gari Market

Crime is said to be a rare occurrence and most people tend to generally feel safe in the marketplace. However, it is still regarded as a major concern and the main safety concerns remained consistent amongst both genders of tradespeople, as shown above.

5.4. Conclusion

The findings of the study show a vast majority of the shop owners/traders and customers are dissatisfied with the level of grid power supply they currently receive. Currently, there is no supply of grid power from the Distribution Company. The traders use noisy and expensive generators either individually or communally in an arrangement referred to as "maja" where they pay a minimum of N200 for 8 hours with restriction on appliances that can be connected and as much as N1000 depending on the load. Most shop owners/traders are willing to pay for a less expensive, reliable, safe, less noisy, and cleaner alternative power supply. Provision of uninterrupted power would encourage expansion of the kind of goods that can be sold at each shop. About 54% of shop owners said that given access to uninterrupted electricity, they would expand their business; this gives them the flexibility to develop their product line, employ more people and monitor expenses. Also, generator expenses and other business expenses incurred by a majority of the traders, only exist to erode their profit margins. On average, the market serves anywhere between 12-30 customers on a day-to-day basis, who spend an average of roughly N14,650 per month; the potential for profitability in the marketplace exists as there is clearly a demand for the products and services offered. About 20% of the surveyed traders put their shop opening hours down to traffic and light. The occupants have signalled that strategic placement of street lighting in and around the marketplace would alleviate some of the safety concerns in the area as well as provide a safer environment for customers and shop owners alike; it could also allow for extended shopping times and more frequent visits from customers, which could improve the profitability and revenue generation from the market.

5.5. Energy Audit

5.5.1. Survey Statistics

A total of 13,598 shops were identified in the market. Data was obtained from 12,929 of those shops; this signifies a 95.1% enumeration rate. The data showed the building utilization distribution and the use of energy. It can be seen that 50% are shops, 37% stores and 13% stalls.



Figure 32: Geographical representation of layout in Sabon Gari Market

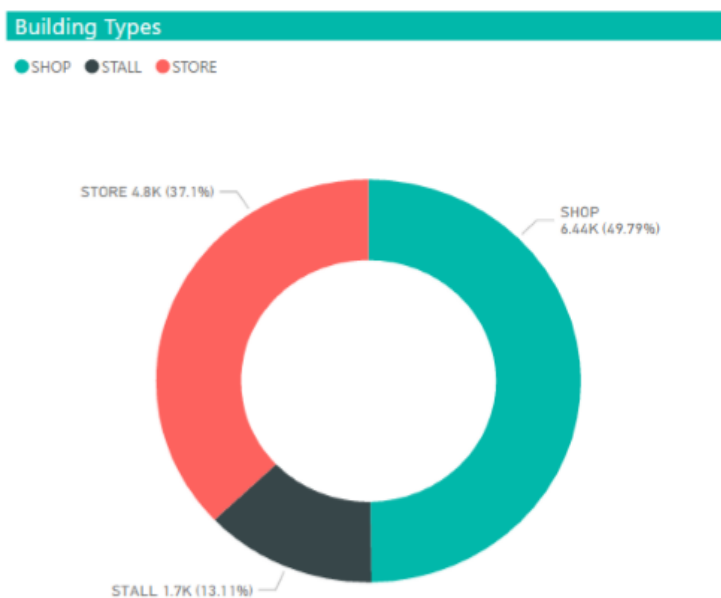


Figure 33: Distribution of building types in Sabon Gari Market

There are 36 different blocks within Sabon Gari Market based on the information gathered from the market.

5.5.2. Load Analysis

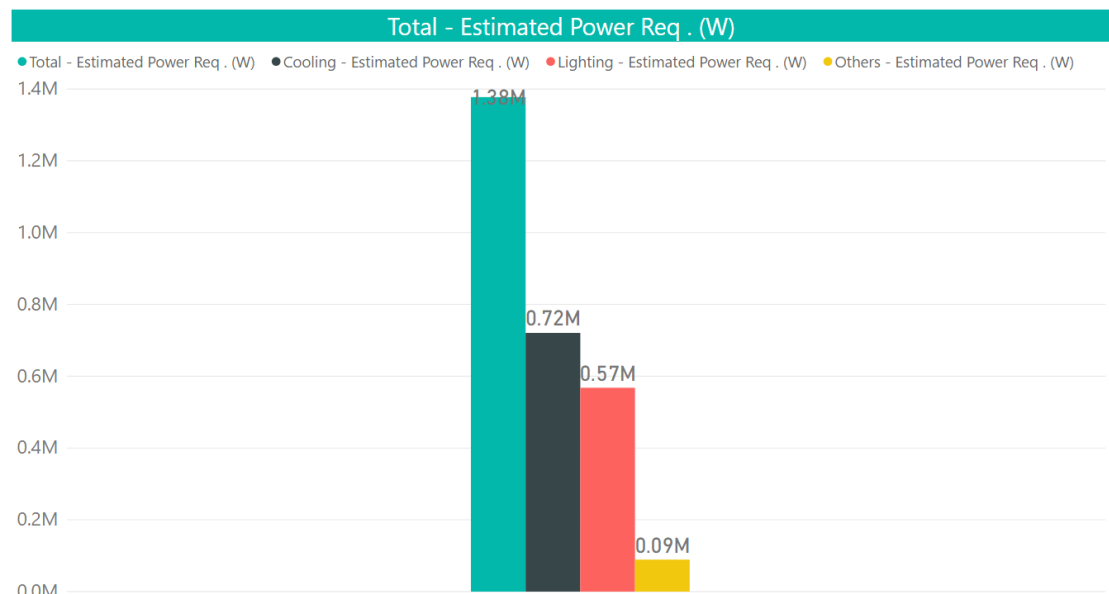


Figure 34: Estimated power requirements in Sabon Gari Market

The total estimated power requirement for the market is about 1.38W. The power requirements within the market are evenly distributed with over 1.3 MW expended on cooling, lighting and other activities in all 36 identified blocks. It shows that blocks, C Line, D Line and Yan Kura areas of the market show the highest consumption due to the density of shops within the vicinity of these blocks.

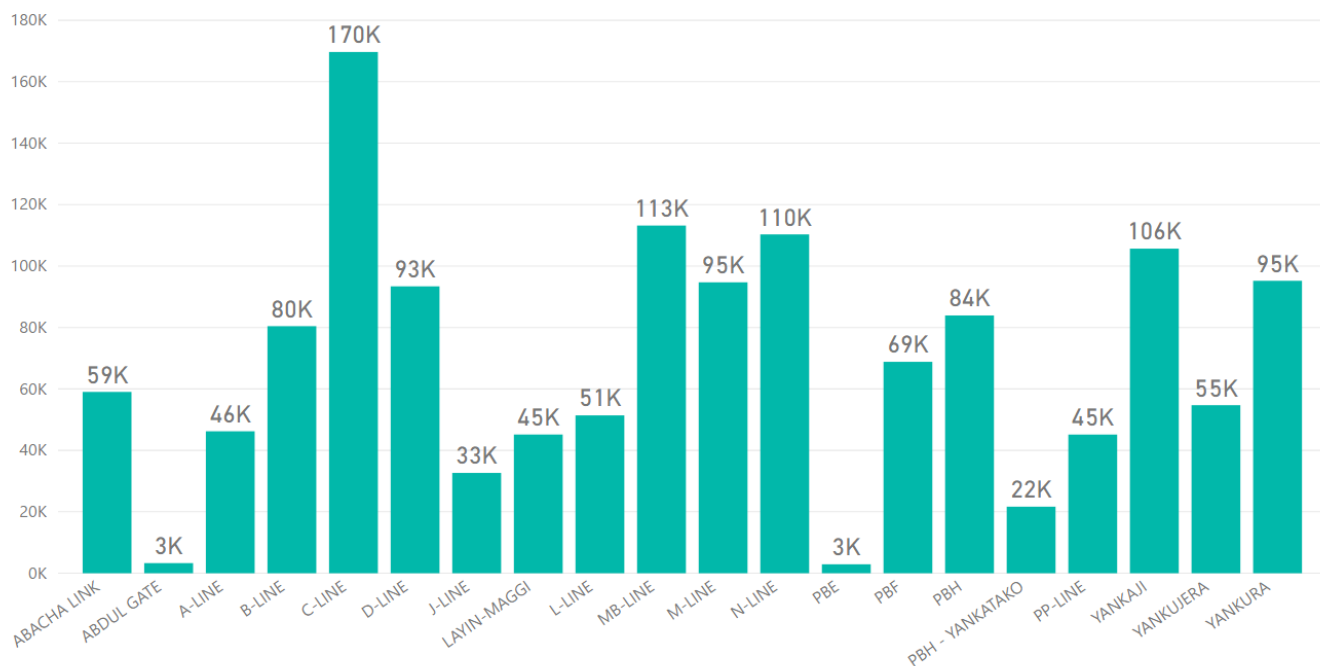


Figure 35: Total estimated power requirement by sections in Sabon Gari Market

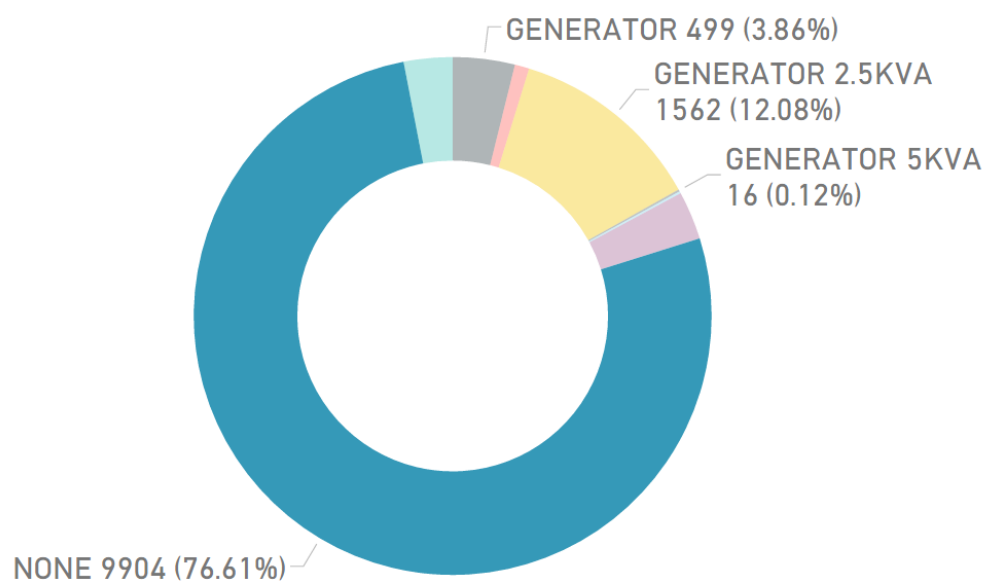


Figure 36: Alternative sources of energy used in Sabon Gari Market

5.6. Recommendation

Based on the fact the market is mostly retail and there is very little fabrication the recommended solution for the deployment of decentralised solar solution using high capacity solar home systems (1kW to 5Kw each) to meet the current demand.

High Capacity Solar Home Systems could be deployed for users with less load requirements that have smaller load requirements such as lighting, charging and DC fan use. Users with larger load requirements could use more sophisticated DC & AC Solar home systems that have capacity to power more appliances.

Metering will be undertaken using, a pay as you go platform where the customer pre-pays for the energy they consume.

Electricity Demand	1.38MW – current demand 3.29MW – estimated total demand for entire market
Type of Configuration	High capacity, Small and Medium solar home systems
Proposed System Size	1MW decentralised solution (Phase 1)

Table 10: Proposed system overview for Sabon Gari Market

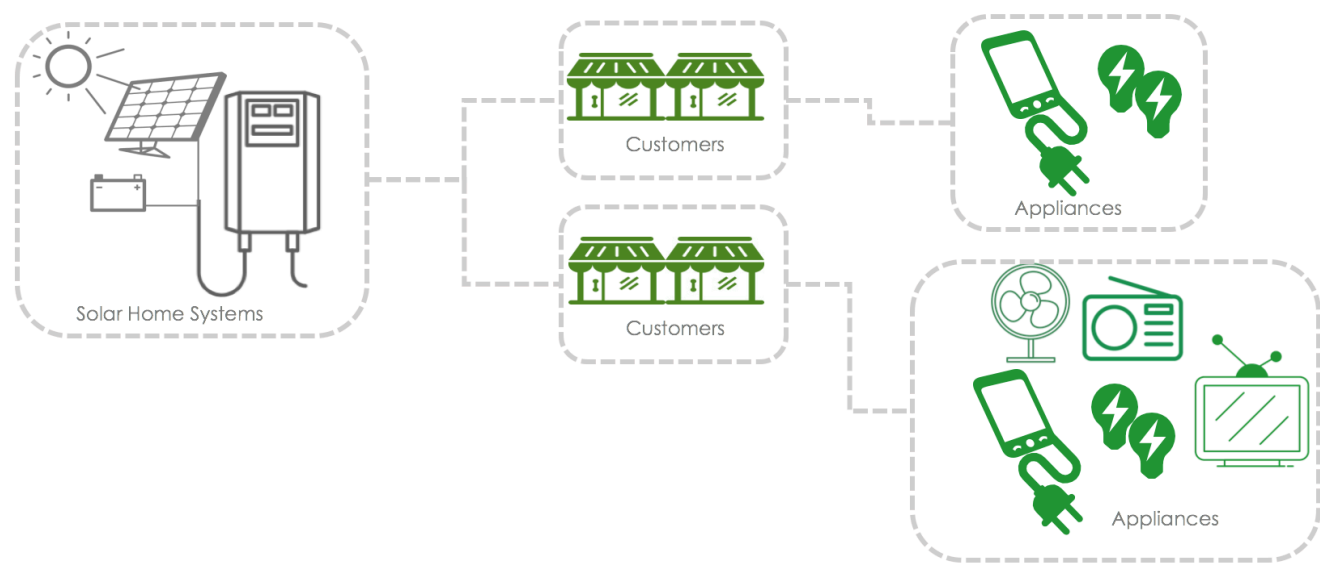


Figure 37: Representation of distribution network for Sabon Gari Market

SOMOLU PRINTING COMMUNITY



RURAL ELECTRIFICATION AGENCY

6. SOMOLU PRINTING COMMUNITY

6.1. Introduction

Somolu printing community is located in Lagos State within Somolu and Bariga Local Government Area. The community is split into 8 zones (Zones 1 to 6 located within Somolu and Zones 7 to 8 within Bariga). For the purpose of this study, the exercise was carried out within Zone 1 to 6.

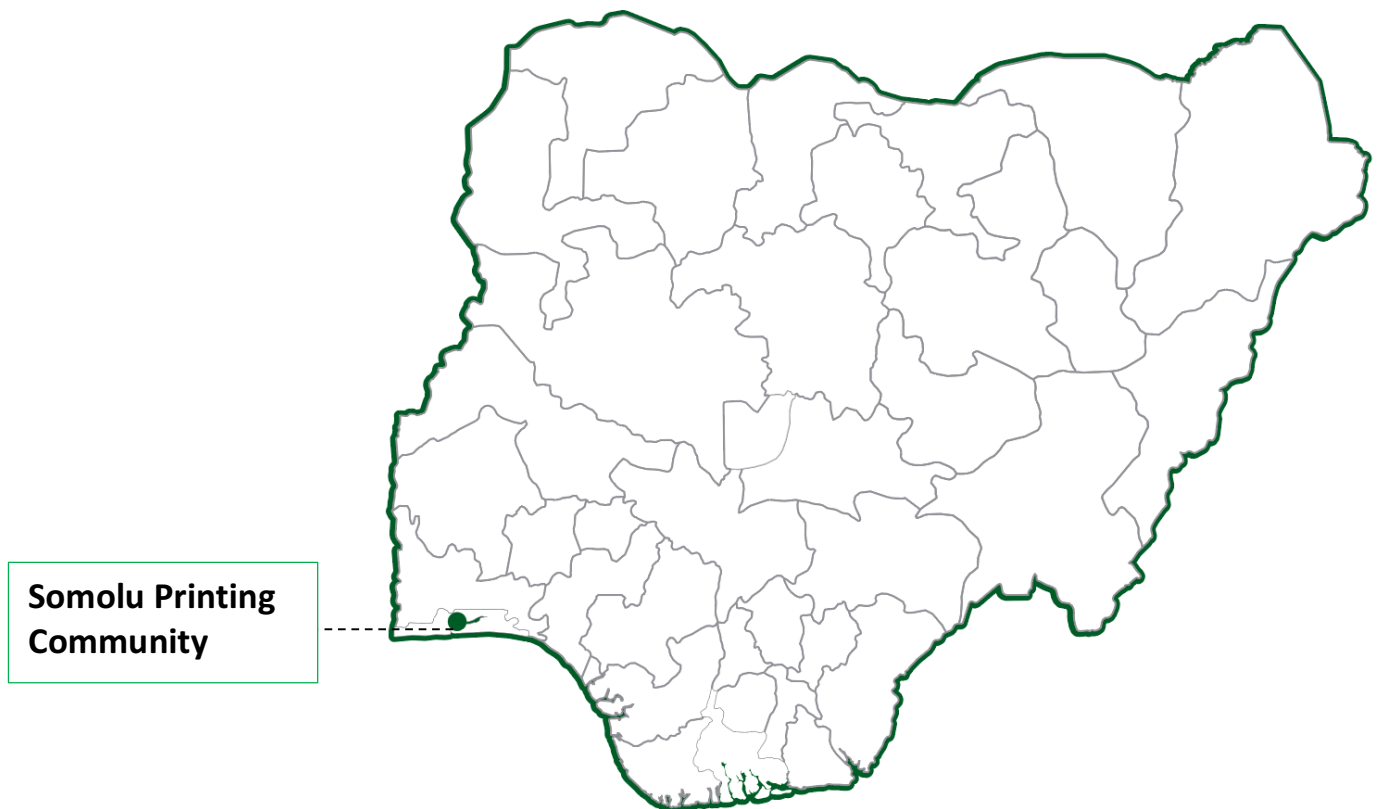


Figure 38: Location of Somolu Printing Community

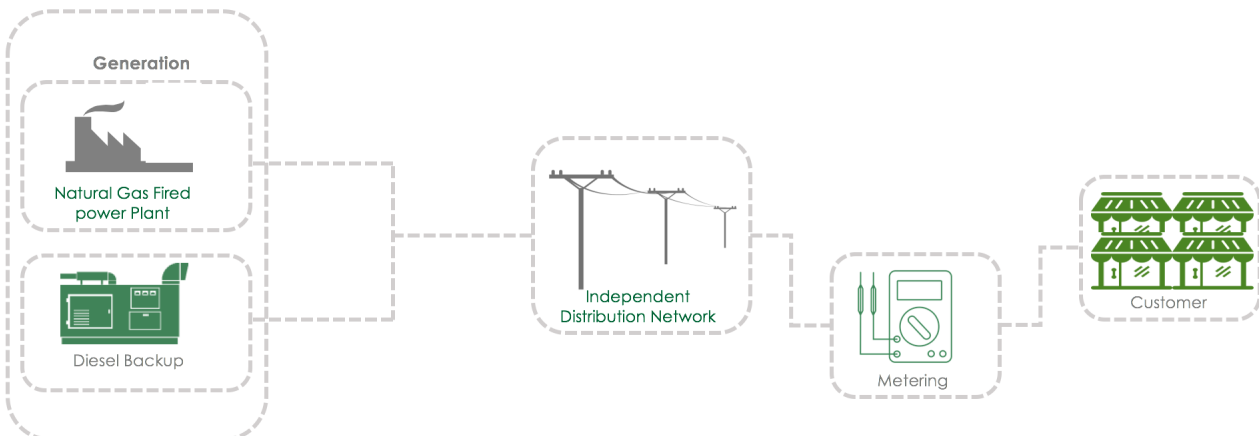
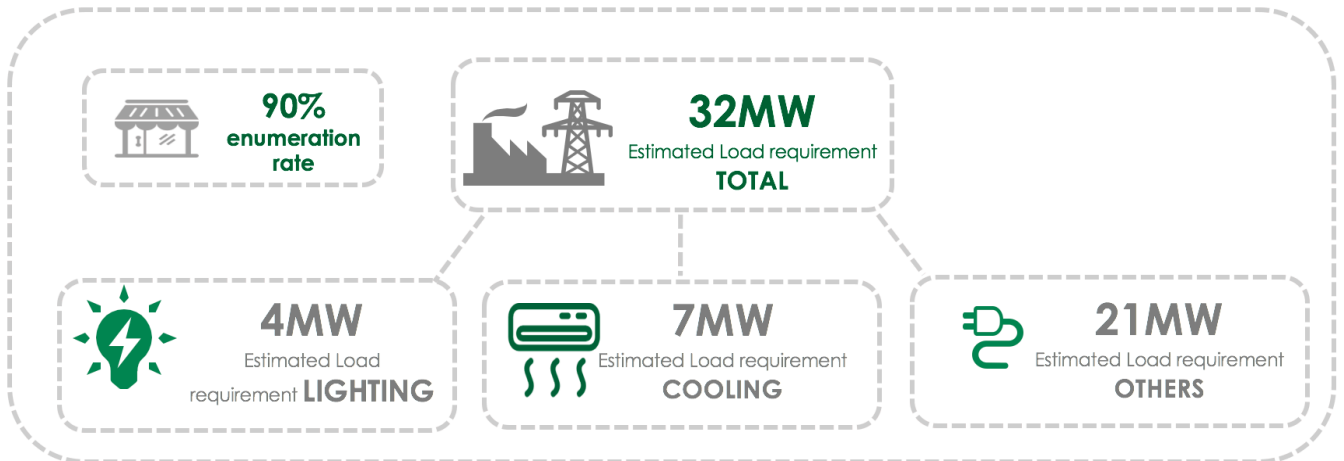
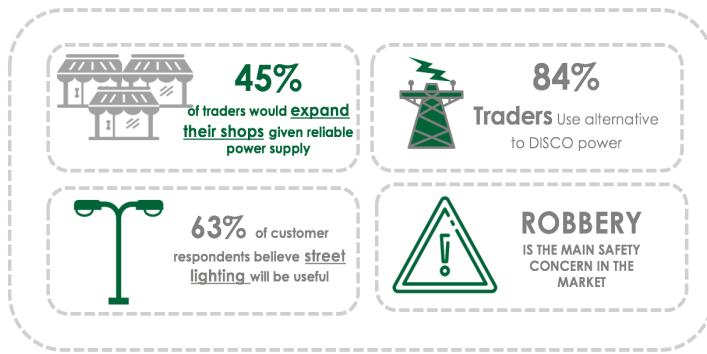


Figure 39: Overview of Somolu Printing Community findings

Picture 11: Men at Work. Somolu Printing Community, Lagos State



6.2. Background

Somolu Printing Community is located in Somolu Local Government Area in Lagos State and has a population of 555,089 people, land area of 14.6 sq.km and population density of 38, 019 sq.km. The printing profession is about 160 years old in Nigeria and believed to be one of the highest employers of printers in the country.

Known for its large concentration of printers in Lagos, the Somolu Printers Community is faced with challenges ranging from high cost of printing machines, huge maintenance cost on machines and generators, irregular power supply, and high production cost due to amount spent on power supply. The printers in Somolu are registered under the umbrella called **Association of Professional Printers of Nigeria (ASSPPON)**.

There are about 10,700 professional printers in Somolu (with some extending towards the Bariga area of Lagos) with printing activities like graphics design, general paper printing, commercial (large format) printing, foil printing, paper cutting, engraving, cladding and signage.

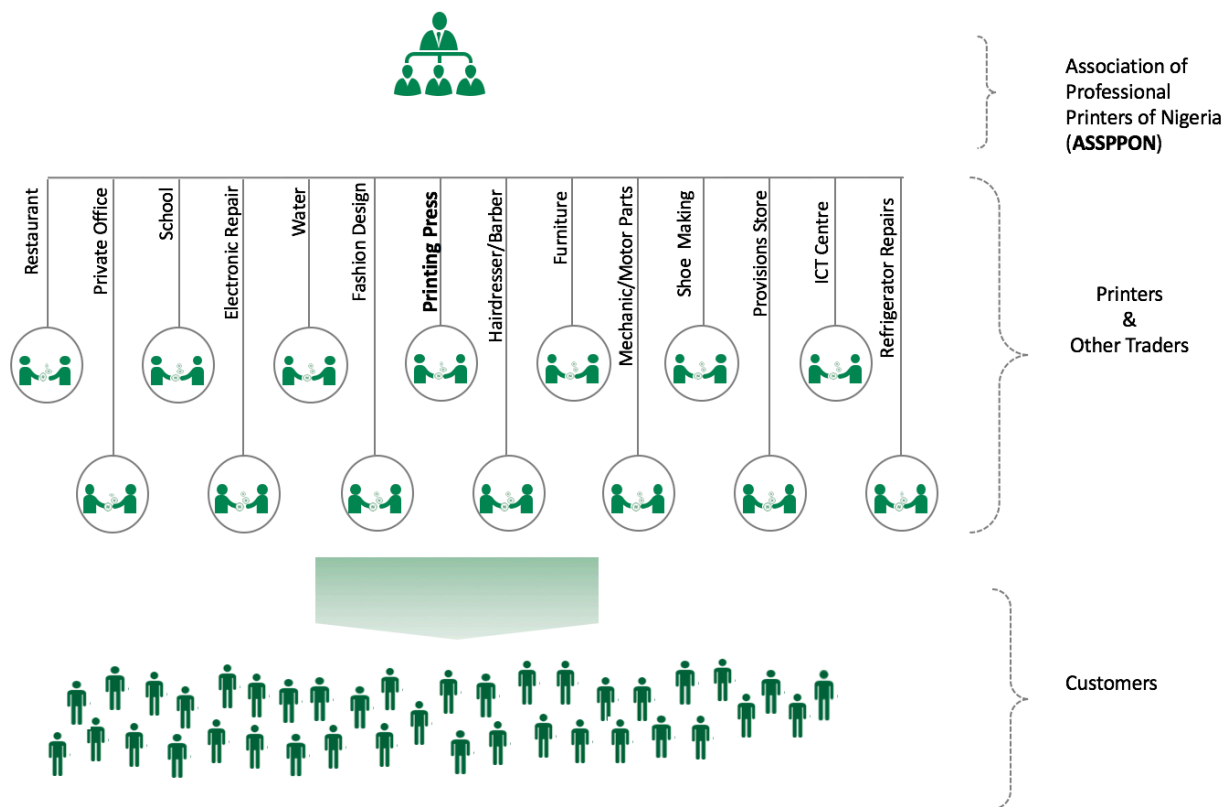


Figure 40: Structure of Somolu Printing Community

6.3. Socioeconomic Analysis

6.3.1. Survey Statistics



Figure 41: Summary of survey statistics from Somolu Printing Community

Picture 12: Printing Press. Somolu Printing Community, Lagos State



6.3.2. Traders

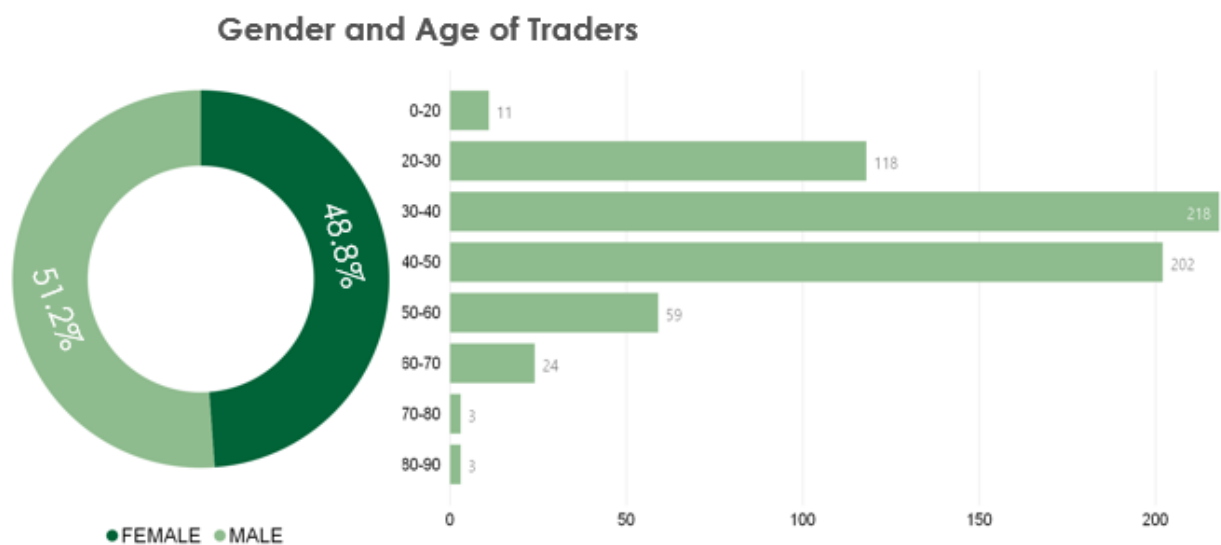


Figure 42: Gender and age distribution of traders in Somolu Printing Community

Traders were surveyed in Somolu Local Government, 52% of whom were female and majority of whom were aged 30 -40 years. Traders most commonly expressed concerns around expenses related to self-generation, and raised issues of health and safety due to air and noise pollution in the community during general interviews.

"Constant power will enhance our productivity and increase our profit margin because the issue of buying fuel and maintaining generators will be ruled out."

Adefope Oluwale Johnson
Chairman, Association of Professional Printers
Shomolu Division

Business Type	Male	Female	Total
<i>Electronic Repair</i>	74%	26%	100%
<i>Fashion Designer</i>	45%	55%	100%
<i>Food</i>	0%	100%	100%
<i>Fridge Repairer</i>	100%	0%	100%
<i>Furniture</i>	100%	0%	100%
<i>Hairdresser/Barbering Saloon</i>	57%	43%	100%
<i>ICT</i>	86%	14%	100%
<i>Mechanic/Motor Parts</i>	86%	14%	100%
<i>Printer/Printing Press/ Printing Material</i>	75%	25%	100%
<i>Private Office</i>	58%	42%	100%
<i>Restaurant/Beer Parlour</i>	10%	90%	100%
<i>School</i>	50%	50%	100%
<i>Shoe Making</i>	100%	0%	100%
<i>Store (Foodstuff, Toiletries, Provision)</i>	35%	65%	100%
<i>Water</i>	100%	0%	100%

Table 11: Gender distribution of survey participants by business type in Somolu Printing Community



Picture 13: Somolu Printing Community, Lagos State

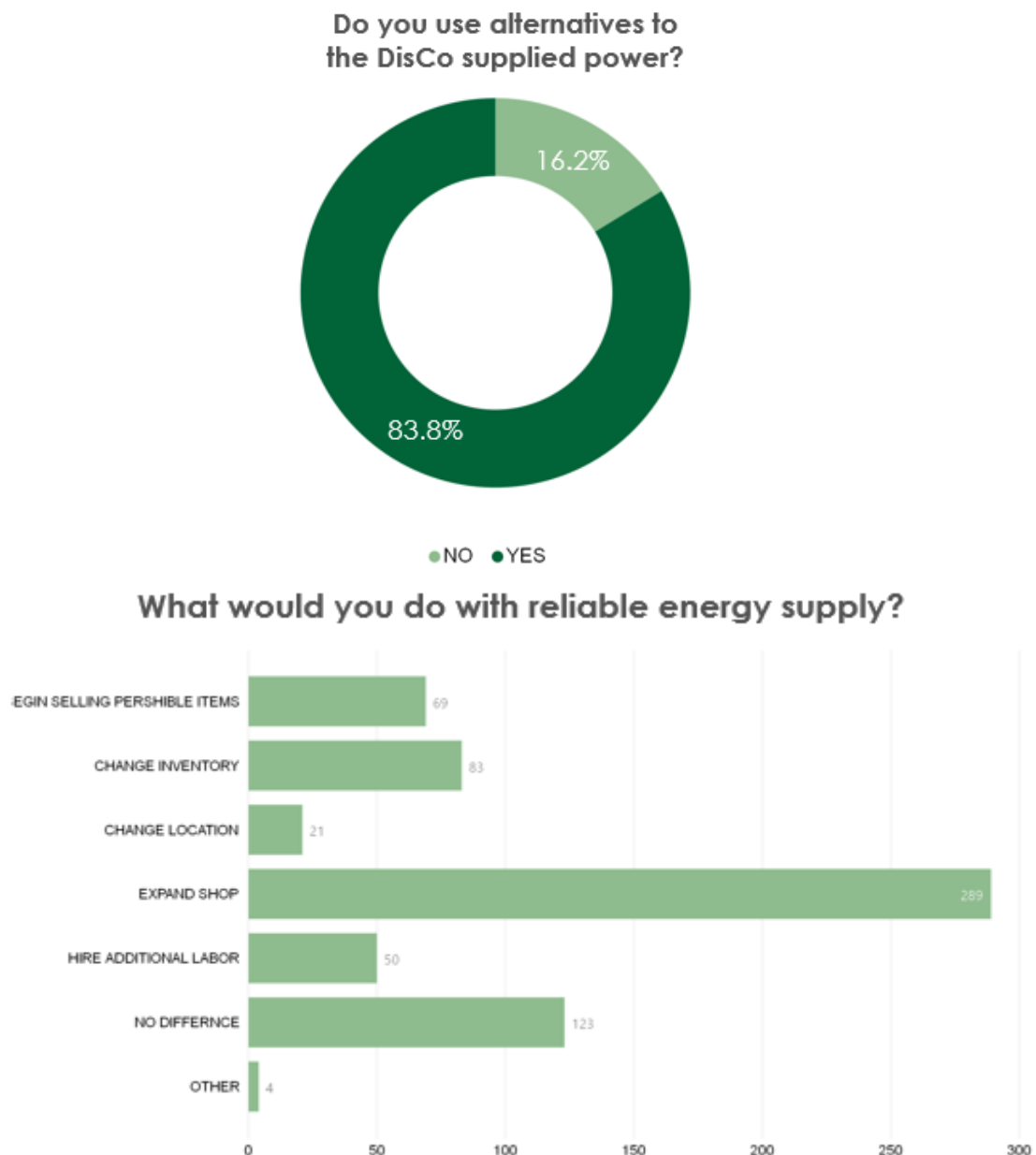


Figure 43: Energy source and effects of energy supply for traders in Somolu Printing Community

A majority of traders (82%) of traders noted that they had to use alternative supply to the local distribution company in order to run their businesses, and noted that if they had reliable power, they would be able to expand their businesses (48.5%) and employ people 6%. This supports the theory of change which suggests that reliable power supply will have positive impacts on revenues for business, thereby leading to expansionary economic effects.



Picture 14: Generator powering shops in Somolu Printing Community, Lagos State

6.3.3. Customers

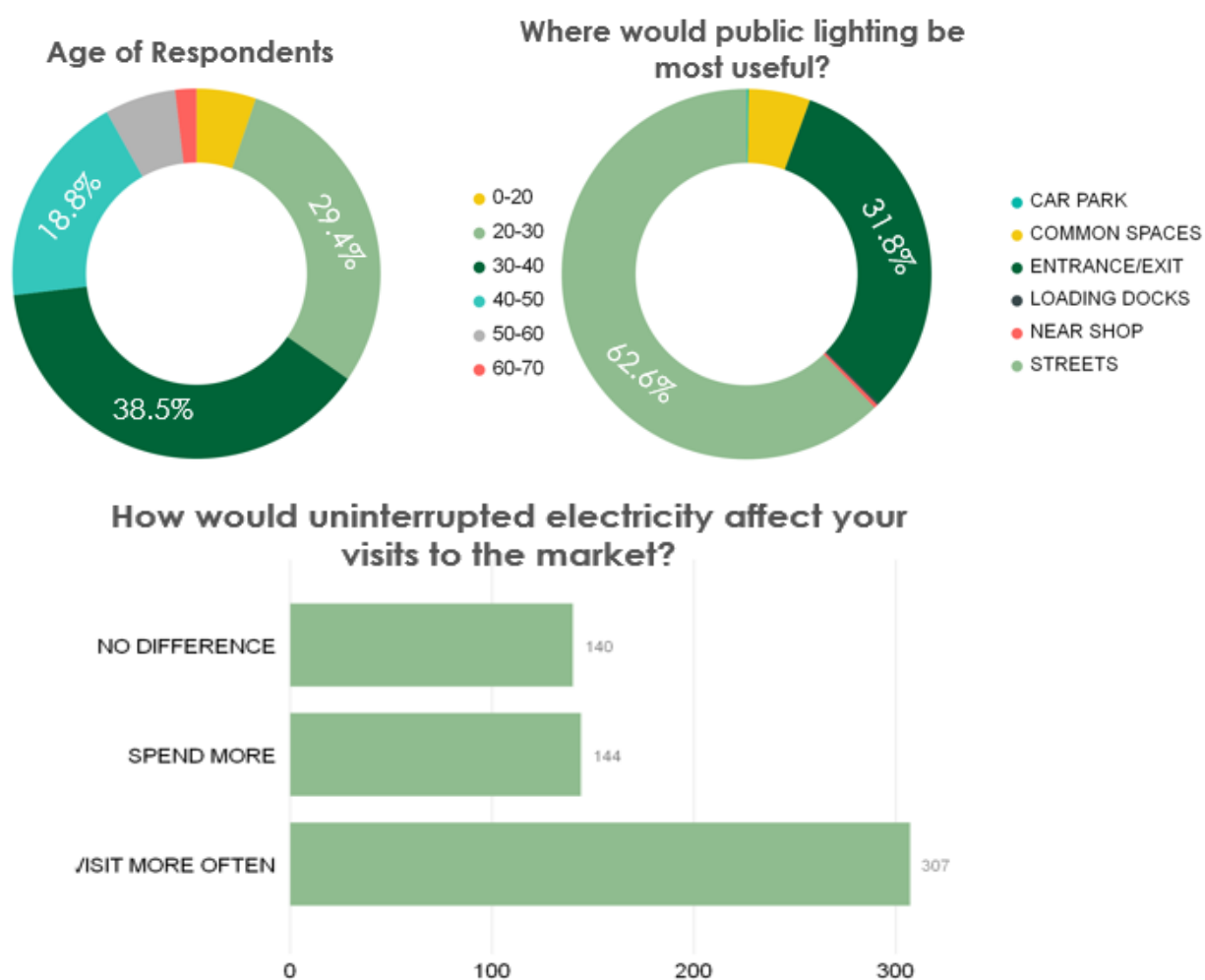


Figure 44: Assessment of age and behaviour of customers in Somolu Printing Community

51.3% of customers stated that they would use the services of the printing community more often if the power was reliable and steady – supporting the theory of change of increased revenue with reliable power. The need for street lighting was particularly emphasized as a priority to customers.

Items Purchased	7AM-12PM	5PM-9PM	12PM-5PM	9PM-12PM	Total
<i>Papers/Printing Materials</i>	49%	5%	46%	0%	100%
<i>Foodstuffs/Provisions</i>	27%	15%	58%	1%	100%
<i>Auto Repair</i>	36%	0%	64%	0%	100%
<i>Toiletries</i>	17%	33%	50%	0%	100%
<i>Clothing Material</i>	27%	14%	59%	0%	100%
<i>Wood</i>	67%	0%	33%	0%	100%
<i>Phone and Computer Accessories</i>	45%	0%	55%	0%	100%

Table 12: Most common times of day for each purchase type by customers in Somolu Printing Community



Picture 15: Market Activity in Somolu Printing Community, Lagos State

6.3.4. Residents

Do you use alternative power supply?

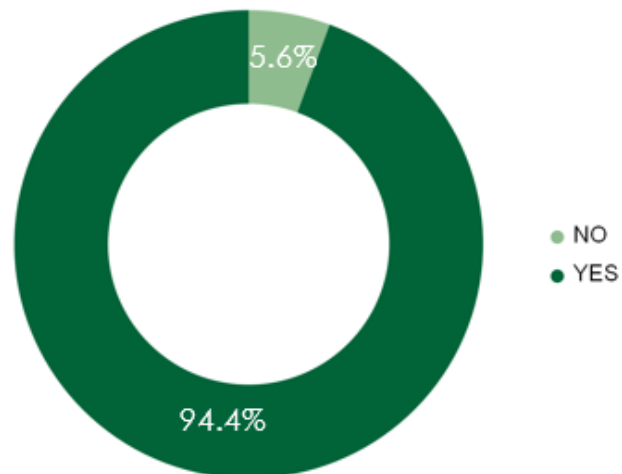


Figure 45: Use of alternative energy sources by residents in Somolu Printing Community

A vast majority of residents of the Somolu Community (94.4%) have alternatives to grid supplied electricity.

What is the largest source of noise?

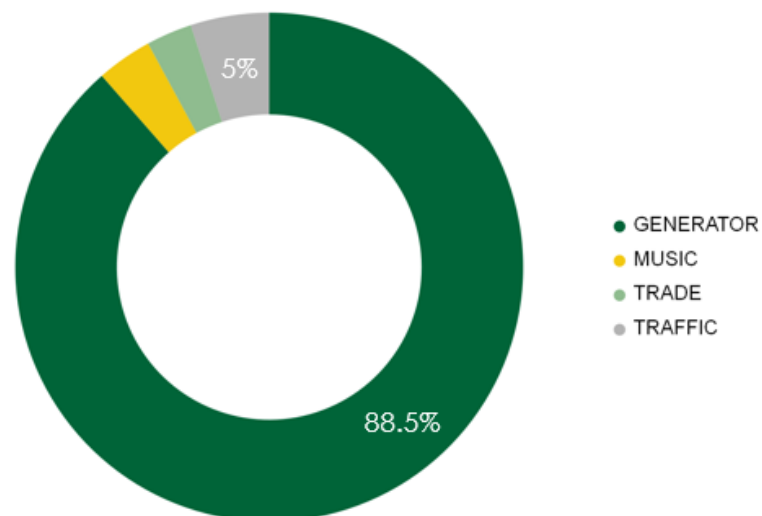


Figure 46: Source of noise for residents in Somolu Printing Community

They additionally identified generator noise as the single largest source of noise pollution in the neighbourhood, reducing quality of life.

Safety Concerns	MALE	FEMALE
<i>Robbery(Shop)</i>	14%	15%
<i>Vandalism</i>	11%	11%
<i>Harassment</i>	22%	18%
<i>Robbery(Personal)</i>	52%	55%
<i>Drugs</i>	1%	1%
<i>Rape</i>	0%	0%
Total	100%	100%

Table 13: Safety concerns by gender in Somolu Printing Community

The main safety concerns were consistent with both genders of trades people,

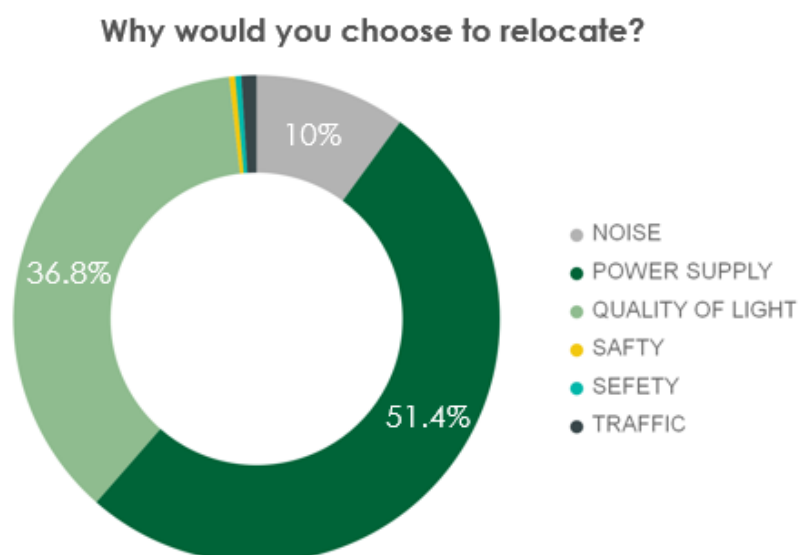


Figure 47: Assessment of relocation possibilities amongst residents in Somolu Printing Community

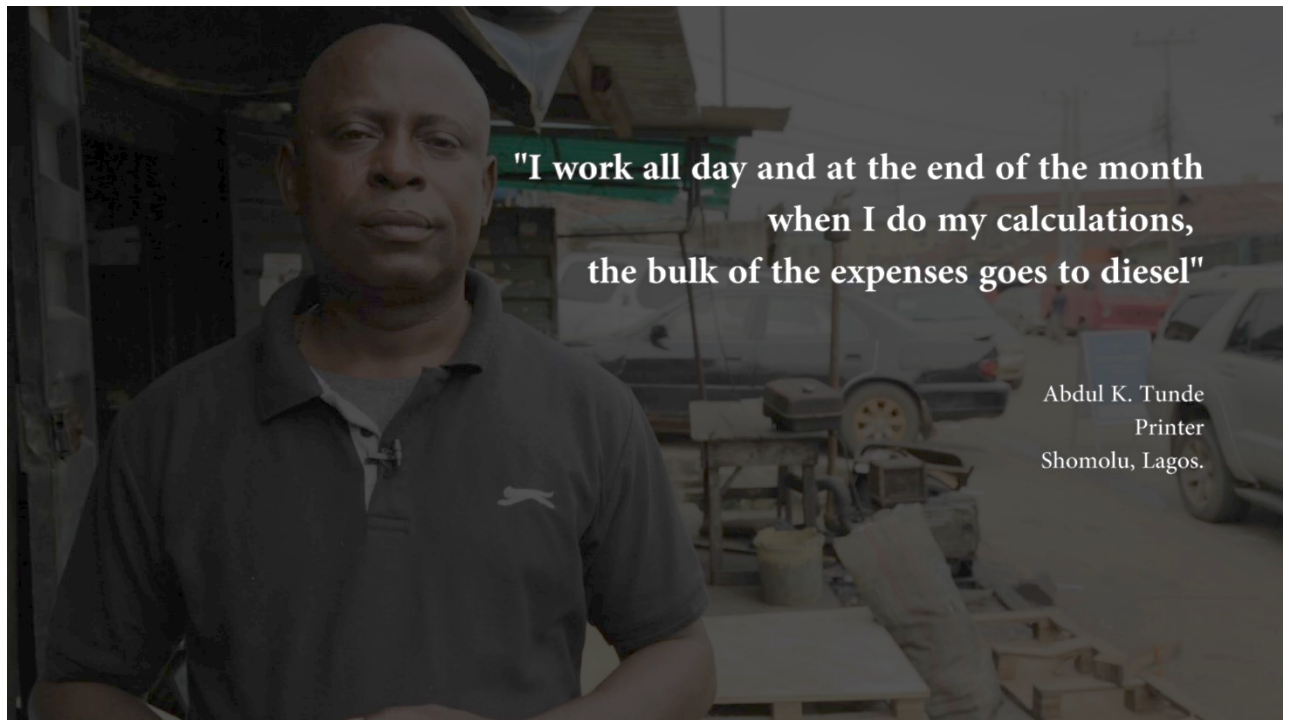
Issues such as supply and the quality of the power once supplied were the largest reason for a desire to move out of the Somolu community.

Picture 16: Oil Spills around Generator. Somolu Printing Community, Lagos State



6.4. Conclusion

The surveys suggest that the energy intervention should encourage more customer spending and business expansion while improving the quality of life of its residents, and reducing the air and noise pollution associated with self-generation. Traders also showed significant ability to pay, as a number of traders self-reportedly spend up to N300,000 monthly on both grid and off grid power solutions.



6.5. Energy Audit

6.5.1. Survey Statistics

A total of 4,262 shops in the printing area were enumerated. The printing community is separated into 6 zones. Most shops (959) are located in Zone 6 of the community. Data was obtained from 3,830 shops, signifying an almost 90% enumeration rate.

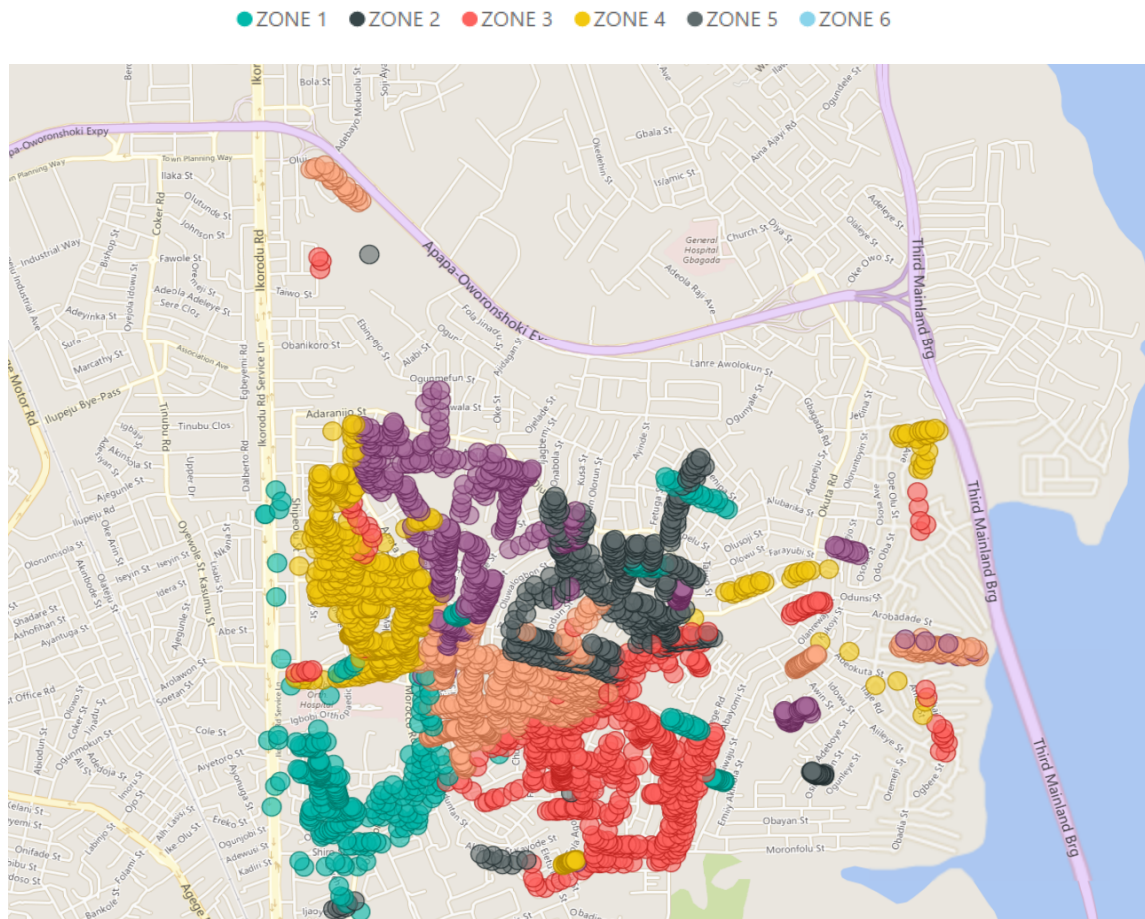


Figure 48: Geographical representation of market layout in Somolu Printing Community

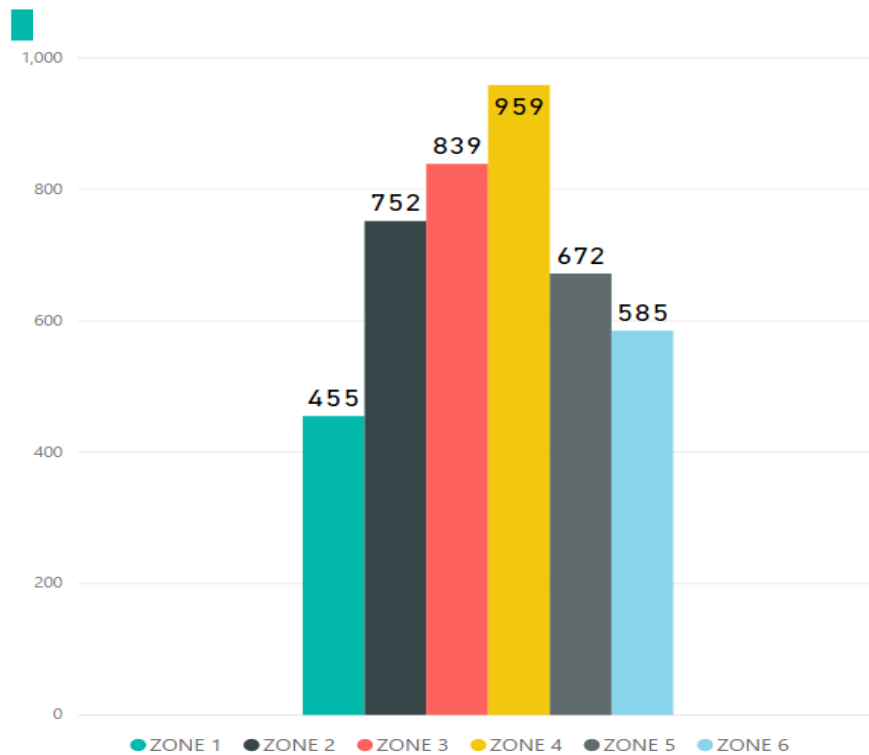


Figure 49: Number of shops by zone in Somolu Printing Community

6.5.2. Load Analysis

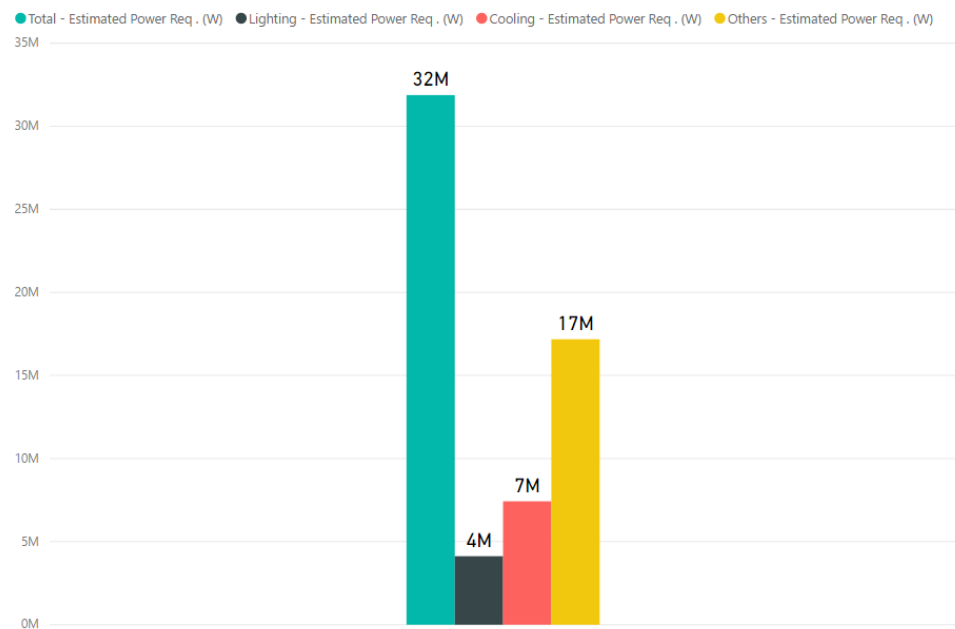


Figure 50: Estimated power requirement in Somolu Printing Community

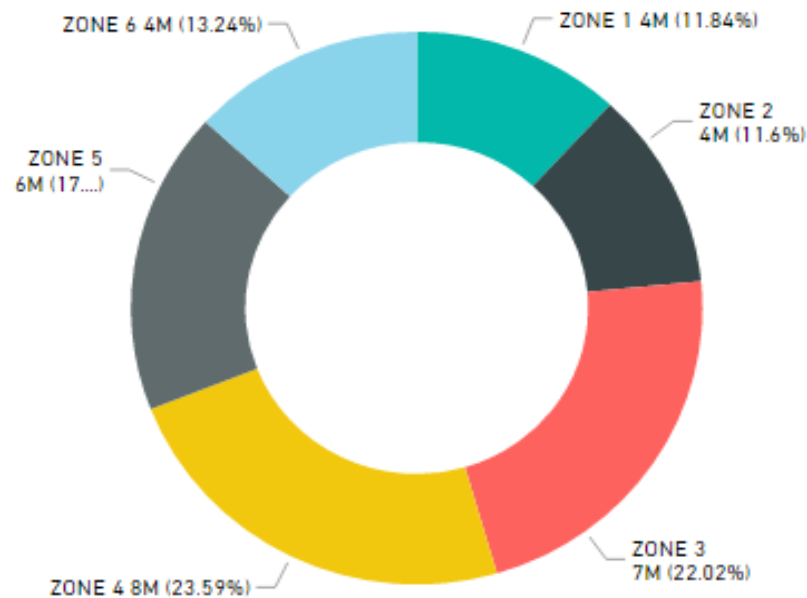


Figure 51: Total estimated power requirement by zone in Somolu Printing Community

The total estimated power requirement & ideal plant size for the community is 32MW. 4.1MW (14.4%) of that is required for lighting and another 7.4MW (25.9%) for cooling. Zone 4 of the market requires the more power than all the other zones.

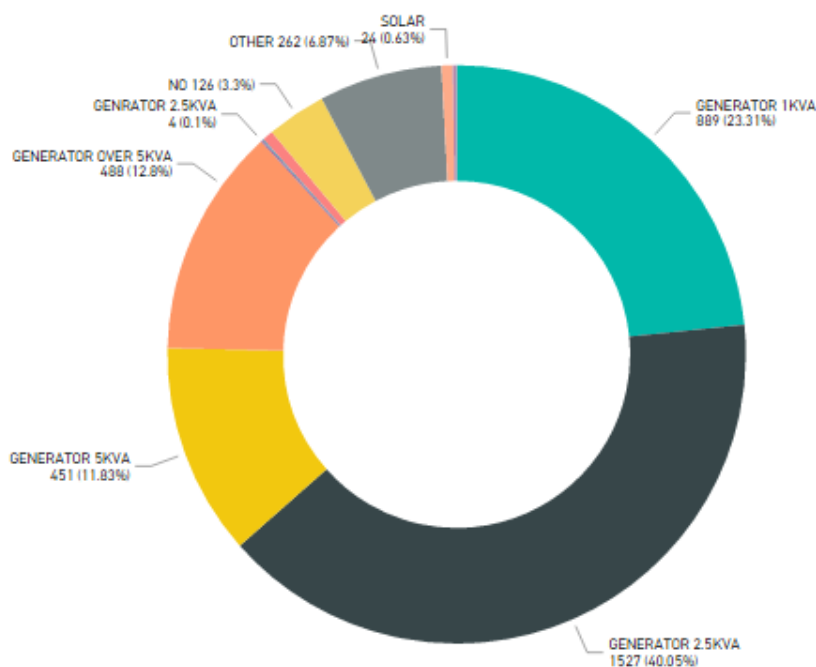


Figure 52: Alternative sources of energy used in Somolu Printing Community

The data showed that 96.09% of Shops surveyed use one form of self-generation or the other. A large majority of this selection use a generator to power their shops (over 86%). The percentages of the various generator sizes used in the market are depicted above.

6.5. Recommendation

Based on the energy audit conducted for Somolu Printing Community, the total energy demand for zone 1 - 6 is 32MW (printing presses and residents). Phase one of the project will power printers in zone 2 and 4 where there is the highest concentration of printing presses then the Lagos State Water Corporation, Somolu General Hospital, National Orthopaedic Hospital Igbobi and Igbobi College with a combined load of 4.73MW.

The preferred solution for a **gas fired plant** for Somolu Printing Community was arrived at by reason of the heavy machinery used by the printing presses; this led to the initial proposal for an installed capacity of 5MW which will be expanded as demand increases. It may be beneficial to take advantage of the natural gas pipeline in the area.

Electricity Demand	4.73MW – Printers located in zone 2 and 4 32MW – current demand for zones 1 to 6
Type of Configuration	Compressed Natural Gas Plant
Proposed System Size	5MW (phase 1) Scalable

Table 14: Proposed system overview for Somolu Printing Community

In order to ensure consumers are only billed for the energy consumed, all consumers (shops) should be individually metered. This will also foster trust between the power generator and consumers.

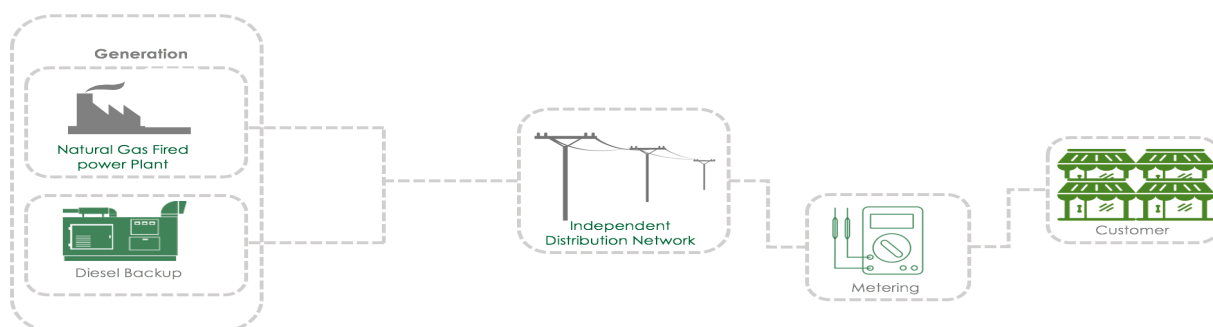


Figure 53: Representation of distribution network for Somolu Printing Community

SURA SHOPPING COMPLEX



RURAL ELECTRIFICATION AGENCY

7. SURA SHOPPING COMPLEX

7.1. Introduction

The Sura Shopping Complex is located in Lagos. It is an Ultra-modern shopping market built to improve the marketing experience from the old Sura Market adjacent to it. The Shopping Complex covers a land area of about 42,000sqm, with 1,047 shops for used mainly for commercial purposes.



Figure 54: Location of Sura Shopping Complex

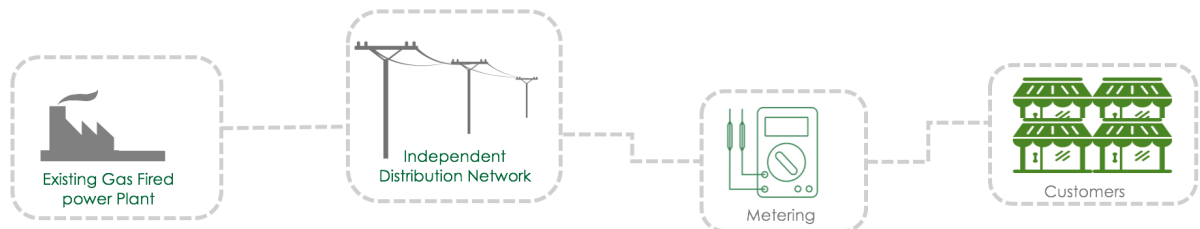
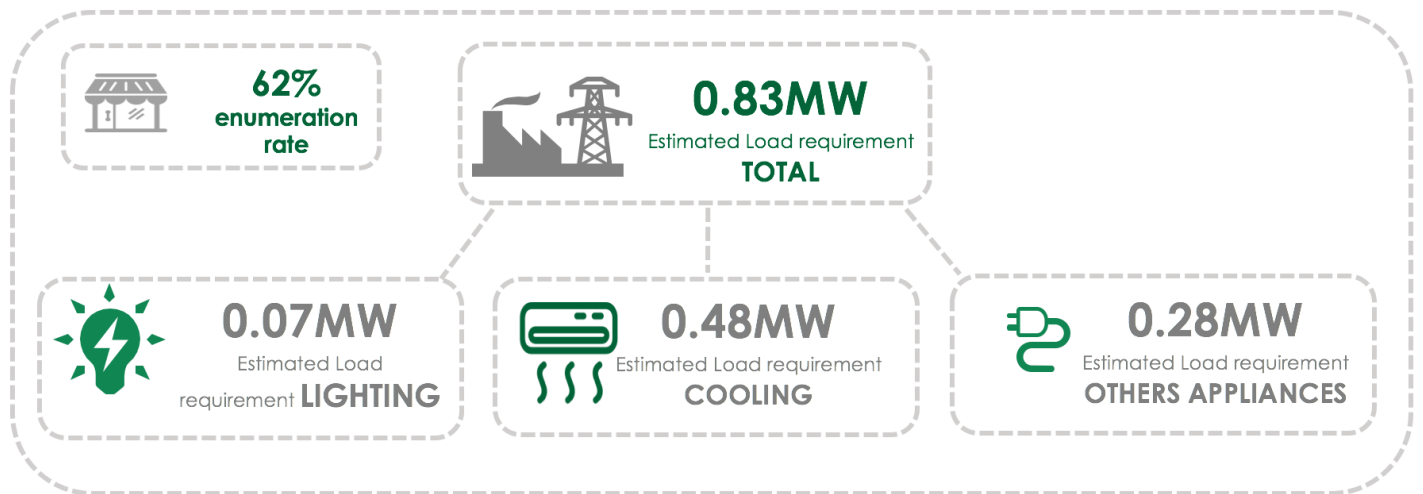
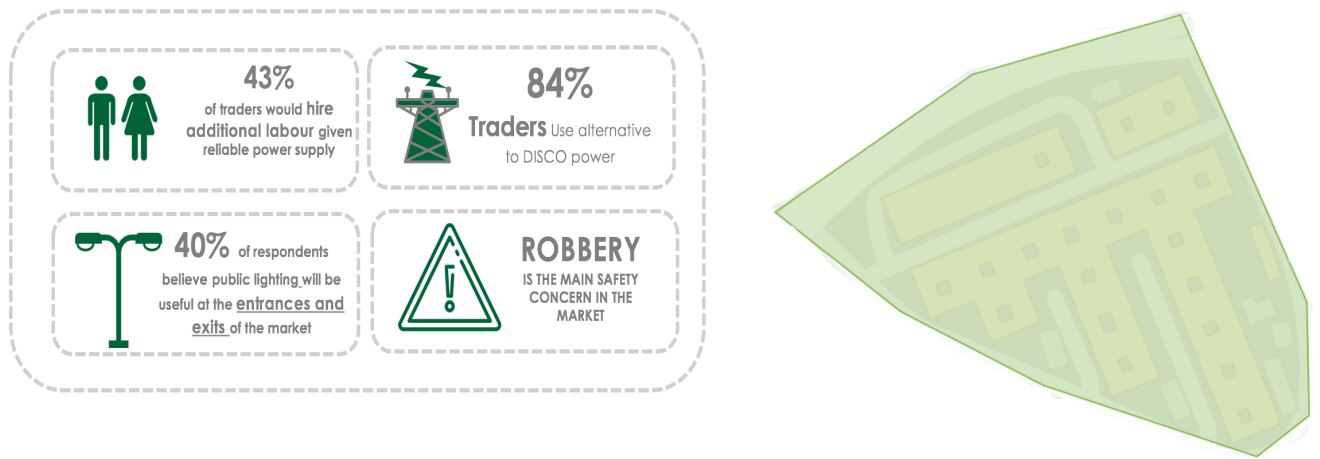


Figure 55: Overview of Sura Shopping Complex findings

7.2. Background

Lagos Island is the principal and central local government area in Lagos, Lagos State with a population of 209,437. The LGA only covers the western half of Lagos Island; the eastern half is under the jurisdiction of the LGA of Eti-Osa. Lagos Island is connected to the mainland by three large bridges. Forming the main commercial district of Lagos, Lagos Island plays host to the main government buildings, numerous markets and offices. Most Nigerian banks' head offices are located on Lagos Island. Other medium and large-scale businesses such as real estate consultancy firms, electrical appliances manufacturers and retail stores.

The Sura shopping complex in Lagos is known particularly for discounted household items, domestic goods, including food stuff, fruits and vegetables. It is located in Osborne road, Simpson Street in Lagos Island. The Shopping Complex covers a land area of about 42,000sqm located on coordinates with 1,047 shops used mainly for commercial purposes.

The proposed power solution for Sura Shopping Complex is for Power to be supplied from an existing Power Plant which is about 2km away.

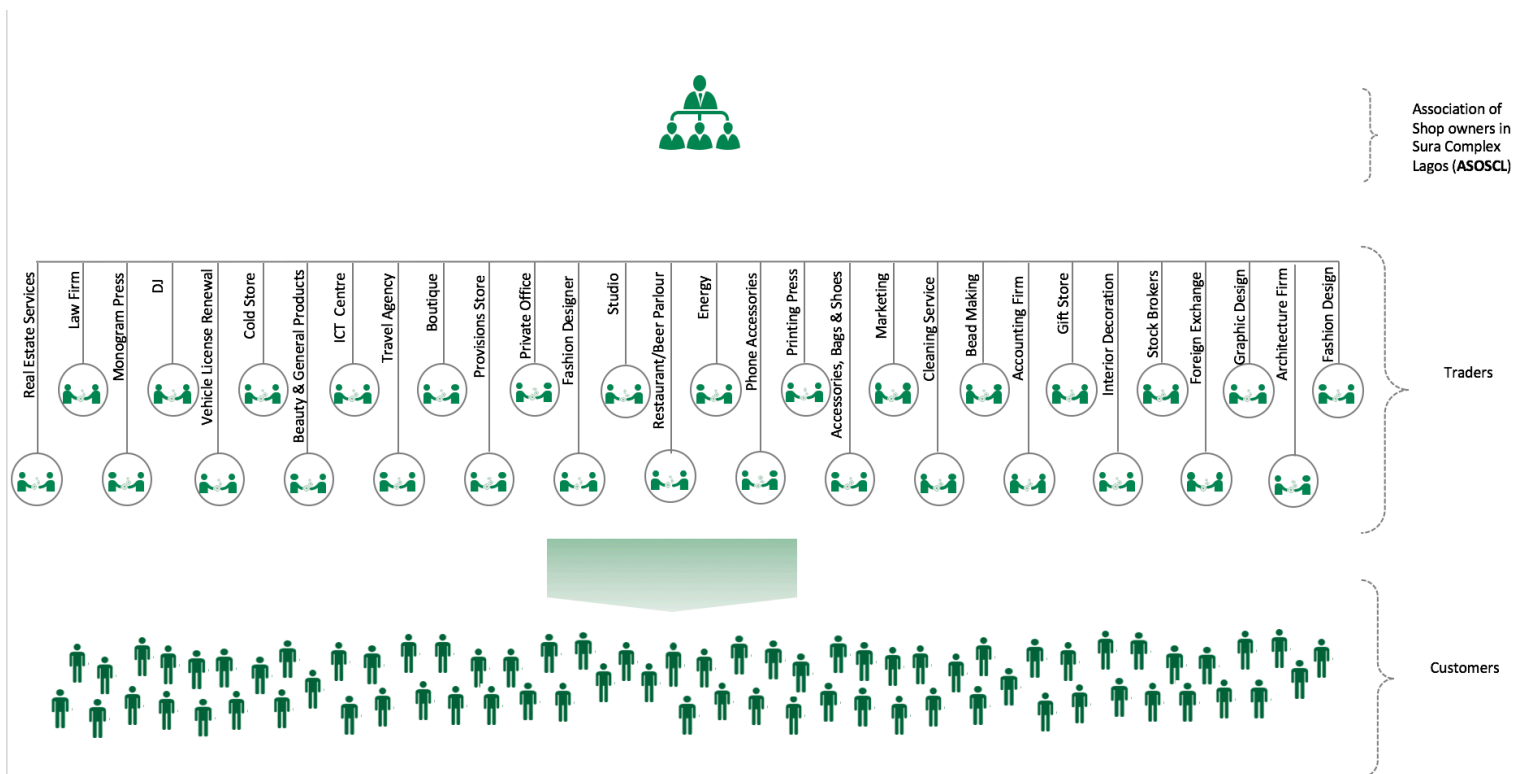


Figure 56: Structure of Sura Shopping Complex

7.3. Socioeconomic Analysis

7.3.1. Survey Statistics



Figure 57: Summary of survey statistics from Sura Shopping Complex

7.3.2. Traders

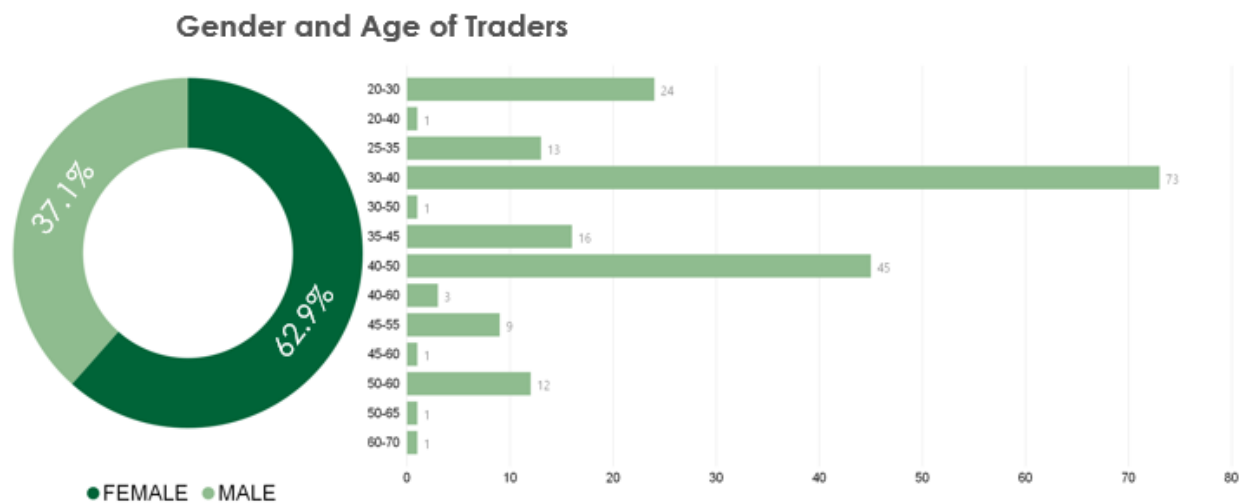


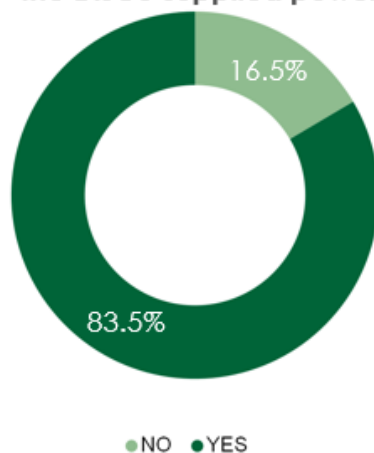
Figure 58: Gender and age distribution of traders in Sura Shopping Complex

There were a total of 44 traders' respondents. 28 of them were females and 16 of them were males. And 13 of them were within the (20-30) age bracket, 20 of them were within the (30-40) while the remaining 11 were within the (40-50), (50-60), (60-70)

Business Type	Female	Male	Total
<i>Cold store</i>		100%	100%
<i>Computer accessories</i>	100%		100%
<i>DJ</i>		100%	100%
<i>Enterprise</i>	100%		100%
<i>Estate management</i>	100%		100%
<i>Estate surveyor</i>		100%	100%
<i>Field</i>	100%		100%
<i>Food restaurant</i>	100%		100%
<i>Foodstuff</i>	100%		100%
<i>Goods</i>	100%		100%
<i>Intercoms</i>	50%		100%
<i>Law firm</i>		100%	100%
<i>Marketer</i>	100%		100%
<i>Pharmacy</i>		100%	100%
<i>Property and management Consult</i>	100%		100%
<i>Provision</i>	100%		100%
<i>Shoe</i>		100%	100%
<i>Slabs NIG. Limited</i>	100%		100%
<i>Super store</i>	100%		100%
<i>Beauty and general products</i>	100%		100%
<i>Clothing store</i>	44.44%	55.5%	100%
Total	63.4%	36.36%	100%

Table 15: Gender distribution of survey participants by business type in Sura Shopping Complex

Do you use alternatives to the DisCo supplied power?



What would you do with reliable energy supply?

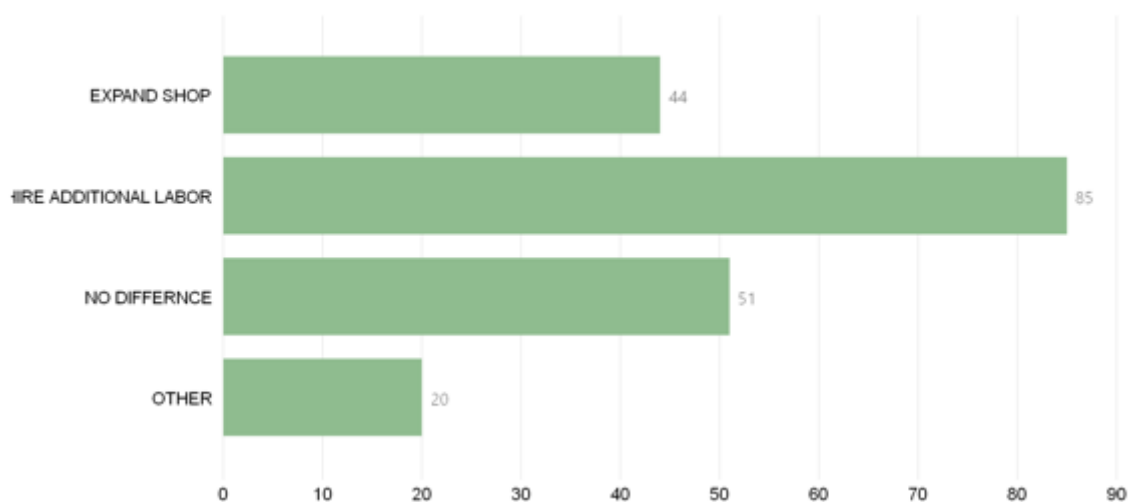


Figure 59: Energy source and effects of energy supply for traders in Sura Shopping Complex

The survey showed the benefits of having uninterrupted power supply from the traders' perspective is to increase productivity i.e. expand shop (40.91%), hire additional labour (25%). 73% of respondents use alternative sources of energy to power their businesses and 87.5% (from the survey) use generator as their primary alternative power while the remaining 13% use candlelight or solar.



Picture 17: Entrance to Sura Shopping Complex, Lagos State

7.3.3. Customers

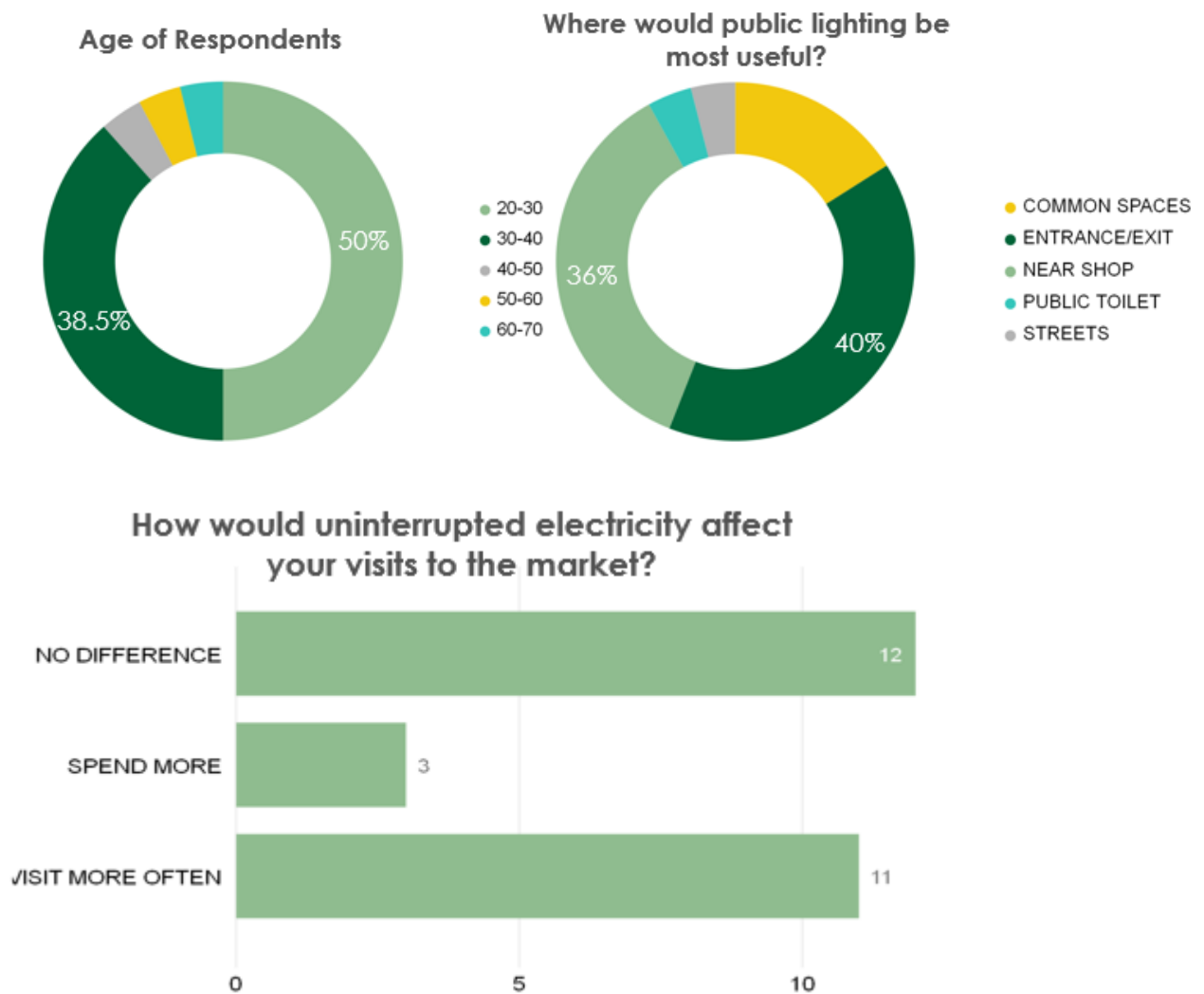


Figure 60: Assessment of age and behaviour of customers in Sura Shopping Complex

The survey had a total of 26 customer respondents, 10 males and 16 females. 23 of them are in the (20-30) and (30-40) age range. While the remaining 3 fall within the (40-50), (50-60) and (60-70) age range.

45% of them indicated having public lighting in the entrance and exit would be beneficial. 29% reported that public lights will be beneficial near the shops. And the rest indicated streetlights within the common spaces would be good. From this report, the most frequently indicated benefit of public lighting is to improve illumination in public spaces/common spaces, the entrance and exit of the shopping complex.

7.4. Conclusion

The dominant age groups for both categories of respondent are the (20-30) and (30-40). Reliable power supply plays a very important role as it affects both the traders and their customers' behaviour. 73% of the traders use generator to power their shops. The enterprise traders spend more on powering their generator (diesel and fuel) than what they spend on electricity bills. 50% of the traders reported that they will expand their businesses, hire additional labour, and do other things that will lead to profitability.

With regards to security, a lot of the respondents reported that they feel safe in the environment and that crime rarely occurs in the shopping complex. Most of them stated harassment and personal robbery as their key safety concern.

There are functioning street lights in most parts of the area. The respondents laid public lighting emphases in open spaces, entrances and exit of the shopping complex and close to the shops. As this will increase commercial activities, Aesthetics. Increase the level of Safety for Shop Owners and customers.



Picture 18: Sura Shopping Complex, Lagos State

7.5. Energy Audit

7.5.1. Survey Statistics

There is a total of 1,047 shops in the shopping complex. Data was obtained from 651 shops, while the rest of the shops were locked, unoccupied or under construction and as a result, inaccessible. That signifies a 62% enumeration rate.

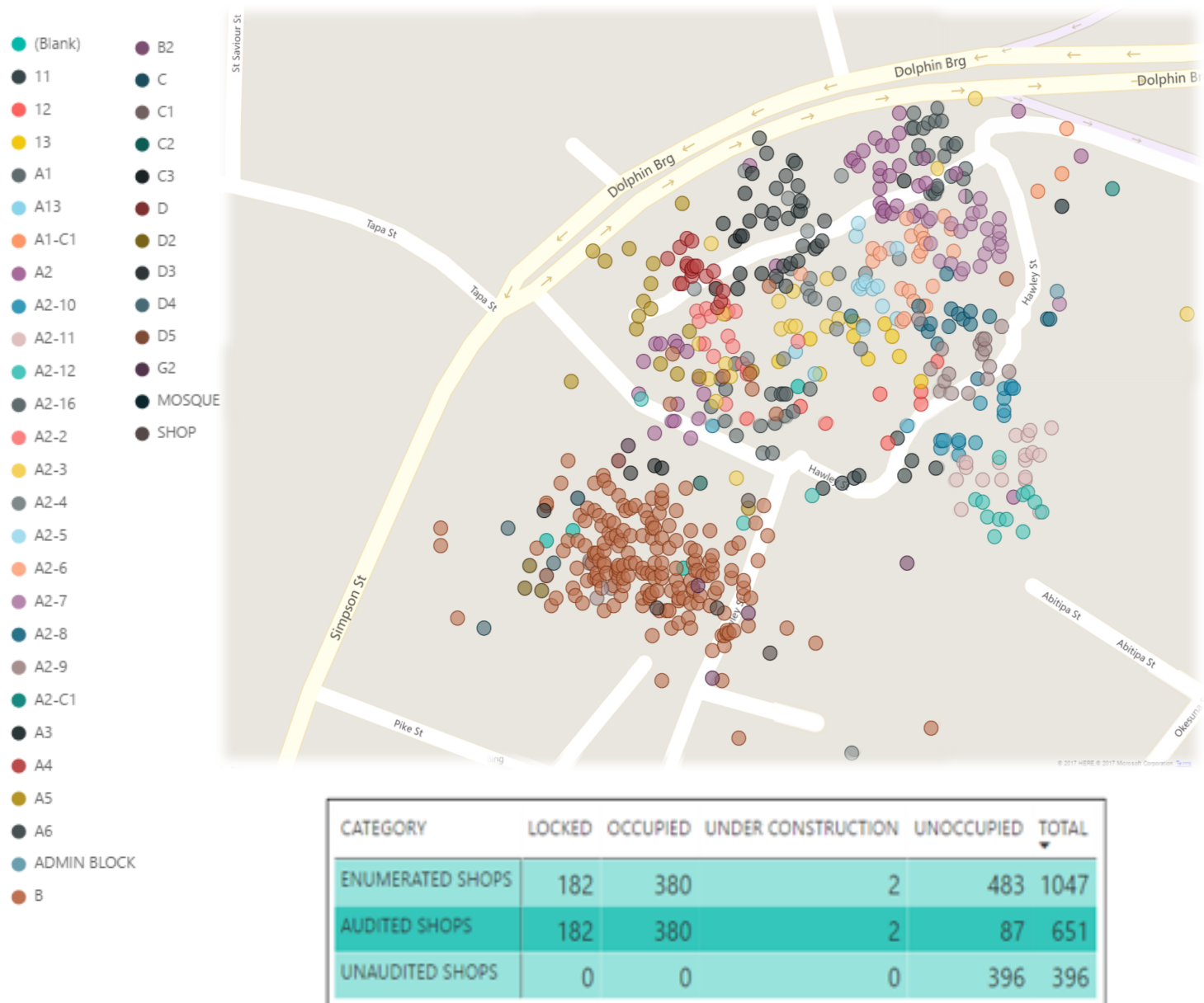


Figure 61: Geographical representation of market layout and number of shops enumerated in Sura Shopping Complex

7.5.2. Load Analysis

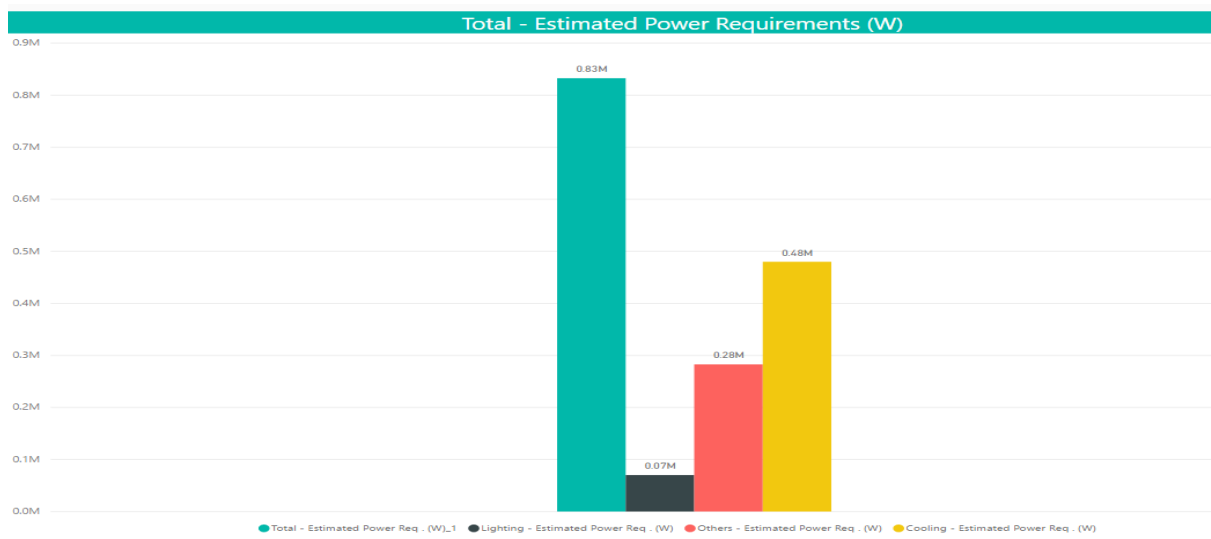


Figure 62: Estimated power requirements in Sura Shopping Complex

The total estimated power requirement & ideal plant size for the community is 0.82MW. 0.07MW (8.4%) of that is required for lighting and another 0.48MW (57.6%) for cooling.

The shops surveyed in the complex used one form of self-generation or the other. The data showed that majority of self-generation at the Complex is by generator. The numbers of various Generator sized used in the market can be seen below.

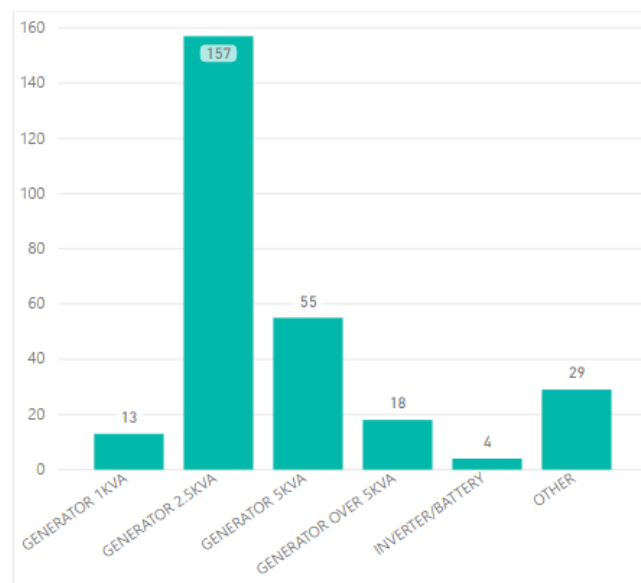


Figure 63: Alternative sources of energy used in Sura Shopping Complex

7.6. Recommendation

The Shopping complex is proposed to be connected to an existing Power Plant approximately 2km away from complex.

Electricity Demand	0.83MW – current demand 1.5MW – estimated total demand for entire complex
Type of Configuration	Natural Gas Plant
Proposed System Size	N/A

Table 16: Proposed system overview for Sura Shopping Complex

The proposed power solution for Sura Shopping Complex is for Power to be supplied from an existing Power Plant which is about 2km away.

In order to ensure consumers are only billed for the energy consumed, all consumers (shops) should be individually metered. This will also foster trust between the power generator and consumers.

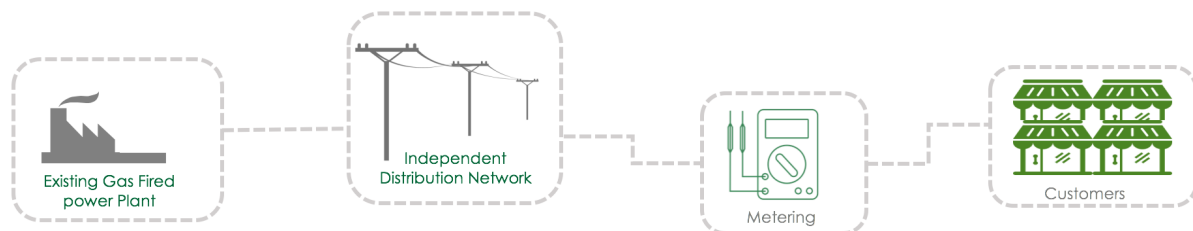


Figure 64: Representation of distribution network in Sura Shopping Complex

CONCLUSIONS AND RECOMMENDATIONS



RURAL ELECTRIFICATION AGENCY



Picture 19: Field Engineers. Sabon Gari Market, Kano State

8. CONCLUSIONS & RECOMMENDATIONS

8.1. Introduction

The Baseline Survey and Energy Audit for the Energizing Economies Project that was undertaken across the 4 markets in 3 states had the following objectives:

- To measure stakeholder responsiveness,
- To understand socio-economic impact before project intervention and
- To gather accurate data of energy requirements in these sites, respectively.

These findings demonstrate the important role that sustainable power plays in supporting urban regeneration – by assisting local economic development, crime reduction and environmental vitality – as well as direct impact on livelihoods and economic activity. It also demonstrates the wider effects of sustainable power in its capacity to compel end-users to invest in shared and private assets and to improve people's ability to consume other services. In this manner, sustainable power supply reinforces the benefits of other infrastructural upgrades and strengthens perceptions of local ownership and responsive governance, particularly when complemented by other infrastructural interventions. The following section provides site-specific overview of the major measurable impacts noted in the survey and audit exercise.

8.2. Ariaria International Market

The dominant age group in both male and female respondents is 20-30. The survey indicated that reliable energy supply plays a very important role in the life of both respondents. Suggested areas for improved public lighting by the survey gave guidance on how to improve these concerns with the streets/entrance points being highlighted as the ideal starting points. Their responses indicated lighting as a major determinant for shopping and safety in the night. Constant

supply of light will also reduce expenses on petrol and will give a guide for possible tariff structuring. Survey findings also indicated that crime is not a major concern in the market place; however, 3% of the total population stated fear of criminal activities like vandalism, sexual harassment and robbery. The survey shows the establishment of street lights at these locations will make people feel safe and might also extend trading hours.

8.2.1. Recommendation

Based on the results from the Energy Audit, the system recommendation for Ariaria Market is to implement a Compressed Natural Gas (CNG) Power Plant to meet the current and forecasted demand.

In order to ensure consumers are only billed for the energy consumed, all consumers (shops) should be individually metered to ensure project sustainability. This will also foster trust between the power generator and consumers.

For phase 1 of the project, 5 units of 1MW Gas Generators with 2 Units of 1MW Deisel Generators that will serve as backup in case of any need for system downtime, during operation hours.

The next phase of the project involving scaling up of the system, it can be migrated from CNG to Liquefied Natural Gas (LNG), where the site will have room for 3MMscf of LNG storage on site.

Electricity Demand	2.06MW – current demand
	6.67MW – estimated total demand for entire market
Type of Configuration	Compressed Natural Gas Plant
Proposed System Size	5MW – Phase 1

Table 17: Recommended systems for Ariaria Market

8.3. Sabon Gari Market

The findings of the study show that a vast majority of the shop owners/traders and customers are dissatisfied with the level of grid power supply they currently receive. They often use noisy and expensive generators either individually or communally in an arrangement referred to as "maja" where they pay a minimum of N200 for 8 hours with restriction on appliances that can be connected and as much as N1000 depending on the load. Most shop owners/traders are willing to pay for a less expensive, reliable, safe, less noisy, and cleaner alternative power supply. Provision of uninterrupted power would encourage expansion of the kind of goods that can be sold at each shop. About 54% of shop owners said that given access to uninterrupted electricity, they would expand their business; this gives them the flexibility to develop their product line, employ more people and monitor expenses. Also, generator expenses

and other business expenses incurred by a majority of the traders only exist to erode their profit margins. On average, each trader in the market serves anywhere between 12-30 customers on a day-to-day basis, who spend an average of roughly N14, 650 per month; the potential for profitability in the marketplace exists as there is clearly a demand for the products and services offered. About 20% of the surveyed traders put their shop opening hours dependent on traffic and light. The occupants have signalled that strategic placement of street lighting in and around the marketplace would alleviate some of the safety concerns in the area as well as provide a safer environment for customers and shop owners alike; it could also allow for extended shopping times and more frequent visits from customers, which could improve the profitability and revenue generation from the market.

8.3.1. Recommendation

Based on the fact the market is mostly retail and there is very little fabrication the recommended solution for the deployment of decentralised solar solution using high capacity solar home systems (1kW to 5Kw each) to meet the current demand.

High Capacity Solar Home Systems could be deployed for users with less load requirements that have smaller load requirements such as lighting, charging and DC fan use. Users with larger load requirements could use more sophisticated DA & AC Solar home systems that have capacity to

power more appliances. Metering will be undertaken using, a pay as you go platform where the customer pre-pays for the energy they consume.

Electricity Demand	1.38MW – current demand
	3.29MW – estimated total demand for entire market
Type of Configuration	High capacity, Small and Medium solar home systems
Proposed System Size	1MW decentralised solution (Phase 1)

Table 18: Recommended system for Sabon Gari Market

8.4. Somolu Printing Community

The surveys suggest that the energy intervention should encourage more customer spending and business expansion while improving the quality of life of its residents, and reducing the air and noise

pollution associated with self-generation. Traders also showed significant ability to pay, as the traders self-reported spending more than N12, 000 a month on both grid and off grid power solutions.

8.4.1. Recommendation

Based on the energy audit conducted for Somolu Printing Community, the total energy demand for zone 1 - 6 is 32MW (printing presses and residents). Phase one of the project will power printers in zone 2 and 4 where there is the highest concentration of printing presses then the National Orthopaedic Hospital, Igbobi and Igbobi College with a combined load of 4.73MW.

The preferred solution for a gas fired plant for Somolu Printing Community was arrived at by reason of the heavy machinery used by the printing presses; this led to the initial proposal for an installed capacity of 5MW which will be expanded as demand increases. It may be beneficial to take advantage of the Oando gas link in the area.

In order to ensure consumers are only billed for the energy consumed, all consumers (shops) should be individually metered to ensure project sustainability. This will also foster trust between the power generator and consumers.

Electricity Demand	4.73MW – Printers located in zone 2 and 4 32MW – current demand for zones 1 to 6
Type of Configuration	Compressed Natural Gas Plant
Proposed System Size	5MW Phase 1

Table 19: Recommended system for Somolu Printing Community

8.5. Sura Shopping Complex

The dominant age groups for both categories of respondent are the (20-30) and (30-40). Reliable power supply plays a very important role as it affects both the traders and their customers' behaviour. 73% of the traders use generator to power their shops and few don't have access to electricity. The enterprise traders spend more on powering their generator (diesel and fuel) than what they spend on electricity bills. 50% of the traders reported that they will expand their businesses, hire additional labour, and do other things that will lead to profitability.

With regards to security, a lot of the respondents reported that they feel safe in the environment and that crime rarely occurs in the shopping complex. Most of them stated harassment and personal robbery as their key safety concern.

There are functioning street lights in most parts of the area. The respondents laid public lighting emphases in open spaces, entrances and exit of the shopping complex and close to the shops, as this will increase commercial activities, aesthetics and increase the level of Safety for Shop Owners and customers.

8.5.1. Recommendation

The proposed power solution for Sura Shopping Complex is for Power to be supplied from an existing Power Plant which is about 2km away.

Electricity Demand	0.83MW
Type of Configuration	Connection to existing Gas Fired Power Plant
Proposed System Size	N/A

Table 20: Recommended system for Sura Shopping Complex