

Lighting Papua New Guinea

PNG Off-Grid Lighting Market Analysis 2014



LIGHTING PAPUA NEW GUINEA

Catalyzing Markets for Modern Lighting



IFC International
Finance Corporation

This report was commissioned by IFC and developed in partnership with Enclude, an advisory firm dedicated to building an inclusive and prosperous global economy.

It is designed to provide key market information for private sector companies seeking to provide off-grid lighting to PNG bottom of the pyramid consumers. The report relies on the inputs of a broad range of industry experts, manufacturers, distributors and NGO leaders both within and outside PNG.

IFC would like to particularly thank all those who provided their time to be interviewed for the report. IFC would also like to extend thanks to the Enclude consultants who conducted market research and interviews for the report.

About IFC

IFC, a member of the World Bank Group, is the largest global development institution focused exclusively on the private sector. Working with private enterprises in more than 100 countries, IFC uses capital, expertise, and influence to help eliminate extreme poverty and promote shared prosperity. In FY13, IFC investments climbed to an all-time high of nearly \$25 billion, leveraging the power of the private sector to create jobs and tackle the world's most pressing development challenges. For more information, visit www.ifc.org.

About Lighting Global

Lighting Global is a joint IFC and World Bank program that works towards improving access to better lighting in areas not yet connected to the electricity grid. Lighting Global catalyzes and accelerates the development of sustainable markets for affordable, modern off-grid lighting solutions for low-income households and micro-enterprises.

A key role of Lighting Global is supporting activities of the Lighting Africa and Lighting Asia programs as well as activities in other markets, including Papua New Guinea. These regional programs work independently to catalyze the development of sustainable markets for affordable, modern off-grid lighting solutions, targeting low-income households and micro-enterprises that are underserved by the electric grid. Lighting Global serves as an umbrella for the Quality Assurance Framework, which was originally developed out of the Papua New Guinea Solar Market Program.

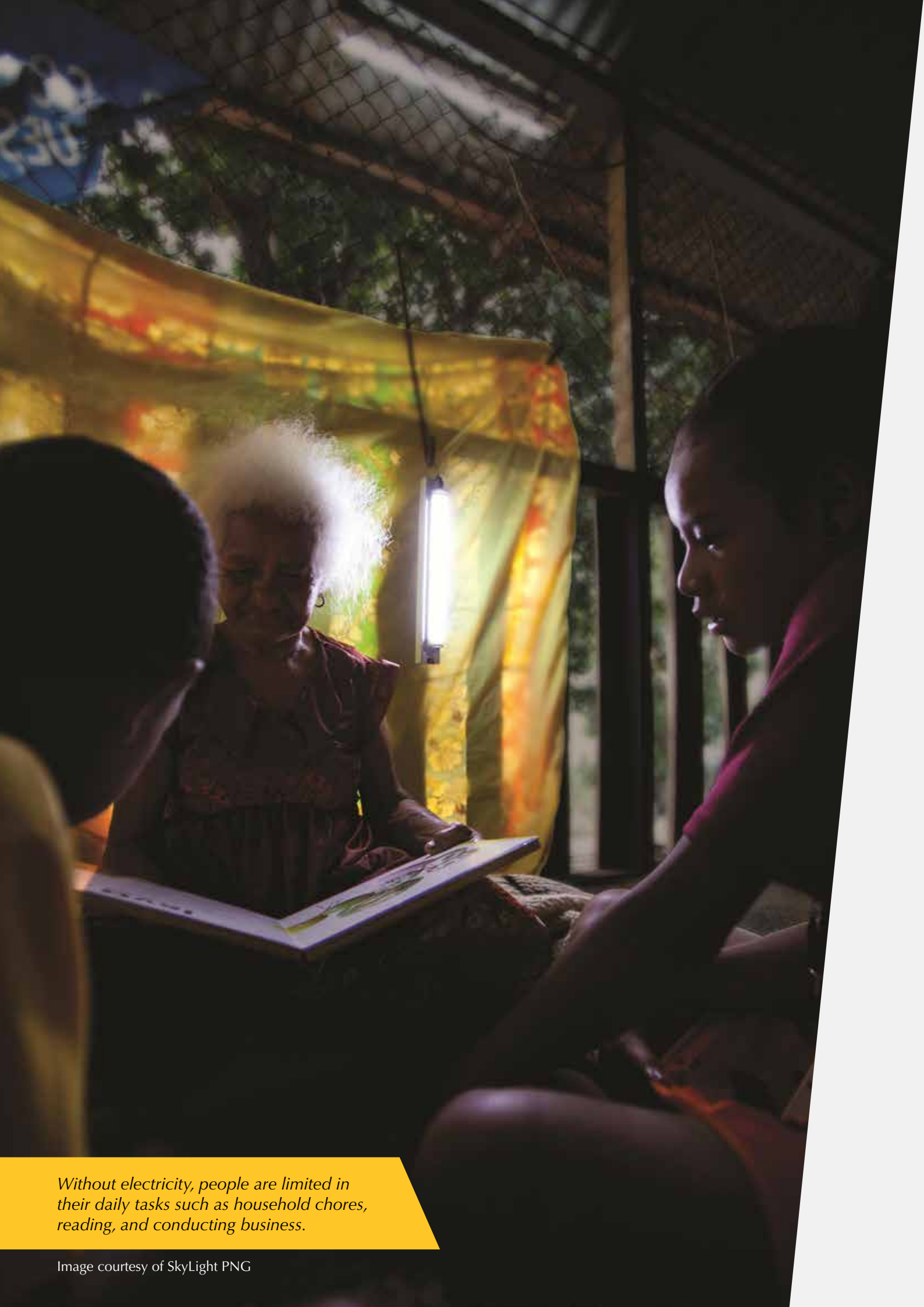
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Image courtesy of SkyLight PNG



Approximately 6.3 million people in Papua New Guinea do not have access to the electricity grid.



Without electricity, people are limited in their daily tasks such as household chores, reading, and conducting business.

Image courtesy of SkyLight PNG

CONTENTS

EXECUTIVE SUMMARY.....	9
INTRODUCTION AND SCOPE.....	13
PURPOSE OF THE REPORT	13
SCOPE.....	13
1.THE PNG LIGHTING IMPERATIVE	15
PNG'S OFF GRID POPULATION	15
2.THE CURRENT STATE OF THE PNG OFF-GRID LIGHTING MARKET ..	17
ACUTE ENERGY ACCESS CHALLENGE	17
KEROSENE AND DIESEL EXPENDITURES	19
ENERGY CONSUMER SEGMENTATION	21
HOW OFF-GRID LIGHTING CURRENTLY SERVES THE PNG MARKET	24
ACCESS TO FINANCE FOR OFF-GRID LIGHTING PRODUCTS	25
3. CURRENT SOLAR MARKET IN PNG: STILL AT THE STARTING GATE ..	29
SOLAR LIGHTING MARKET	29
OVERVIEW OF MARKET PLAYERS	31
SOLAR DISTRIBUTION CHANNELS	32
4. POTENTIAL DEMAND DRIVERS	35
STAGNANT GRID GROWTH.....	35
UNAFFORDABILITY OF KEROSENE AND DIESEL PRICES.....	35
GROWTH OF MOBILE PHONES	36
GROWTH OF MOBILE MONEY PRODUCTS IN PNG	37
PLS PRICING BECOMING MORE AFFORDABLE	38
ENABLING REGULATIONS FOR SOLAR MARKET ENTRANTS	38
5. COMMUNICATION CHANNELS REACHING THE OFF-GRID POPULATION.....	39
6. MARKET ENTRY POINTS AND POTENTIAL DISTRIBUTION MODELS	41
DISTRIBUTION CHANNELS	41
7. RECOMMENDATIONS FOR SCALING UP.....	49
RISKS AND MITIGATIONS.....	49
FOR MANUFACTURERS	50
FOR DISTRIBUTORS	51
8. CONCLUSION.....	53

ANNEX	54
LIGHTING GLOBAL QUALITY – VERIFIED PRODUCTS AS OF DECEMBER 2013	54

LIST OF BOXES

8 THINGS TO KNOW ABOUT THE PNG OFF-GRID LIGHTING MARKET	11
IFC'S LIGHTING PNG ASSOCIATE SERVICES.....	12
PAPUA NEW GUINEA: 'THE LAND OF THE UNEXPECTED'	14
PAPUA NEW GUINEA: INFRASTRUCTURE	16
THE WANTOK 'ONE TALK' SYSTEM	27
PNG TRADE STORES.....	28
HOW PEOPLE CURRENTLY CHARGE PHONES IN OFF-GRID COMMUNITIES IN PNG	36

LIST OF FIGURES

PERCENTAGE OF HOUSEHOLDS WITH ACCESS TO THE GRID, AND PERCENTAGE OF POPULATION WITH MOBILE ACCESS.	10
PERCENTAGE OF HOUSEHOLDS WITHIN 5 KM OF A NATIONAL ROAD BY PROVINCE, 2012.	15
PNG ELECTRIFICATION, MARKET COMPARISON.	17
PNG ELECTRIFICATION, OFF-GRID AND GRID BASED.	18
NUMBER OF GRID CONNECTED HOUSEHOLDS PER PROVINCE.	18
AVERAGE EXPENDITURE (USD MILLION) BY OFF-GRID HOUSEHOLDS PNG ON KEROSENE, BATTERIES, CANDLES, AND FIREWOOD.	19
KEROSENE RETAIL PRICES PER LITRE, 2005-2013.	20
PROVINCIAL TOWN AVERAGE COST OF DIESEL PER LITER, 2004-2013.	20
BREAKDOWN SOURCE OF INCOME FOR MARKET SEGMENTS	21
BREAKDOWN OF SOURCES OF LIGHTING FOR OFF-GRID CONSUMERS.....	23
KEROSENE DISTRIBUTION DIAGRAM FOR PNG	25
SOLAR LIGHTING MARKET PENETRATION, IN PERCENTAGES.	29
OFFICIAL IMPORTS OF PLS INTO PNG PER ANNUM.	30
RETAIL PV PRICES PER WP IN PNG VERSUS OTHER MARKETS (USD).	30
AVERAGE TIME FRAME OF PRODUCT FROM MANUFACTURER TO END USER.	32
HOUSEHOLDS WITH ACCESS TO ELECTRICITY, PROJECTED UP TO 2030 ACCORDING TO PNG GOVERNMENT ESTIMATES.....	35
MONTHLY TRACKING OF MOBILE BANKING TRANSACTION IN 2013.	37
HOUSEHOLD ACCESS TO MEDIA SOURCES, 2012	39
BULK PROCUREMENT OPPORTUNITIES	43
TRADITIONAL DISTRIBUTION CHANNEL.....	44
PARTNERSHIP SALES	46

LIST OF TABLES

FOUR SEGMENTS OF OFF-GRID ENERGY CONSUMERS	21
KEY AGRICULTURAL CROPS PEAK SEASONS	22
SEGMENTATION OF PNG OFF-GRID ENERGY CONSUMERS	23
LIGHTING SOURCE MARKET BREAKDOWN.....	24
OVERVIEW OF FINANCIAL INSTITUTIONS IN PNG	26
RECEIPT OF PRIVATE TRANSFERS IN CASH OR IN KIND BY RURAL AND URBAN AREAS, REGIONS, AND SEX.	26
DISTRIBUTION CHANNELS FOR SOLAR LIGHTING.....	31
OVERVIEW OF SUPPLY CHAIN ACTORS, CURRENT ROLES AND CAPACITIES	33
OVERVIEW OF RELEVANT REGULATIONS.....	38
HOW PNG GETS INFORMATION	40
POTENTIAL BTL MARKETING OPPORTUNITIES	40
HIGHLIGHTS OF THREE MAIN PLS DISTRIBUTION CHANNELS IN PNG	42
POTENTIAL AGRIBUSINESS PARTNER ANALYSIS	46
ADDRESSING CHALLENGES TO SCALING UP.....	49

LIST OF ABBREVIATIONS

BOP	BOTTOM OF THE PYRAMID
BTL	BELOW THE LINE
PLS	PICO-POWERED LIGHTING SYSTEM
BOS	BALANCE OF SYSTEM
KWH	KILOWATT-HOUR
LED	LIGHT EMITTING DIODE
LNG	LIQUEFIED NATURAL GAS
PNG	PAPUA NEW GUINEA
POM	PORT MORESBY
PV	PHOTOVOLTAIC
SHS	SOLAR HOME SYSTEM





PNG's market in pico powered lighting systems (PLS) is poised for rapid growth

Image courtesy of AT Projects

EXECUTIVE SUMMARY

Only 10 percent of the population in Papua New Guinea (PNG) has access to the national electricity grid, leaving 6.3 million people without access to the energy needed to meet their basic needs. Lack of reliable lighting limits people's ability to undertake daily activities like household chores, reading, schoolwork, and conducting business outside of daylight hours.

There is an emerging opportunity to provide clean, sustainable and affordable lighting solutions to under-served and off-grid energy consumers in PNG through quality 'pico powered lighting systems' (PLS).

Commercial attempts to distribute PLS products are at an early stage of development and the majority of systems that currently exist in PNG have been distributed as part of donor programs, NGO/church based initiatives and CSR activities. These activities are almost always on a small scale, often involving poor quality products with no after sales support or consumer education.

Some specialist electrical retailers sell PLS in PNG's urban and provincial centers, and IFC estimates that 30,000 PLS were imported into PNG in 2012. However, these were largely of poor quality and little effort has been made to distribute and retail them beyond urban centers. Nevertheless, all retailers interviewed for this report testified to vastly increasing sales over the last 12 months, suggesting increasing consumer awareness and demand driven by word of mouth.

PNG'S PLS MARKET IS POISED FOR RAPID GROWTH

While the PLS market is still in a nascent stage, stagnant grid growth combined with increasing costs of lighting, particularly kerosene, is creating an opportunity for PLS manufacturers and distributors to enter the PNG market and achieve significant sales volumes over a 3–5 year timeframe.

- It is estimated that PNG consumers spend between **\$USD120-150 million per annum on off-grid lighting** through an expensive mix of kerosene lanterns, battery powered torches, and to a lesser extent, candles and fire wood.
- Kerosene in particular drives off-grid household lighting costs, as it is **sold between \$4.25 – \$6.75 USD per liter in rural areas**, often twice the price at which it is sold in other markets. Kerosene prices increased by 30 percent over the last 5 years.
- As in Africa, demand for PLS in PNG is also likely to be driven by the rapid growth in mobile phone ownership. Currently, **62 percent of individuals and 88 percent of households own a mobile phone but many have no capacity to charge** their phones in their own homes.
- PNG has a favorable regulatory environment with **zero kerosene or diesel subsidies** and zero tariffs on solar panel or component part imports.

These factors indicate the PNG market is ready to enter a new phase where commercial models can be developed and new market entrants can achieve scale. There are, however, some significant challenges to entering the PNG market.

CHALLENGES TO PNG MARKET ENTRY AND SCALE

- **Lack of consumer awareness:** Low levels of solar device awareness among potential distributors as well as consumers.
- **First-mover costs:** Current underdeveloped state of the market, coupled with low consumer awareness, makes it difficult for market entrants to achieve scale quickly.
- **Ongoing Security Issues:** High levels of crime and ineffective security and law enforcement add complexity of product distribution and increase costs of business operations and below-the-line marketing efforts.
- **Challenging landscape and highly dispersed and diverse off-grid populations:** Approximately 85 percent of PNG's population lives in small rural communities that are dispersed across the mountainous topography, which creates challenges for last-mile product distribution.

SOLUTIONS ARE AVAILABLE AND INNOVATIONS ARE ON THE HORIZON

Key recommendations for PLS manufacturers:

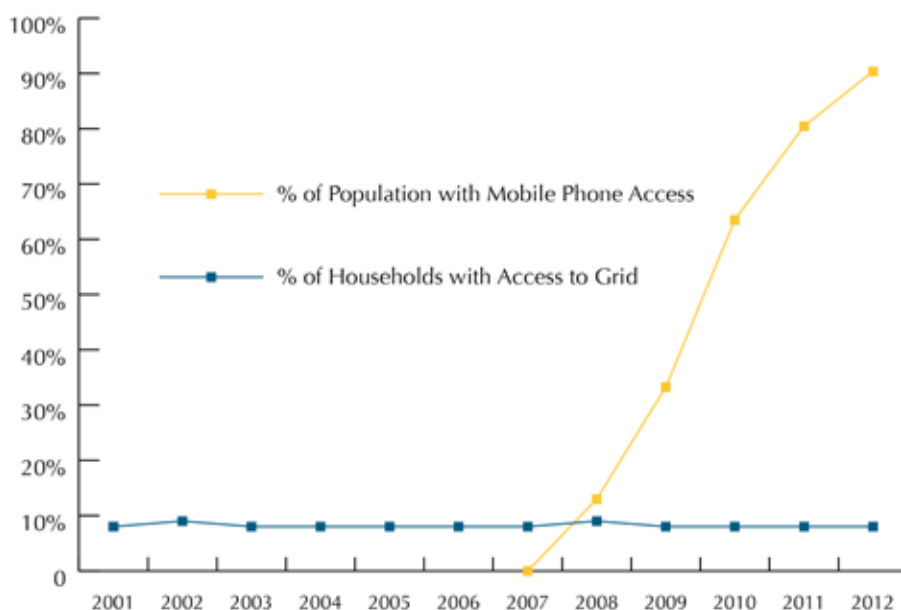
Leverage Potential Bulk Procurement Opportunities for Market Entry

Entry and expansion strategies for manufacturers of quality lighting products are likely to focus on initial bulk procurement opportunities, with so-called 'aggregators' or institutional players in the PNG market (extractive industry players, utilities, and telecommunications).

Diversify distribution channels

Upon market entry, it will be important to diversify partners and distribution models as bulk procurement opportunities will be limited after time. There is opportunity to link with existing retail chains already servicing 'the last mile', but also there is scope to mobilize new partners-such as utilities, NGOs, mining companies, agricultural trading companies, banks/MFIs and mobile phone companies-to enter the market and promote PLS.

Figure 1: Percentage of households with access to the grid, and percentage of population with mobile access.



- PNG's mobile phone penetration outgrew the grid in 2008 and the gap has grown rapidly.
- The average phone user pays between \$7-14 a month to charge their phone
- Cellphone charges cost between \$1 and \$3.5 per charge.
- Currently smart phones are 20 percent of the market and growing fast.

Innovate business models

Similar to other markets, innovative distribution and retail models are emerging in PNG aim to serve the last mile, with many large retailers now looking at establishing village distribution networks. The growth of mobile banking will also offer opportunity to find innovative solutions for end user finance for off grid lighting products. Off grid solar product manufacturers and distributors will need to keep open to innovative business models.

Key recommendations for distributors:

Build Consumer Education and After Sales Service capacity

Make sure retailers provide proper 'user guidance' to customers. Many functional issues can be prevented by basic customer education on how to use the PLS. Keep in mind that word of mouth of unsatisfied customers spreads easily in PNG.

After-sales service will need to be delivered via the supply chain, as will communication and exercise of any rights under warranty. After sales service can potentially be made more viable by connecting it to 'graduation' from a small solar lantern to a larger system, for example by offering a part exchange (buying back the product against a certain % of the price) if clients decide on an upgrade.

Focus on Below the Line (BLT) Consumer Awareness

Given the high illiteracy rates and low rates of solar product consumer, leveraging mobile phone technology, radio and annual cultural events to build brand and consumer awareness will be crucial. In these campaigns, communicate the benefits as well as the economics of investing in durable, high quality products.

8 THINGS TO KNOW ABOUT THE PNG OFF-GRID LIGHTING MARKET

1. There are more than 1.3 million off-grid households not currently using solar devices for their lighting needs.
2. Poor quality solar lighting products have not achieved significant market penetration, giving manufacturers of quality products an opportunity to build market confidence and focus on a quality product orientation.
3. The number of households with mobile phones surpassed the grid in 2008. Now, 88 percent of PNG households have access to a mobile phone but have little capacity to charge it.
4. Papua New Guinean households spend an average of \$USD 120-150 million a year on off-grid lighting.
5. While kerosene is the most frequently used source of lighting, it is not dominant as households also rely heavily on battery powered torches, biomass and candles.
6. There are zero import tariffs on solar products or their component parts in PNG.
7. There are no subsidies for kerosene or diesel in PNG.
8. Currently it is estimated that only 2 percent of households use solar for their lighting needs.



Image courtesy of Lighting Africa

IFC'S LIGHTING PNG ASSOCIATE SERVICES

Over recent years IFC has developed the Lighting Africa and Lighting Asia projects as market transformation programs that consists of a series of country-level projects where IFC supports companies in entering the market, scaling up their distribution models, accessing financing and addressing policy and regulatory constraints.

In PNG, IFC is seeking to replicate and roll out a program to support companies to enter the market and scale-up operations when they become project associates. Support from IFC includes:

Quality Assurance: Support with product testing through Lighting Global's Quality Assurance Framework.

Market Intelligence: Access to IFC's market intelligence including market analysis updates, results from focus groups and regular access to IFC project staff.

B2B Connections: Access to IFC PNG Solar Distributor Directory and direct connections to potential distributor/manufacturer partners.

Facilitate Innovations in Business Models: Work with distributors to develop innovative distribution models in PNG, focussed on BOP consumers.

Consumer Awareness: Access to IFC's PLS Consumer Awareness Campaign.

INTRODUCTION AND SCOPE

1.1. PURPOSE OF THE REPORT

The PNG Off-Grid Lighting Market Analysis was commissioned by IFC to provide intelligence on the size and scope of the PNG off-grid lighting market, as well as potential opportunities for the private sector to better meet the needs of PNG consumers.

Globally, the off-grid lighting market is fast growing and encompasses a wide spectrum of products and business models. This report focuses on approaches that are most applicable in the PNG market. Our conclusions and recommendations are based on stakeholder interviews, literature review and leveraging existing research on PNG household demographics.

This report is written for the following audiences:

- a. Global manufacturers of quality off-grid lighting products who are participating in the Lighting Global program and interested in finding market entry points and distribution channels for their solar products in PNG;
- b. Potential distributors of solar off-grid lighting products in PNG, primarily PNG based retailers and entrepreneurs.

The report is intended to provide practical guidance for private sector players as they think about entering this new market, finding partners and reaching new consumer segments.

1.2. SCOPE

The market research performed by the team of Enclude focused on 'pico powered lighting systems' (PLS). The following types of products and technologies were considered for the purposes of this market study:

Function: Lighting systems range from being task-specific (e.g., torches/flashlights) to the more general ambient lighting functions. Some of these products may include added functions such as mobile phone charging, but light is typically the primary design driver.

Technology: The PLS include a battery, a light source and a charging solution. The battery is rechargeable and, for a vast majority of devices, powered by a solar cell that is integrated in the unit or included as a stand-alone panel. The light source is typically Light Emitting Diode (LED)-based, although a few products still use Compact Fluorescent Light (CFL) technology.

The solar panel size is restricted to 10 watts and below, which differentiates these devices from the majority of Solar Home Systems. Dynamo (e.g., hand crank or pedal power) technology is also an interesting emerging option for powering PLS.

Quality: Products must meet a certain quality standard (e.g., sufficiently long life and truth in advertising). Currently, the standards defined by Lighting Global's quality assurance program to meet the needs of un-electrified households are best articulated and most widely accepted.

As of December 2012, 46 products had passed Lighting Global's minimum quality standards. However, since products are submitted for testing on a voluntary basis, this does not mean that non-LA verified products are necessarily of low quality.

As the introduction of poor quality products in the market leads to market spoilage, our analysis focuses on the quality end of the market in terms of performance and durability, rather than inexpensive (USD \$1-5), typically dry cell battery-powered, non-solar LED torches/flashlights.



PAPUA NEW GUINEA: 'THE LAND OF THE UNEXPECTED'

Located in the South-west Pacific Ocean, Papua New Guinea (PNG) includes 600 islands and the eastern half of the island of New Guinea, which is where most of the population lives. The total size is somewhat larger than that of the State of California and the country shares a large land border with Indonesia.

PNG is called the 'land of the unexpected' and not without reason.

With over 1,000 different tribal groups over 800 languages, PNG is one of the most diverse and complex countries in the world. According to the 2012 census, PNG has 7.05 million inhabitants, with 50% under the age of 21, and an extremely fast growth annualized growth rate of 2.8 percent. PNG is going through a rapid economic transformation, driven by major extractive industry and resource developments.

The modern extractive sector draws on substantial reserves of metal ores and hydro-carbons and accounts for 80 percent of merchandise exports. The leading development is the \$16 billion PNG LNG project, which will make PNG a net energy exporter in 2015 and contribute to significant rates of economic growth over the coming years.

However, the majority of people derive their incomes largely from cash crops including coffee, cocoa, palm oil, fresh product and livestock. A significant part of the rural population depends on subsistence farming.

I. THE PNG LIGHTING IMPERATIVE

1.3. PNG'S OFF GRID POPULATION

Approximately 6.3 million people¹ in PNG live without electricity, with significant ramifications for the economy and quality of life among PNG residents. Lack of access to reliable lighting limits the productivity of nearly 90 percent of the country, hindering residents' ability to carry out basic activities at night or in the early morning, including household chores, reading, schoolwork and conducting business. As the introduction of poor quality products in the market leads to market spoilage, our analysis focuses on the quality end of the market in terms of performance and durability, rather than inexpensive (USD \$1-5), typically dry cell battery-powered, non-solar LED torches/flashlights.

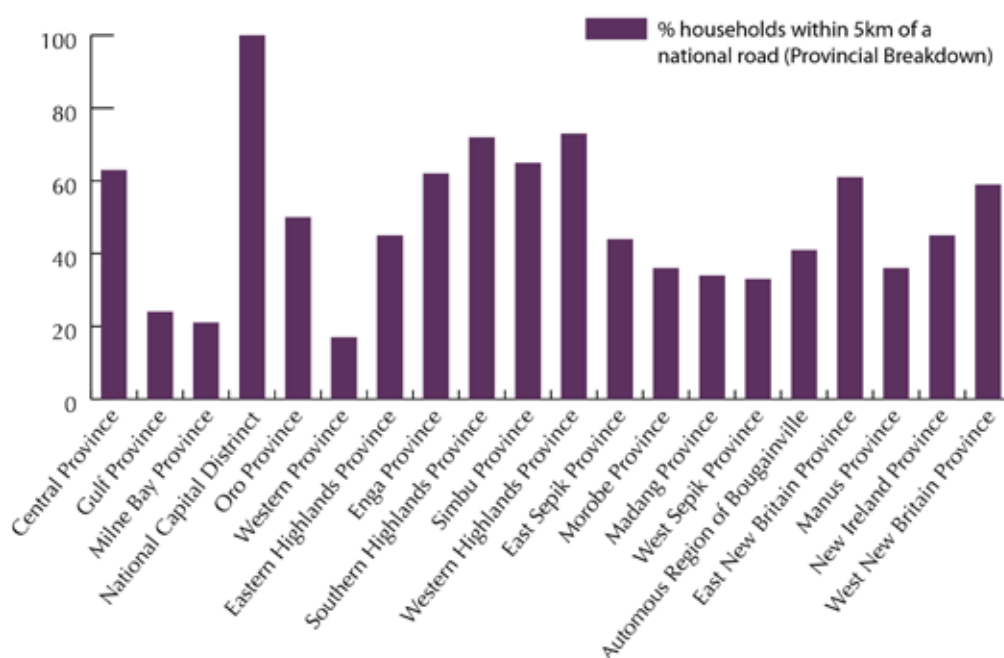
Given the slow growth of electrification, the PNG lighting crisis increasingly separates those with reliable lighting from those who lack it, leaving a substantial proportion of the population further behind. People in PNG use a mixture of fuels and lighting sources to meet their lighting needs, including kerosene, diesel, biomass (wood), battery powered torches and candles.

A few of the major impacts that could be achieved by replacing traditional lighting fuels with high-quality, renewable solar lighting include:

Impact on income generating activity: Access to proper lighting (of high enough illumination to enable reading and doing household and business-related activities) is likely to have a positive impact on productivity in general and income-generating activity more specifically.

On average, 55% of PNG's rural households live more than 5km from a national road (see below figure 2), so obtaining fuel for lighting can be a time-consuming task that requires traveling long distances. This activity is often undertaken by women, reducing the time they have available for income-generating activities.

Figure 2: Percentage of households within 5 km of a national road by Province, 2012.



Source: Michael Bourke, *Agriculture in PNG*, 2007

1. Based on census data and data from PNG Power Ltd

Likewise, a significant number of Papua New Guineans engage in economic activities that, without proper lighting, must end at sundown. For instance, micro-retail outlets, fisherman and small holder farmers cannot sell, catch or process products without lighting. In industries like farming, which have a limited window for post-handling of products and delivery to market, the limits to productivity created by lack of lighting can have serious consequences.

The improved phone charging capability offered by PLS will also have a significant impact on economic opportunities for off-grid energy users. Farmers will be able to contact potential buyers of their crops more easily; small retail outlets will be able to order goods more easily; and women artisans may have better access to buyers and markets for handicrafts.

Impact on Education: According to a 2010 household survey, 38% of the population aged 8 and older are not able to read and write, and illiteracy rates are even higher in the Highlands (47%) and Momase (40%).² In addition, only 23% of the rural population enrolls in some form of secondary education.³ Research in other markets indicates that PLS are often used by children for undertaking homework. In Bangladesh, for example, a study revealed that when solar-powered lighting was introduced, children in the newly solar powered homes remained awake longer each day and used 38% of their additional time for studying and reading. Similarly, a study of the impact of portable solar lighting in India found that its introduction raised average study hours of students per household from 1.5 hours to 2.7 hours, with a correlated positive effect on school performance.

Impact on household spending: Another important impact of fuel-based lighting on PNG's poor households is the cost burden of paying for expensive kerosene. As fuel costs have increased by over 30 percent in recent years, off-grid households are now spending more and more of their income on fuel-based lighting. Retail prices in rural areas increased even further. Expenditures on kerosene can take up a significant proportion of household income, on average accounting for nearly 50 percent of a household's lighting expenditure - and almost 60 percent for off-grid households. Cost savings from the adoption of solar lighting products is a significant benefit.

Impact on Health: The health implications of fuel-based lighting are two-fold: chronic illness due to indoor air pollution, and risk of injury due to the flammable nature of the fuels used. Kerosene lamps emit fine particles that are a major source of air pollution. These particles quickly become lodged in the bronchial system and can result in chronic disease and death. Burning a liter of kerosene emits 51 micrograms of PM10 per hour, which is just above the World Health Organization's 24-hour mean PM10 standard of 50 micrograms per cubic meter. Since these particles may not disperse easily in the close quarters of a typical BOP household or small business, burning a lamp indoors for just four hours can result in concentrations of toxic particles several times higher than the World Health Organization standard.¹⁰

Impact on the Environment: While it is important to recognize that off-grid PNG households are at the bottom of the spectrum of CO2 emitters, the burning of kerosene and particularly diesel do create significant emissions.

PAPUA NEW GUINEA: INFRASTRUCTURE

Port Moresby (pop. 300,000) is one of the most disconnected capital cities in the world, with good transportation links to only two PNG provinces. Lae (pop. 75,000) operates as the industrial and transportation capital of the country, with shipping connections to over 600 islands. In addition, it is the starting point of the Highlands Highway, which provides access to over 50 percent of the population of PNG residing in the Highlands.

In PNG, transport networks are largely in poor condition with about 85 percent of main roads and nearly all feeder roads impassable or abandoned during some part of the year. The World Bank estimates that 17 percent of the population has no access to any road and 35 percent lives more than 10kms from a national road.

2. The National Research Institute, 2010

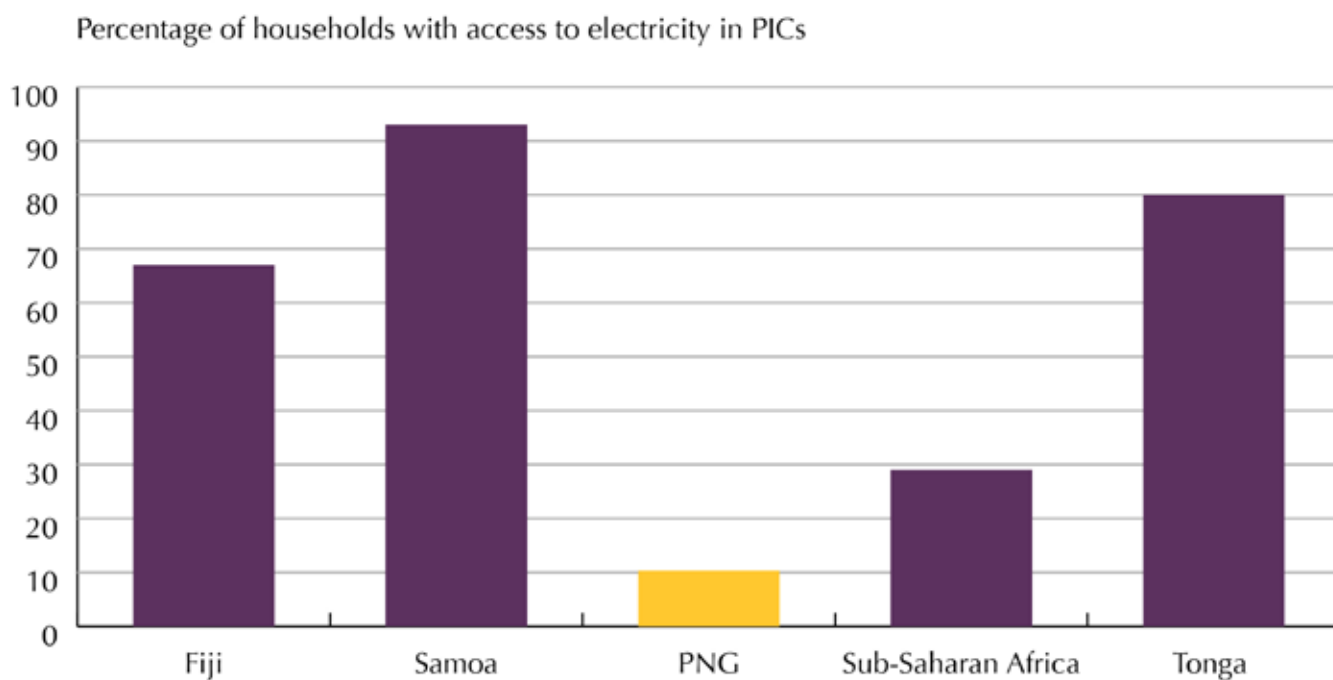
3. The National Research Institute, 2010

2. THE CURRENT STATE OF THE PNG OFF-GRID LIGHTING MARKET

2.1. ACUTE ENERGY ACCESS CHALLENGE

With 6.3 million of PNG's 7 million plus people off the grid, the country has one of the lowest electrification rates in its region and even lower than some of the poorest countries in the world.

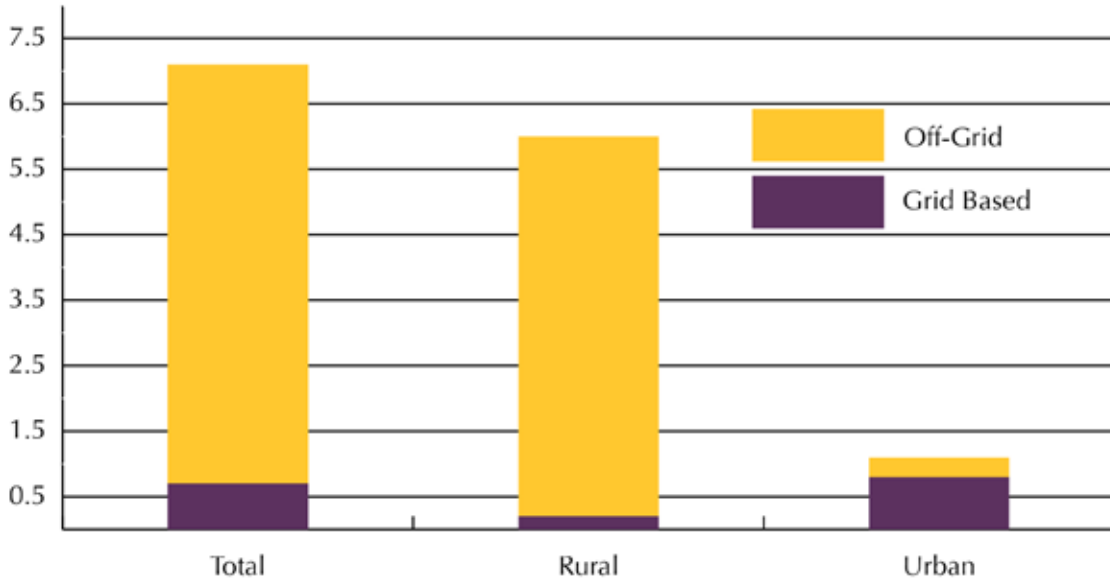
Figure 3: PNG Electrification, Market Comparison.



Source: PNG Power and World Bank.

A large number of those who have grid access face significant under-electrification and experience power outages on a daily basis. The vast majority of the off-grid population can be found in rural parts of PNG, where 98 percent of all households have no access to the energy grid.

Figure 4: PNG Electrification, off-grid and grid based.

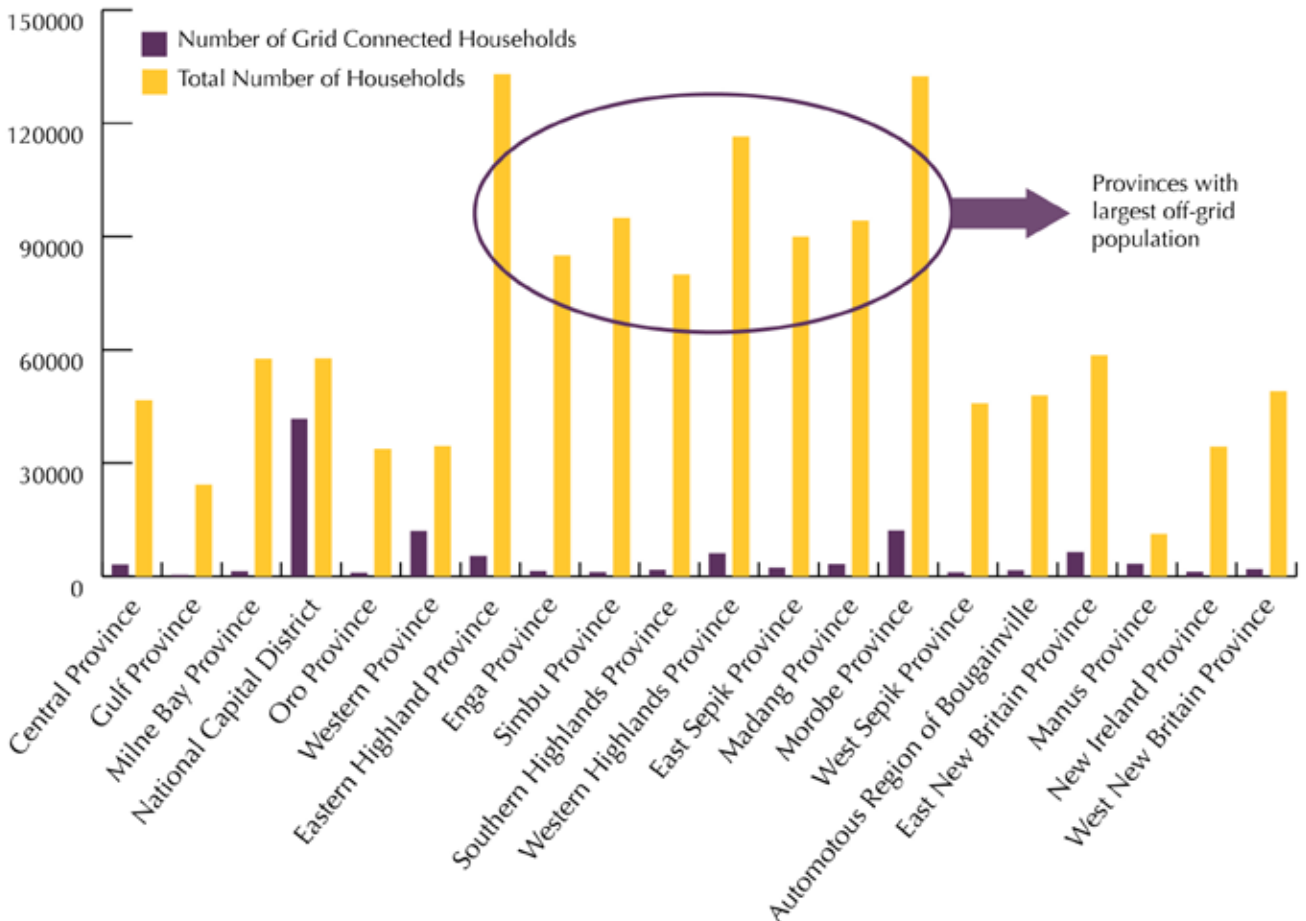


Source: PNG Power. Analysis from IFC

The grid is almost entirely focused in urban areas and provincial towns, often only connecting a few thousand people per province. The majority of grid-connected households reside in the two largest cities of Port Moresby and Lae. See below provincial breakdown of household connections in PNG.

PNG FACES ONE OF THE MOST ACUTE ENERGY ACCESS CHALLENGES IN THE WORLD

Figure 5: Number of grid connected households per province.



Source: INA, PNG District and Provincial Profiles, March 2010. Analysis from IFC

PNG has nearly 1.3m off-grid households, 30 percent of which can be found in three provinces: East Highlands Province (10.5 percent), Western Highlands Province (9.7 percent) and Morobe Province (9.9 percent). The other two thirds of off-grid households are scattered across an additional 18 provinces.⁴

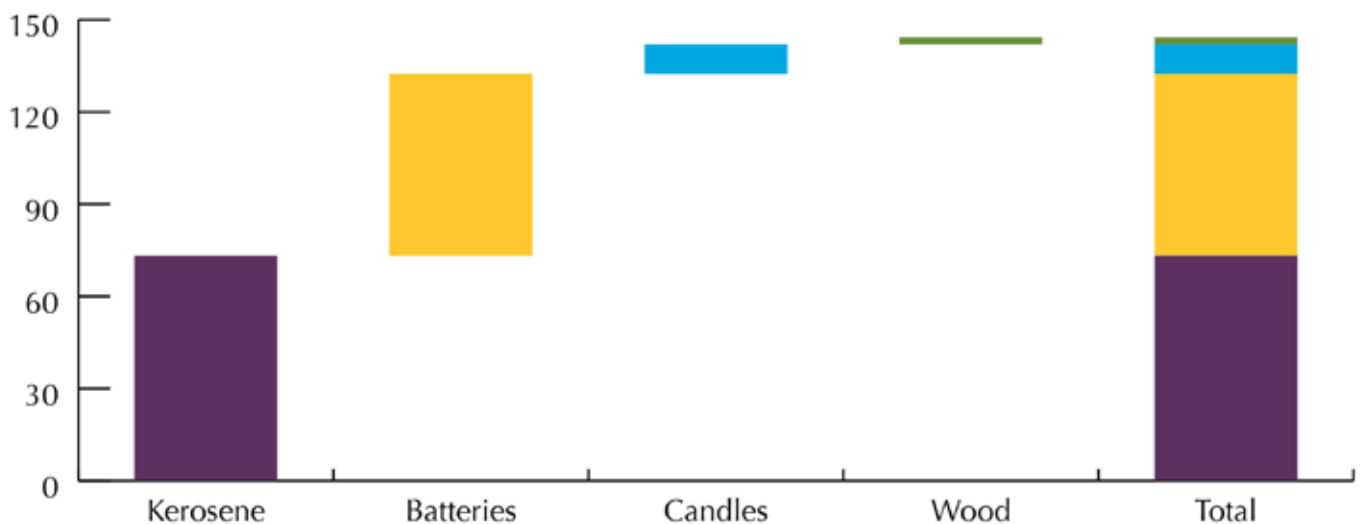
It is important for distributors of solar lighting devices to note that while Morobe, Eastern Highlands Province and Western Highlands Province are all relatively remote, they are connected by the Highlands Highway which runs from Lae in Morobe to Mt Hagen in Western Highlands.

2.2. KEROSENE AND DIESEL EXPENDITURES

On average, off-grid Papua New Guineans spend more than **120-150 USD million per annum**⁵ on lighting fuel, with kerosene and battery costs accounting almost 90 percent of the total. Other primary sources are candles and firewood.

KEROSENE AND BATTERY POWERED TORCHES ARE THE LARGEST SOURCE OF LIGHTING FOR OFF-GRID HOUSEHOLDS IN PNG

Figure 6: Average expenditure (USD million) by off-grid households PNG on kerosene, batteries, candles, and firewood.



Source: Stakeholder interviews. Analysis from IFC

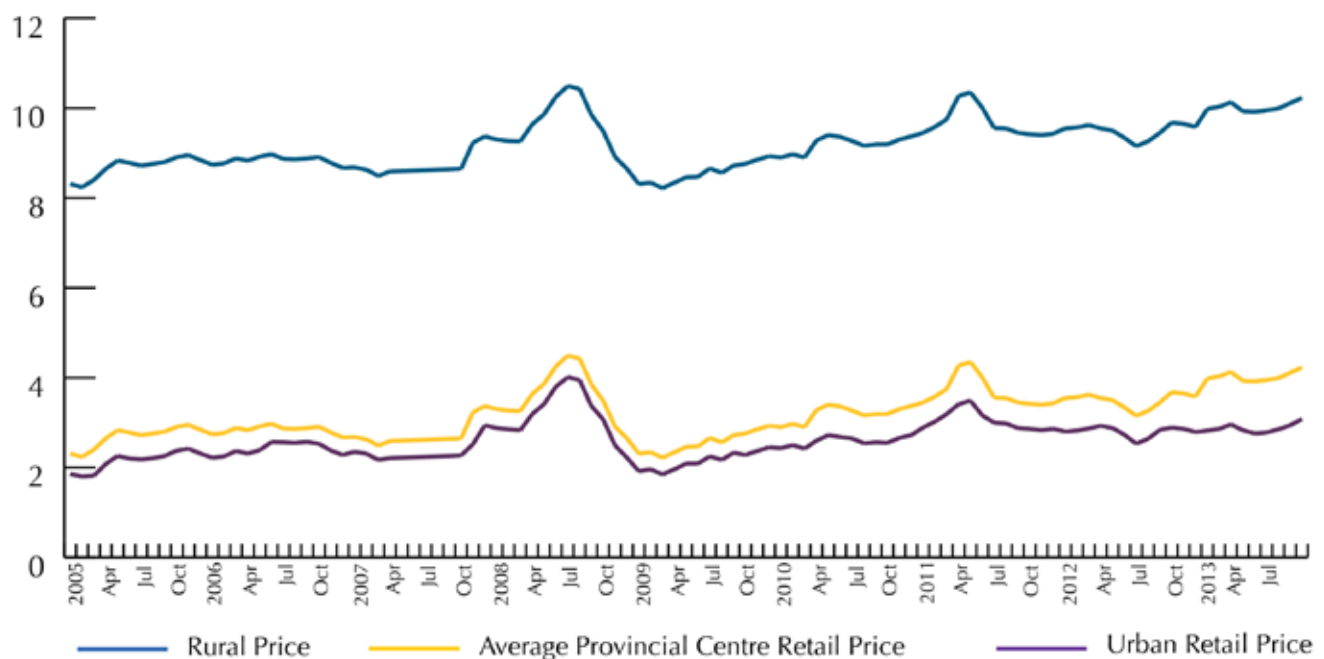


PLS could replace candles or battery-powered lights in the household, making domestic chores easier

4. INA report, 2010
5. Based on stakeholder interviews and IFC analysis

Average kerosene costs in PNG have increased in both urban and rural areas over the last 10 years and off-grid consumers have experienced significant price volatility, including two large price hikes.

Figure 7: Kerosene Retail Prices per litre, 2005-2013.



Source: Data from ICCC provided to IFC, IFC Analysis

During the price hikes indicated in the graph above, anecdotal evidence suggests that consumers switched from kerosene to other forms of lighting, notably to batteries, where prices have been more stable. While the bulk prices and distribution prices in the cities are relatively within range of international market prices, the sales prices in the rural areas have increased more rapidly.

A small number of off-grid households also use diesel generators for lighting who are also severely impacted by potential fuel price fluctuations.

Figure 8: Provincial town average cost of diesel per liter, 2004-2013.



Source: Data from ICCC provided to IFC, IFC Analysis

2.3. ENERGY CONSUMER SEGMENTATION

Using data from the 2010 PNG Household Income and Expenditure Survey (HIES), it is possible to segment the market for off-grid energy consumption into 4 distinct household clusters.

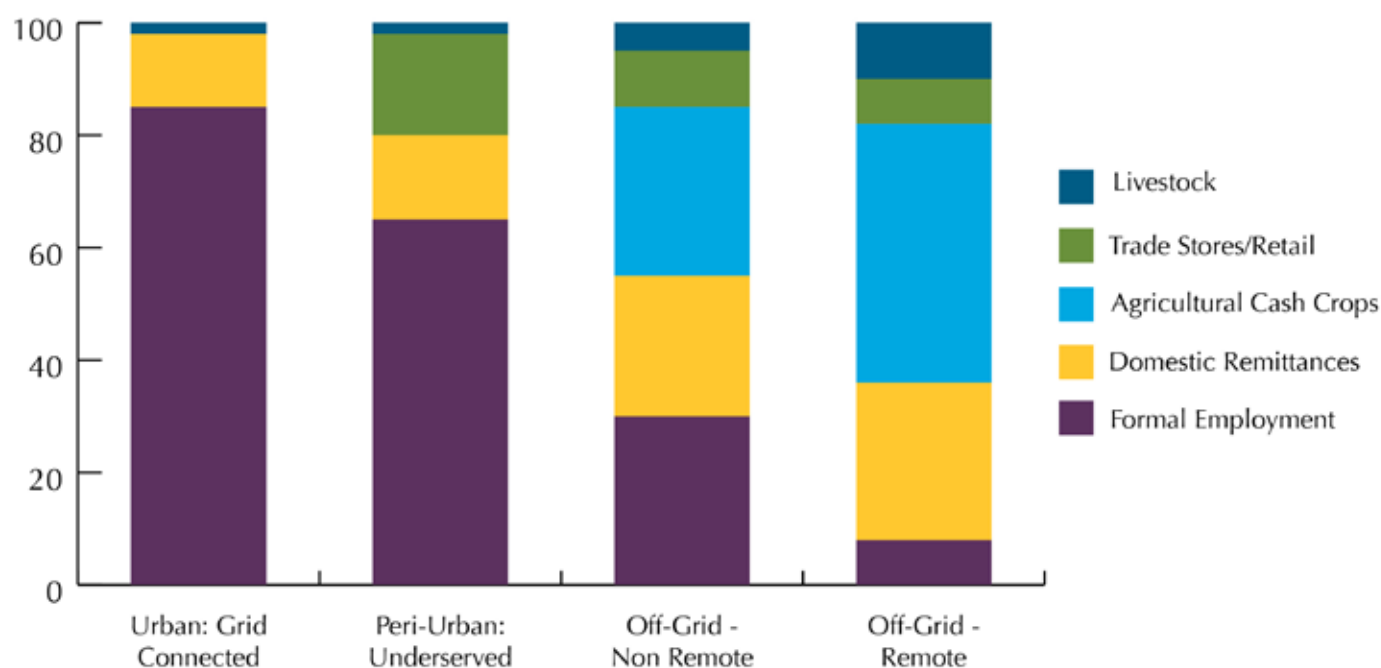
Table 1: Four segments of off-grid energy consumers

Consumer Segment	Description	Estimated # of HHs	Dwelling Type	Average Monthly Off-Grid Lighting Costs (USD)
Urban Based: Grid Connected	City based, formal employment	50,000 est.	Brick, Wood, Fibro	\$41-49 USD
Urban Based: Underserved	Settlement based, informal urban employment	41,000 est.	Metal Sheets, Tin	\$16-25 USD
Off-Grid: Non-remote	Within 50km of provincial centers, farmers, formal employment & transportation	400,000 est.	Wood, traditional bamboo	\$82 - 95 USD
Off-Grid: Remote	Coffee, cocoa, palm oil, subsistence farmers	900,000 est.	Traditional bamboo, mud	\$20-35 USD

Source: HIES, World Bank and IFC Analysis

There is a clear breakdown within these market segments based on how households obtain their income and whether they do so through formal or informal employment.

Figure 9: Breakdown source of income for market segments



Source: IFC Analysis

For off-grid households, agricultural cash crops are a key source of income. Because of the seasonal nature of these incomes, mobile phone retailers and general trade store owners indicate they see significant spikes in sales during peak crop cycles. These months will be potential peak seasons for PLS sales once consumer awareness is improved.

Table 2: Key agricultural crops peak seasons

Crop	Number of Farmers	Months of Peak Crop	Average Incomes
Coffee	2.5 million	August - November	\$4-5000 USD
Cocoa/Copra	2 million	March – April & October - November	\$4,000 USD
Palm Oil	200,000	All year round	\$6,000 USD
Fresh Produce	400,000	Fruits – August to December Vegetables – All year round	\$1,500 USD

Source: IFC Agribusiness Strategic Review, 2011-15

Sources of lighting also differ substantially among the different market segments. The more remote and poorer a household is, the more likely it is to rely on kerosene for lighting.

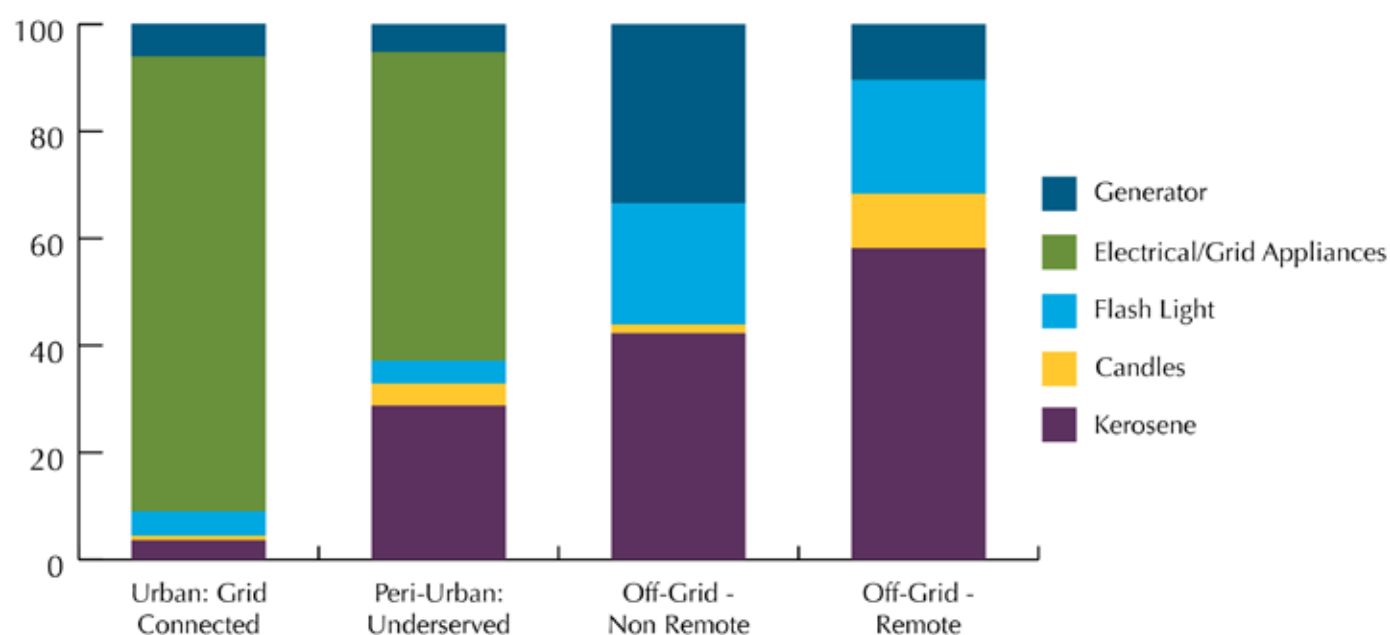
Figure 10: Breakdown of sources of lighting for off-grid consumers.



Installing solar panels in a rural, non-remote household

Image courtesy of AT Projects

Source: IFC Analysis



All four market segments offer good prospects for manufacturers, distributors and retailers of off grid lighting products:

Table 3: Segmentation of PNG Off-Grid Energy Consumers

Consumer Segment	Product of Likely Interest	Estimated # of HHs	Purchasing Point
Urban Based: Grid Connected	Larger SHS	50,000	Electrical goods retailers, employer schemes
Urban Based: Underserved	SHS and lanterns (single and multiple)	41,000	Urban based wholesalers and retail outlets
Off-Grid: Non-remote	SHS and lanterns	400,000	Urban based retail outlets, agricultural input retailers, trade stores
Off-Grid: Remote	Lanterns and torches	900,000	Agriculture supply chains, CSR initiatives and trade stores.

Source: PNG Power, HIES and IFC Analysis

Once again, the more rural and remote the household, the more difficult it becomes to inform consumers, and to deliver and service products. Current and potential purchase points are elaborated in Section 3.

2.4. HOW OFF-GRID LIGHTING CURRENTLY SERVES THE PNG MARKET

Main sources of light for off grid communities in PNG are kerosene, diesel gen-sets, torches powered by batteries, and to a more limited extent, candles and wood.

Table 4: Lighting Source Market Breakdown

Source	Market Description	Distribution Channels
Kerosene/ diesel	<p>Some 25 thousand metric tons of kerosene are consumed by PNG households annually⁶ for lighting purposes.</p> <p>While the bulk prices and distribution prices in the cities are relatively within range of international market prices, the sales prices in the rural areas has increased more rapidly.</p> <p>The inaccessibility of many parts of the country and underdeveloped distribution channels are important reasons for these high (and often informal) retail prices for kerosene in rural areas. Rural prices can be many times higher than in the urban centers.</p>	<p>Kerosene is sold at wholesale in PNG by NYSX listed Interoil, which has nationwide wholesale rights to kerosene as well as diesel in PNG.</p> <p>Interoil has retail sales at 16 different locations across the country and kerosene is bought by retailers (often trade store owners and village stores) who put the fuel into smaller containers (often Coca Cola bottles) and sell it by road sides, in villages and in provincial towns.</p>
Batteries/ Torches	<p>Batteries are widely available in PNG in super market chains, at local markets and in street stalls. Batteries come in different sizes (penlights, including the thicker C and D types) and qualities (in terms of battery life).</p> <p>For lighting purposes, batteries power torches or the odd permanent lamp using incandescent lights, as well as a growing number of LED torches.</p> <p>Low and high grade batteries are available, and prices are generally higher in rural areas and in small kiosks.</p>	<p>Batteries are largely brought into PNG by large wholesalers to stores in large urban centers (Port Moresby and Lae) and provincial centers (Goroka, Mt Hagen, Rabual etc).</p> <p>Batteries are then often purchased in bulk by trade stores that are better placed to service the last mile. Batteries are then sold at retail either in formal trade stores or village-based informal trade stores.</p>
Candles	<p>Candles are retailed primarily by small trade stores to off-grid energy consumers in packs of 6. Candles are used at night in village houses to provide a small amount of lighting.</p>	<p>Candles are wholesaled to trade stores, which then transport them to village communities.</p>
Firewood	<p>Although most wood is used for cooking in PNG, firewood can also serve as a source of lighting for the poor. In rural areas, 95% of households rely on biomass⁷ for cooking and heating needs, especially in mountainous regions and during the rainy season.</p>	<p>Firewood is sold almost entirely within the formal economy and in remote areas. It is not sold in retail establishments but rather collected in the woods.</p>

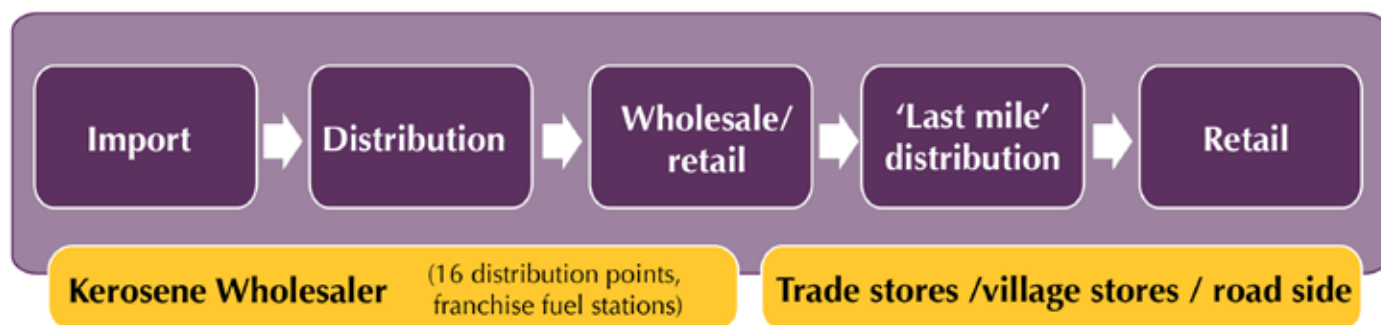
Source: Enclude and IFC Analysis

6. Source: <http://www.factfish.com/statistic-country/papua%20new%20guinea/kerosene%2C%20consumption%20by%20households>

7. HIES 2009-2010

As in other markets, the supply chain for kerosene provides a potential map for how PLS could be distributed in PNG. The kerosene supply chain is dominated by InterOil market thanks to its distribution network of wholesalers and high-volume retail sellers.

Figure 11: Kerosene distribution diagram for PNG



2.5 ACCESS TO FINANCE FOR OFF-GRID LIGHTING PRODUCTS


Modern lighting devices tend to have higher initial purchase prices but lower operating costs, compared to kerosene-based lighting. Also, operational and distribution costs are relatively high in PNG, leading to higher retail prices compared to other countries.

A solar lighting product (phone charging included) of 2.5 Watts was found on display in a retail store for 120 Kina (approx. \$60 USD). In other markets, these products sell for 20-45 USD. Larger systems, such as the 15Watts kits, were selling for prices ranging from 560 to 2000 Kina (\$280-1000 USD).⁸

Financing can help people overcome the upfront cost barrier to modern lighting. This would be the case for larger and more expensive PLS systems. However, the main financial institutions in PNG have not yet developed financing programs or products specifically for purchase or distribution of off-grid solar products.

With respect to finance for PSD traders and retailers, overall, there is very little supply chain financing available in PNG today. According to the 2010 informality survey, informal businesses are more likely to apply to a micro-finance institution or NGO, while formal businesses generally bank with commercial banks.

The table below provides more insight in the main banks and microfinance institutions in PNG, their rural coverage and their main product categories.



Even households who have grid access face significant under-electrification and experience power outages on a daily basis.

Table 5: Overview of financial institutions in PNG

Channel	National and/or regional	Urban or Rural Based	Key product categories	Main financial institutions
Banks	Operate nationally and/or internationally	Primarily urban-based, but have branches in rural areas.	Transactional, personal lending, housing loans, foreign exchange	<ul style="list-style-type: none"> • Australia & New Zealand Banking Group (PNG) Ltd • Bank of South Pacific Ltd • Maybank (PNG) Ltd • Westpac Bank (PNG) Ltd
MFIs	Mainly operate regionally. Only Nationwide Microbank Ltd operates at a national level.	Particularly rural-based, although most have urban presence as well, including Heduru Moni Ltd, Kina Finance Ltd, Credit Corporation Finance Ltd, Nationwide Microbank Ltd.	Loans only (personal, business, consumer loans etc.) No bank system	<ul style="list-style-type: none"> • Credit Corporation Finance Ltd (affiliated with BSP) • First Investment Finance Ltd • Finance Corporation Ltd • Heduru Moni Ltd • Kina Finance Ltd • PNG Home Finance Ltd • PNG Microfinance Ltd • Nationwide Microbank Ltd • Resources and Investment Finance Ltd • Kokopo Microfinance Limited

Source: Enclude

Domestic Remittances or the 'Wantok' Network

In PNG society, notions of reciprocity and family obligations are strong. PNG has a large informal money-transfer network, called 'Wantok', through which (extended) family members in urban regions provide support to their rural families, which is widely used.

Table 6: Receipt of private transfers in cash or in kind by rural and urban areas, regions, and sex.

	National	Rural	Urban	Metro	Southern	Highlands	Momose	Islands
All	48.6	48.6	48.9	49.0	55.8	55.7	43.3	37.7
Male	48.3	48.4	47.4	48.2	56.9	53.1	42.8	36.3
Female	49.0	48.8	50.5	49.9	54.7	54.3	43.9	39.1

Source: HIES 2009

The 'Wantok System' is important for PLS suppliers, because urban-based relatives can be an important sales channel for reaching the off-grid rural target group. A mobile phone survey by IFC recently indicated that 33% of mobile phone owners say that their mobile phone was bought for them by family or a friend.⁹

9. IFC Telecommunications Survey, 2010

THE WANTOK 'ONE TALK' SYSTEM

In Tok Pisin, the most widely spoken PNG language, wantok is the word for 'one talk' or 'one language'—which is significant in a country comprised of nearly 1,000 traditional societies and ethnic indigenous groups, speaking over 850 different languages.

The word wantok can also refer to the tribal roots of a person, and is thereby connected to the basic philosophy of life for the people of PNG: if one of your Wantoks is in trouble, needs money or is hungry, you are compelled to help them as much as you possibly can. In a country with very limited basic services for its citizens, and no safety net for the poor, the Wantok system effectively performs a very important role. In addition to being widely utilized to deliver goods and services to bottom of the pyramid (BOP) individuals, Wantok is in effect a form of social glue that binds the nation together.



Language and family groups play an important role in the social fabric of PNG.

PNG TRADE STORES

There is a dense network of small-scale trade stores and village stores serving rural off-grid households. The 2010 informality survey looked at these rural-based businesses, and provided the data below on number of employees, annual turnover and main hardware assets owned by the business.

Profile of rural based businesses (mainly trade stores)

Number of workers	Total (%)	Informal (%)	Formal (%)
1-3	52.9	74.0	32.5
4-10	31.3	21.0	41.3
11-20	8.0	3.4	12.4
21-35	3.6	1.1	6.0
36-50	1.5	-	2.9
51-100	1.1	0.5	1.8
101 and over	1.7	-	3.3
Average workers	9.79	3.78	15.54

Geographic scope	Total (%)	Informal (%)	Formal (%)
International	1.8	2.4	1.3
National	5.1	1.9	8.0
Province	13.5	5.5	21.0
District	79.6	90.2	69.6

Annual turnover	Total (%)	Informal (%)	Formal (%)
Less than 10,000 PGK	45.7	63.1	30.9
10,000 to 20,000 PGK	30.0	28.0	31.7
20,000 to 250,000 PGK	16.5	6.8	24.7
More than 250,000 PGK	7.8	2.1	12.7

Generally speaking, PNG's trade stores are informal businesses employing 1-3 workers, including the owner, with annual turnover of less than 10,000 PGK (8,800 USD). Most trade stores do not have access to formal credit, and only 25% owns assets that can be used as collateral.

Assets used in business operations

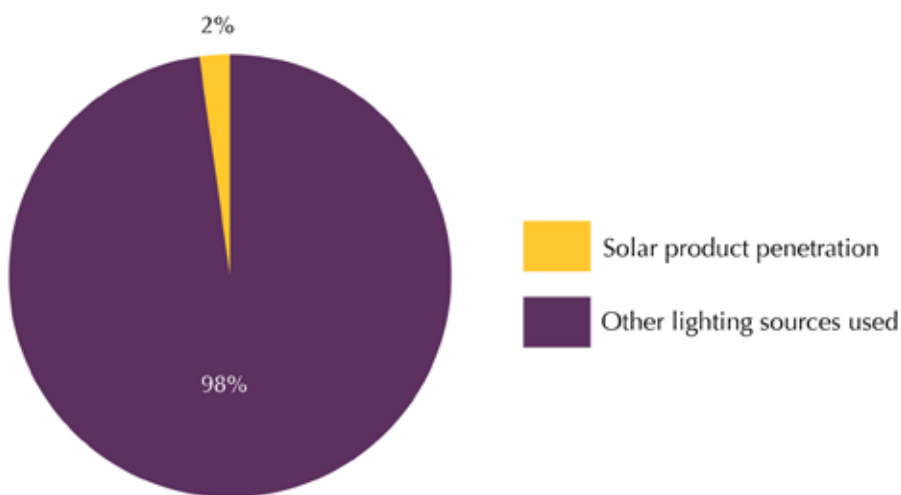
	Informal (%)	Formal (%)
Machinery (electronics, tools, equipment, computers)	24.0	55.1
Premises (house or other buildings)	21.0	52.7
Vehicles or other movable assets	16.1	50.9
Furniture	23.7	40.3
Land	26.9	32.3
None	28.9	7.3

3. CURRENT SOLAR MARKET IN PNG: STILL AT THE STARTING GATE

3.1. SOLAR LIGHTING MARKET

The penetration of the market by renewable lighting products today is very low. Based on the HIES and stakeholder interviews, IFC estimates that of the 1.3m households in PNG, less than 2 percent use solar lighting products and less than 1 percent use high quality solar lighting products.

Figure 12: Solar lighting market penetration, in percentages.



Source: Stakeholder Interviews and IFC Analysis

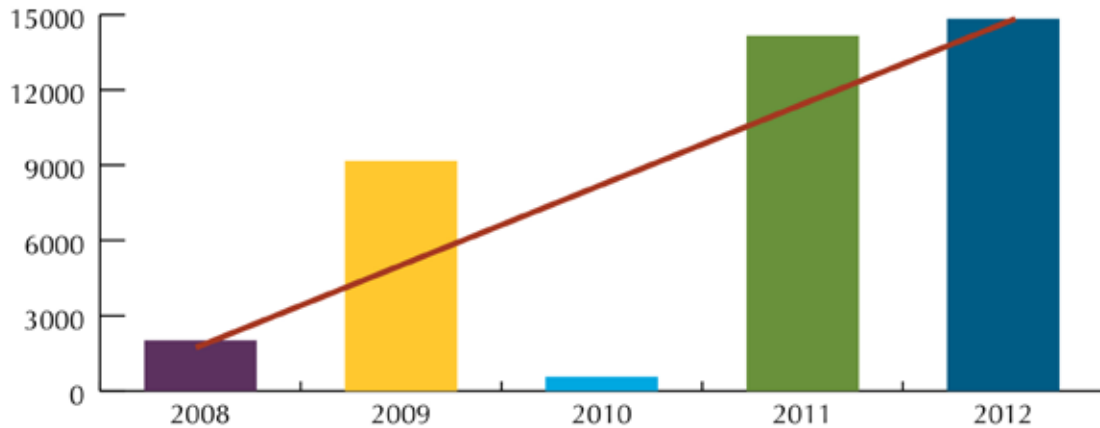


Less than 1 percent of households in PNG use high quality solar lighting products

Image courtesy of Lighting Africa

In 2012, official figures indicate 15,000¹⁰ solar lighting products were imported into PNG. Based on retailer interviews, the number of solar products sold is expected to be even higher, as many products would not have been registered correctly with PNG Customs, and some products would have come across PNG's land border with Indonesia. Based on official import figures combined with feedback from stakeholders, IFC estimates around 30,000 solar lighting products are imported into PNG per annum.

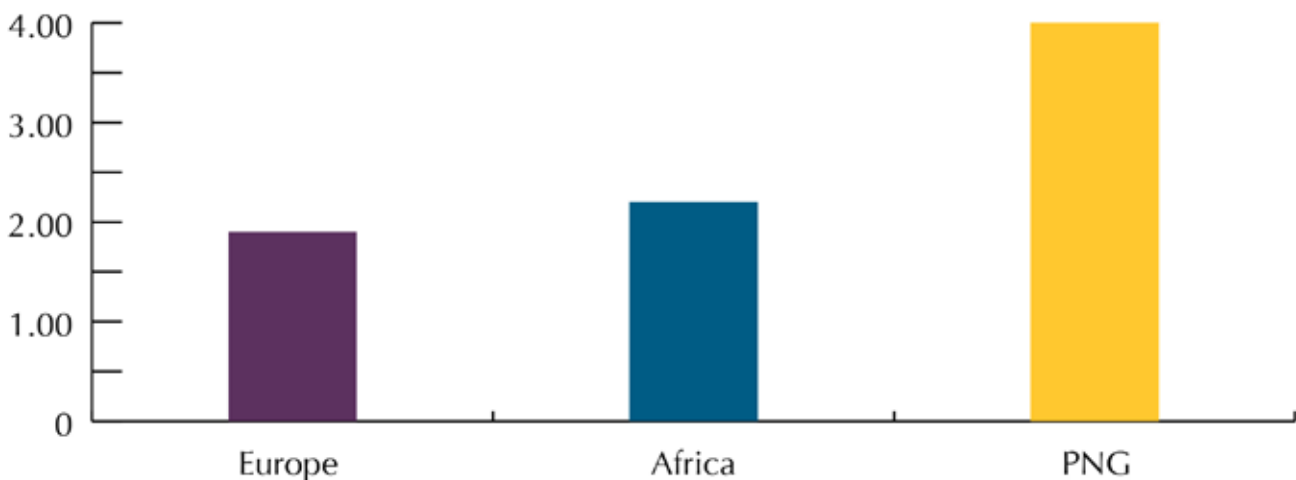
Figure 13: Official imports of PLS into PNG per Annum.



Source: IFC Analysis

Average prices for solar products in PNG are higher than in other markets where PLS are sold. Pricing of solar products in PNG differs substantially among retailers. This may be related to the emerging status of the market, as well as to the higher operational costs associated to doing business in PNG.

Figure 14: Retail PV prices per Wp in PNG versus other markets (USD).



Source: Stakeholder Interviews and Enclude Analysis

10. PNG Customs data

3.2. OVERVIEW OF MARKET PLAYERS

Currently IFC is aware of 8 different solar manufacturers retailing in PNG, 3 of which are Lighting Global Associates.¹¹

Although the sales volume is still relatively small yet, retailing of solar products is done through a variety of channels. The current main market players are specialized solar companies, general hardware and electrical stores, supermarket chains, trade stores, and fuel distributors. Importantly, research conducted for this report also found strong interest from other private sector players, ranging from large wholesalers to agribusinesses, indicating that there is significant interest in expanding into this market. See chapter six for more analysis of potential new entrants.

There is strong interest from other private sector players ranging from large wholesalers to agribusinesses, indicating significant interest in expanding into this market.

Table 7: Distribution channels for solar lighting.

Channel	Number of Organizations	Est. # Sold	Urban or Rural Based	Examples of Market Players
CSR Initiatives/ NGOs	10	Around 800 units per procurement	Almost all rural- based. Extractive industry players and NGOs use solar as a way of meeting community demand for energy.	Exxon Mobil Newcrest Mining AT Projects Kokoda Foundation
Electrical Goods and Hardware Retailers	8	4-5,000 products per annum	Primarily based in Port Moresby and Lae as well as some presence in other provincial centers.	Esco Nuigini Electrical BDBM Farmset
Solar Specialists	4	2,000 products per annum	Currently all Port Moresby-based but looking to expand footprint.	Solar Solutions Sunlight Powa
Supermarkets	5	2,000 products per annum	Port Moresby or Lae based regional specialization. Also selling wholesale to rural trade stores.	SVS Papindos (Lae, Goroka), Bintangor (Goroka, Mount Hagen)
Other Retail outlets	6	3,000 products per annum	Often smaller, provincial-based retailers including car mechanics, agri-commodity exporters and hardware stores.	Rural Power Supplies Ela Enterprizes Spectra

Source: Enclude and IFC Analysis

IFC has found strong anecdotal evidence from current retailers that sales and demand have increased substantially over the last 12 months.

¹¹. Stakeholder interviews

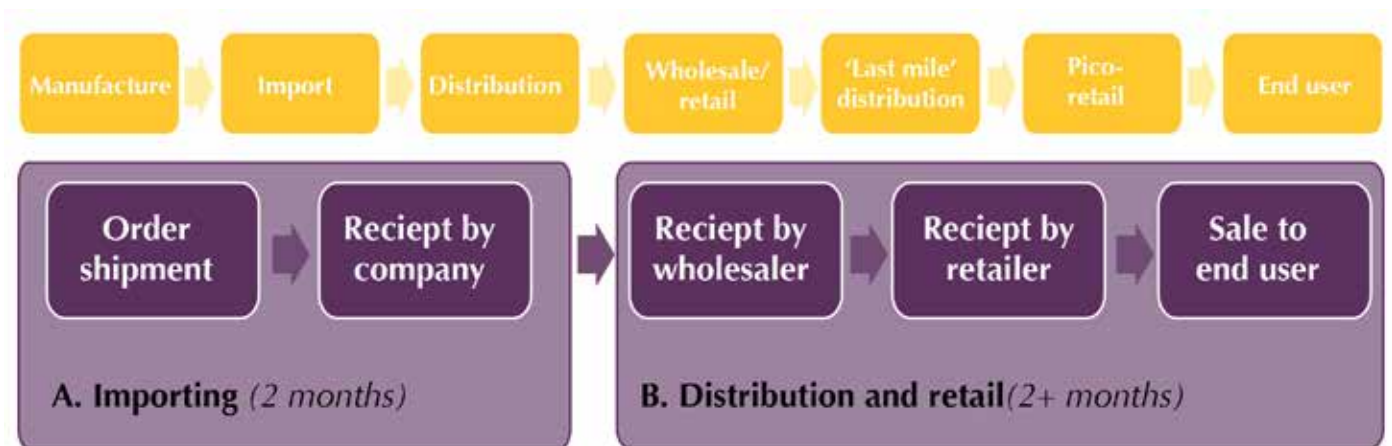
3.3. SOLAR DISTRIBUTION CHANNELS

Distribution of any product in PNG, especially over the last mile to reach rural customers, is not a simple matter. Like most other manufactured goods sold in PNG, the first step in the solar distribution chain is importation.

Despite its geographical proximity to common production sites in China, PNG lies off the major shipping routes, and therefore sea-freight costs are relatively high and services to and from the rest of the world are infrequent. Import clearing delays occur, but according to the businesses we interviewed, conditions are improving. Local partners or shipping agents can assist where necessary.

In order to reach the rural end user, products must travel through rural towns and centers, entering the rural retail network for delivery over the “last mile”. Because of PNG’s limited physical infrastructure, this can be a relatively slow-moving supply chain. A product is likely to be underway for at least 3 months, calculating from order placement to availability in the retailer’s outlet.

Figure 15: Average time frame of product from manufacturer to end user.



In the section below, we describe current players in each stage of the distribution chain and their level of engagement.

Import and wholesale

Currently, each major company active in PLS distribution in PNG handles importation itself. There are no specialized wholesale companies that keep significant amounts of stock. Except for the solar specialist technical companies, the market players are relatively well-capitalized and can do direct imports. However, PLS competes for attention and resources with the core business products of these companies, such as electric equipment or consumer durables. As these products are currently faster moving, sufficient capital is not allocated to maintain significant volumes of PLS stock.

Distribution

Supermarkets and retailers of electrical goods and hardware import, distribute and retail PLS. These companies’ outlets are mainly based in the cities (Port Moresby, Lae, Goroka, Mount Hagen, Madang), and their clientele is mostly the urban-based population, as well as some installation companies/technicians and occasional traders from rural areas.

PNG also has a number of supermarket chains. The main supermarkets are often headquartered in Port Moresby or Lae, with branches in the main urban areas and in regional centers. Besides retailing products to the urban and peri-urban populations, supermarkets also sell products in wholesale to rural traders and owners of rural-based trade stores.

Retailers and distributors to date mainly shelve products, and do not actively sell the benefits of PLS to potential customers. The current market players show low levels of engagement with PLS in respect to:

- **Product knowledge / Marketing and sales:** Traditional distribution companies are selling off-grid solar products off-the-shelf. Products are sold with limited product knowledge from the retailers, with the exception of electrical hardware stores. In most cases, staff does not actively promote pico PV systems to potential clients, and there is no customer education or guidance on what can be expected from a PLS, or on how to use the product.
- **After-sales service:** Traditional PNG retailers currently do not provide formal guarantees for hardware/electronics, mainly because of the perceived potential for abuse of the guarantee conditions. Some retailers (super markets, hardware stores) do provide spare parts and may repair/replace in the first weeks after the sale of a product, in the event that the client can prove a possible defect. Some retailers also tested solar products themselves before bringing them into their stores, in order to avoid products with a high percentage of defects. There are a few long standing solar specialist companies that can offer technical services, as they specialize in procurements for CSR initiatives, development funds and NGOs. Such procurement contracts usually provide basic warrantee arrangements.
- **Finance (supply chain finance, end user finance):** Some traditional distribution companies can offer 30-day supplier credit to regular clients. Currently there are no consumer finance products focused on end-users of solar devices, which is largely to be expected given the nascent state of the market.

Table 8: Overview of supply chain actors, current roles and capacities

	Import and Wholesale	Distribution	Main market	Customer service	Finance (supply chain)	Finance (retail)
Solar specialist-traders	Experienced, with ambition to play wholesale/trading role	-	Procurements by dev. funds, CSR initiatives, NGOs	Yes - limited	NA	
Solar specialist-technical experts	Mainly procure based on orders received, keep limited stock	-	Procurements by dev. funds, CSR initiatives, NGOs	Yes - Service and warrantee contracts	NA	(some - through NGOs)
Electrical Goods and Hardware Retailers	Experienced importers and wholesalers, PLS competes with their other products for financing and shelf space	Urban centers: Port Moresby, Lae, Goroka, Mount Hagen, Madang	(Peri)-urban retail and some rural traders / technicians	Limited. Warrantees generally not respected, product prices not fixed	For known accounts only	No
Supermarkets	Yes, but PLS 'competes' with their other products	Urban and regional centers	(Peri)-urban retail and some rural trade stores	Limited	For known accounts only	No
Trade stores	No	Rural and peri-urban	Not yet informed/mobilized	No	Unknown	No
Fuel supply companies	Yes, limited	Urban and regional centers	(Peri)-urban retail	Not yet		

Source: Enclude and IFC Analysis



Extractive industry players in PNG may drive the introduction of solar technologies in remote areas

4. POTENTIAL DEMAND DRIVERS

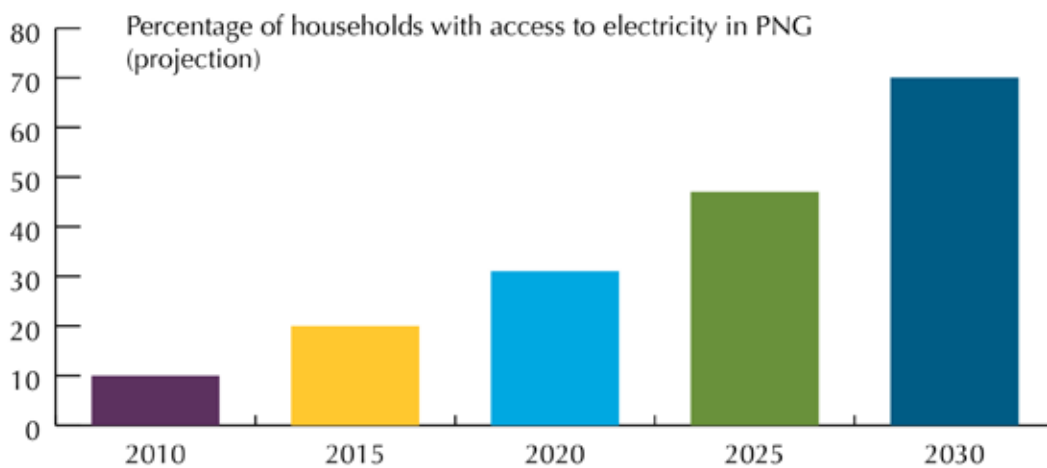
The report has already touched on many of the potential demand drivers for the off-grid solar lighting products in PNG. Below, we explore in greater detail what will drive the market over the next 3-5 years.

4.1. STAGNANT GRID GROWTH

Grid growth in PNG continues to lag behind the overall population and even behind grid growth of other developing countries both within the Pacific region and in Africa. Between 2000 and 2009, the grid remained stable in its reach but actually decreased in its market penetration, as PNG’s population grew by nearly 3 percent per annum.

Even under the most optimistic grid growth scenario (using official PNG Government targets), the off-grid population does not decline substantially by 2020.

Figure 16: Households with access to electricity, projected up to 2030 according to PNG Government Estimates



Source: Government of PNG Medium Term Development Goals

Given slow growth in grid coverage, institutions, the private sector and individual households are more and more likely to look to decentralized solutions for increasing their energy access--including solar devices.

4.2. UNAFFORDABILITY OF KEROSENE AND DIESEL PRICES

Papua New Guineans already spend over 60 USD million per year on kerosene for lighting, not taking into account transportation costs and price premiums paid by the many consumers buying small amounts (less than a liter).

Prices for kerosene have increased over 35 percent since 2004. Given that prices are directly linked to global price of oil price, the cost of kerosene is expected to increase further in the coming years.

4.3. GROWTH OF MOBILE PHONES

The increase in prevalence of mobile phones among PNG's relatively poor and dispersed population has been a great success story of the last 6 years in PNG, with annual rates of growth of around 300 percent from 2007 - 2012. The number of people with mobile phones outstripped the number of people connected to the grid in 2008. Now there are 1.3m households with a mobile phone but no charging capability, creating an additional market impetus for PLS, which would provide households with a convenient and cost-effective means of charging their phones.¹²

Of those who are not connected to the grid, most mobile users charge their phones by making use of another household's electricity (65%), while others take their phone to a mobile phone charging shop (20%), use electricity at their work place (9%), or use a solar charger (5%).¹³

About 52% of people who own or use a mobile phone spend \$7 or less each week on mobile phone services (including charging), while just under a quarter (23%) spend between \$7 and \$14 each week; 21% spend over \$14 each week. A small group (4%) does not spend anything.¹⁴

Given that people pay on average \$2.20 to charge their phone, mobile phone penetration is likely to be a significant market driver in sales of PLS in PNG.

12. IFC and Digicel

13. IFC Telecommunications Survey, 2010

14. IFC Telecommunications Survey, 2010

HOW PEOPLE CURRENTLY CHARGE PHONES IN OFF-GRID COMMUNITIES IN PNG

In a separate project, IFC is working with Digicel, PNG's largest mobile phone network provider, to establish solar lighting and mobile phone charging stations in communities across PNG. Below are two testimonials from participants in pilot locations on the problems that people faced in getting their phones charged previously:

Travelling into town to charge phones

"My village is situated on the border of two clans with a total population of 4,000 people, all of whom use mobile phones. One of the major problems we have had over the last 6 years is to find a way to charge our mobile phones. Now we have to travel into the local town and pay 1PGK (\$0.40) to charge phones. However, we have to pay 4PGK (\$1.80) to get the bus into town and this is too much for a lot of people."

Diesel generators used to charge phones

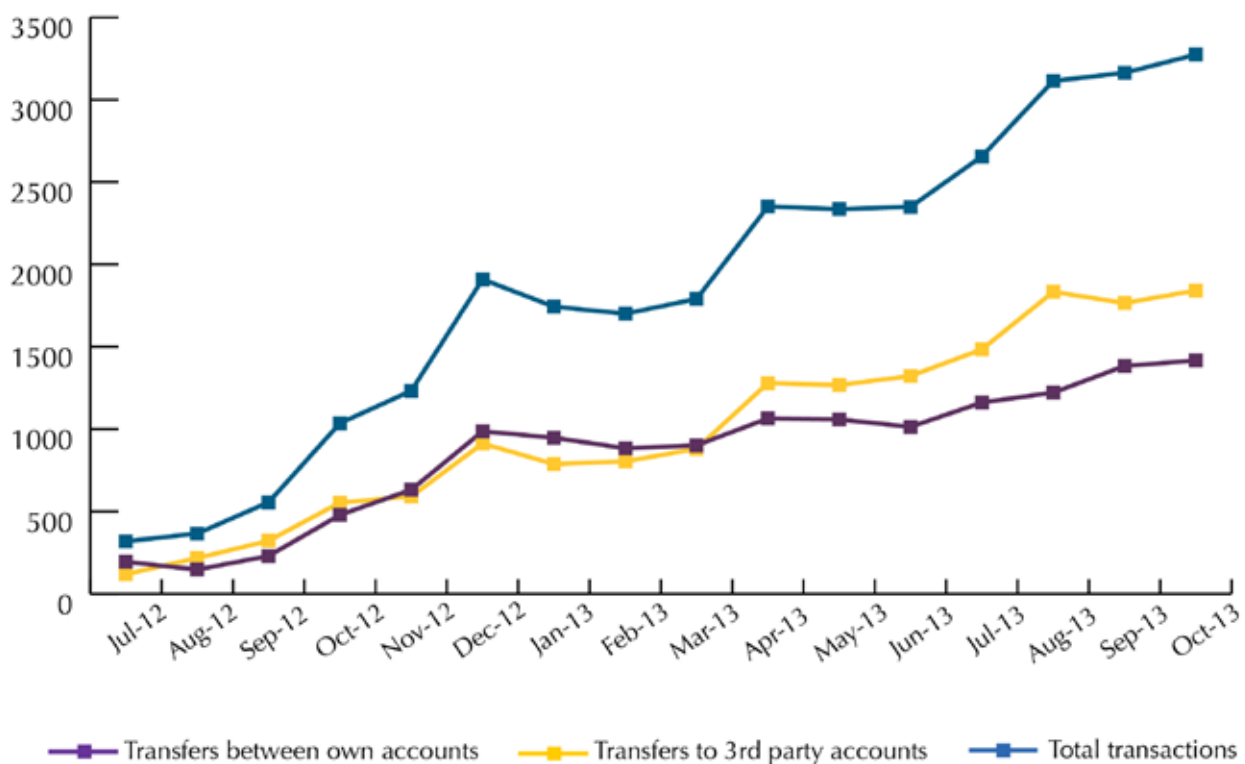
"I am a Digicel flex card reseller and for years now I have thought about how to help people charge their phones. The only way for people to charge is to pay 5PGK (\$2.20) in the few places in the village that have diesel generators, however, often they are out of fuel."

4.4. GROWTH OF MOBILE MONEY PRODUCTS IN PNG

Increases in the use of mobile banking are both a market driver and also a potential avenue for innovation for distributors and manufacturers. Mobile banking usage and money transfer through mobile phones in PNG has been steadily growing since the introduction of these services in 2008. Total transactions are now well above 2 million per month. While about 64% of PNG households are aware of mobile banking, only 10% are active users. Most frequent current users of mobile financial services are urban dwellers, salaried workers with incomes above \$70 a week, and larger businesses which use the services for payment of salaries and bills.¹⁵

The main uses for mobile banking are: topping up credit; receiving money from friends/family; sending money to friends/family; paying bills/school fees; saving money; and accessing personal bank accounts. Mobile banking is expected to further gain popularity with current user segments, as well as increase its outreach to currently underserved SMEs and rural individuals. These rural customers, businesses, and mobile money agents are especially likely to rely on solar as a reliable power option.

Figure 17: Monthly tracking of mobile banking transaction in 2013.



Source: Enclude

Bank of South Pacific Ltd is the largest bank and through its branches (42) and agents (225), has a nationwide footprint. The bank provides mobile and internet banking solutions, as well as a mobile money service, which is called ‘wantok money’. This is a mobile payment system for which the receiver needs to own a mobile phone but does not need a bank account. The money is then paid through a cash agent or through an ATM, using a transaction-specific code.

Over the last 12 months, other large financial institutions have launched mobile banking products that are now increasing customer uptake and the volume of mobile money transactions even further. A notable new entrant is the Australia and New Zealand Bank’s (ANZ) with its ‘Go Money’ product.

15. IFC Telecommunications Survey, 2010

4.5. PLS PRICING BECOMING MORE AFFORDABLE

PLS offer much greater value to BoP customers than they did even two years ago, with total manufacturing cost decreasing by 25 percent since 2010. This trend is expected to continue over time, making products much more affordable for off-grid households. Cost reductions have primarily been driven by rapidly falling costs of major components.

By 2020, PLS products are expected to drop in price by 64 percent due to manufacturing efficiencies alone. In addition, the range of products on offer will also grow to emphasize features and design valued by consumers, mobile phone charging being the most prominent.

4.6. ENABLING REGULATIONS FOR SOLAR MARKET ENTRANTS

The regulatory environment relevant to off-grid solar products is supportive of rapid growth in the market. The national power utility, PNG Power, has rural electrification targets which refer specifically to off-grid lighting. Although there are no direct subsidies for solar energy, and there is no dedicated law or regulation promoting off-grid solar,¹⁶ all solar products are exempted from import duties¹⁷ (0% duty tariff) until at least 2019.¹⁸ Goods and Services Tax (GST) on solar products in PNG is 10%.

To be eligible for tax exemption, importers must clearly indicate that BOS or spare parts (including batteries) are intended for use in solar products.

Table 9: Overview of relevant regulations

Support function	Status	Impact on pico-solar powered lighting systems' (PLS)
Financing support – Solar lighting products	Currently no government support for PLS or other solar	
Subsidies – Conventional fuels	No subsidy on kerosene, and kerosene prices show an upward trend	Solar is becoming increasingly cost competitive
Import tariffs and duties, Taxation policies	All solar products are exempted from import duties (0% duty tariff) up to at least 2019. Goods and Services Tax (GST) on solar products in PNG is 10%.	PLS benefit from 0% duty tariff

Source: Government of PNG

16. Source: <http://www.reegle.info/policy-and-regulatory-overviews/PG>

17. Customs Tariff Act of 1990, tariff item 8541.40.00

18. For 'Photosensitive semiconductor devices', according to Customs Tariff Act of 1990, tariff item 8541.40.00), exemption till 2019 at least. Note: there is a category under which solar lanterns might be categorized: Portable Electric Lamps (cat. 85.10). See document http://www.customs.gov.pg/06_legislation_and_publications/1_legislation/09_Import_Export_Tariff_2012_Version.pdf

5. COMMUNICATION CHANNELS REACHING THE OFF GRID POPULATION

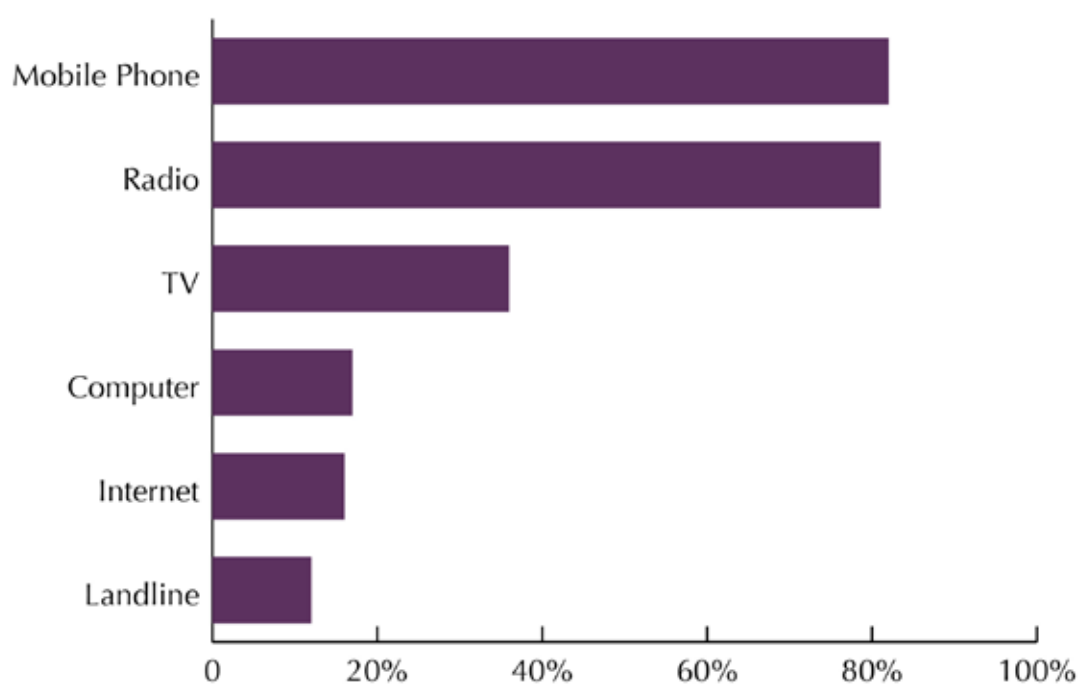
The geographical diversity of PNG, infrastructure challenges and considerable income disparities between different parts of the country imply substantial variations in media access between different provinces. This also means that citizens' household access to different media is most influenced by the region they live in – more than by any other demographic characteristic (age, gender, education, etc.).

Some provinces in PNG have considerable access to all forms of media (TV, radio, newspaper, internet through mobile phones). However, many provinces can be considered 'media dark,' where information is disseminated mainly through word of mouth. For the most part, only provinces with larger cities, Central Province and Morobe, have good access to media channels. Likewise the most populous Highland provinces (Eastern Highlands Province, Western Highlands Province, Simbu) also have good access to media, particularly radio through mobile phones. Media dark provinces include Western Province, West New Britain and Gulf.

Overall, mobile phones and radio are the most readily accessible media devices for PNG citizens and more than four in five households across the country own at least one of the two. Despite their wide popularity country-wide, access to newspapers is often restricted, particularly in the rural areas, by cost, a lack of distribution points and low literacy levels.

In rural areas, the most important sources of information are talking to people in the community (27%); radio (17%); and family and friends. The chart below, however, masks significant variations by region.¹³

Figure 18: Household Access to Media Sources, 2012



Source: Citizen Access to Information Report, AusAID, 2012

19. Source: Citizen Access to Information Report, AusAID, 2012

In terms of the programs or formats preferred by radio listeners, the 2012 survey on citizen access to information in PNG provided the following insights.

Table 10: How PNG Gets Information

Type of programme	% of regular listeners	Notes
News programs	90%	Interest in news rises with education level
Music	86%	Interest in music rises with education and falls with older age
Talkback programs (call-in)	67%	Interest in talkbacks rises with education level and older age. Slightly higher interest among men
Talk shows	39%	Islands less interested than other provinces. Interest rises with education
Dramas	33%	Of most interest to 15-24 year olds and women. Of least interest to citizens with no formal education.
Quiz shows	30%	By far most popular in Momase. Interest rises with education and falls with older age.

Source: Citizen Access to Information Report, AusAID, 2012

Below-the-line marketing opportunities

It is clear that traditional media channels offer an opportunity to reach large portions of off-grid households. However, when introducing a new product to consumers, below-the-line (BTL) marketing can often be more effective in reaching off-grid consumers. Some of the major challenges in running successful BTL marketing campaigns are the cultural and security issues in PNG, which often create barriers to effective village marketing. Many companies have experienced theft of vehicles and products while undertaking these types of promotions.

A potential antidote to these issues is to leverage the growth of cultural festivals in PNG, where products are often promoted in a safer environment. Due to the typically large gatherings, it can also be a quite cost effective way of promoting a brand. An overview of key festivals and dates in PNG is provided below:

Table 11: Potential BTL Marketing Opportunities

Date	Name of festival	Location	Description
Three-day weekend closest to the September 16th	Independence Day	Goroka in the Eastern Highlands	over 100 tribes celebrate their cultural diversity
5-7 August 2014	Ambunti Crocodile Festival	Sepik River in the Middle Sepik area	
August.	Mt Hagen Cultural Show	Mount Hagen, Western Province	60 to 70 tribes
July	Rabaul national mask festival	Rabaul, East New Britain	mounted by the PNG National Cultural Commission
September	Hiri Moale festival	Port Moresby, NCD	Celebrates the sea and man's life on it

Source: PNG Tourism

6. MARKET ENTRY POINTS AND POTENTIAL DISTRIBUTION MODELS

6.1. DISTRIBUTION CHANNELS

Around the globe, solar off-grid product suppliers have developed and deployed different business models, in each case adapting to the local enabling environment and attempting to mobilize existing networks and local institutions for the promotion solar lighting products.

The most common distribution models include a traditional supply chain; institutional partnerships; franchising; and leasing schemes. For the PNG market, similar distribution models can be deployed, but there are opportunities and market characteristics that make it worthwhile to highlight the key benefits and challenges of three specific approaches.



Traditional supply chains provide opportunities for solar product distribution

Table 12: Highlights of three main PLS distribution channels in PNG

Channel	Description	Status and key actors	Opportunity
Tender market / bulk procurements	Solar products are procured by NGOs	PLS are procured by CSR programs (mining, utilities), NGOs, community development funds, political campaigns Awareness of PLS in rural off-grid communities is increasing. After sales service needs to be assured.	Capture emerging opportunities by actively approaching market, especially CSR programs Avoid market spoilage, establish customer education model and after-sales service points
Traditional distribution channel	PLS "piggy back" on distribution network of other goods	Supermarkets, hardware and electrical goods retailers, trade stores, mobile phone retailers Some companies already dealing in solar (see chapter 3)	Further grow volumes by investing in marketing and sales skills, incentive schemes, and improving after-sales chain
Partnership sales	Partnerships with organizations having a strong reputation and outreach to large number of potential clients	PLS to be retailed through or in partnership with companies and institutions whose goals align well with the benefits of PLS No partnership sales distribution active yet	Mobilize channel. Partnerships need to be developed and supported (marketing, sales skills, incentive schemes, financing, after-sales service)

Source: Enclude

In the section below, we have listed the main considerations for each distribution model in PNG, addressing strategies for outreach, marketing, sales and customer service as well as the possibility of mobilizing sources of supplier or end-user finance.



Port Moresby, PNG's capital

Distribution Model #1: Bulk procurement opportunities

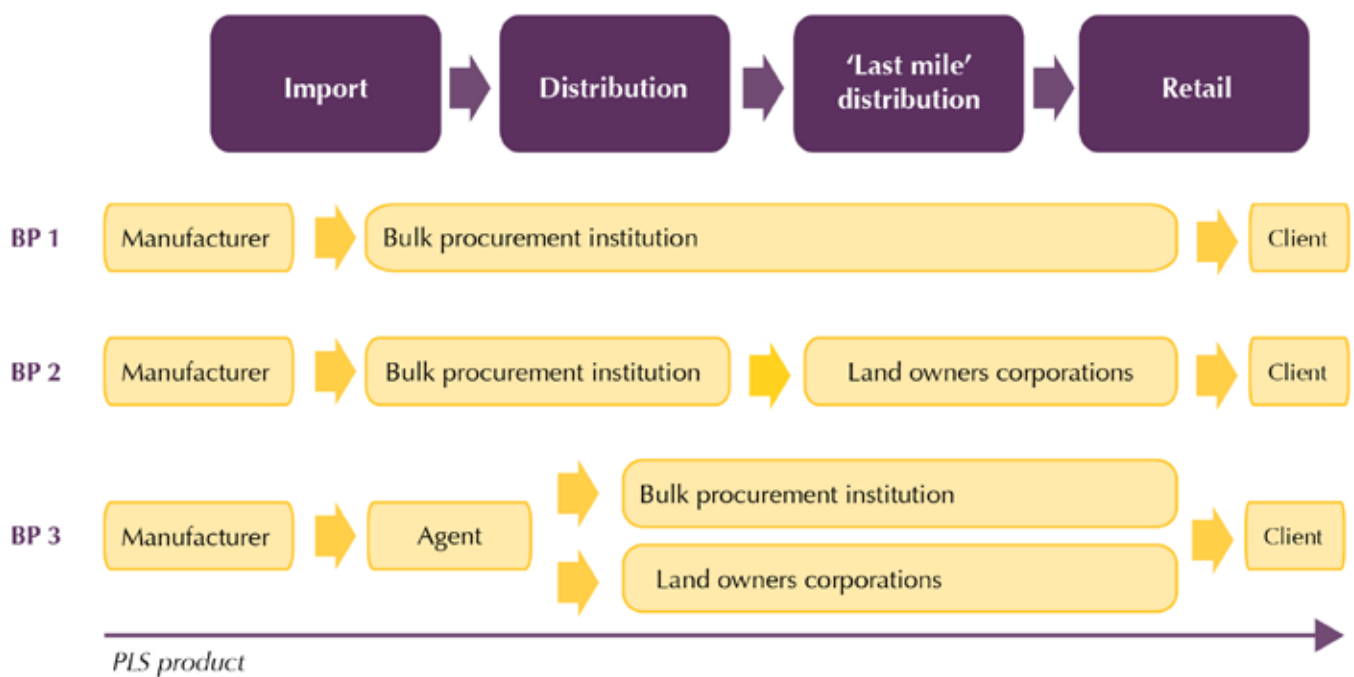
Bulk procurement opportunities will enable manufacturers to find market entry points

The extractive industry dominates the PNG economy and has in recent years led to significant economic growth. As part of their CSR policies, mining companies in PNG seek to minimize environmental impact and ensure that project stakeholders and host communities benefit from the development of the mine.

To this end, the mining companies develop partnerships with different levels of government, businesses and NGO groups, and also fund community programs for improving health, education, agriculture and infrastructure. Almost all mining companies, from the mineral exploration phase onwards, set aside a minimum of 2 percent of their budgets towards community development initiatives, and often these community programs focus on increasing energy access. This presents an opportunity to expand the retailing and possible financing of PLS by working with mining companies.

Also, a natural-resource production companies are often linked to a local land owning group’s land owning business. Traditionally, these land owning corporations provide services to the mining companies, such as transport and meals, and thereby create jobs for the communities. However, a new type of ‘land owners corporations’ seems to be emerging, with a number of companies developing new business that is not linked to specific resource projects.²⁰ These organisations can provide a potential distribution avenue to resource linked communities in PNG.

Figure 19: Bulk procurement opportunities



It is vital that the bulk of the abovementioned bulk procurement opportunities are not considering free handouts. These bulk procurement institutions want to sell off grid lighting products commercially, either by themselves at mine sites (see BP1 in the graphic above) or through ‘land owner corporations’ (BP2 in the graphic), which are set up to represent the interests of land owners and often provide services to the mine in trucking and catering etc.

A well-coordinated campaign that gives basic PLS products to low income rural households can have tremendous impact on customer awareness in a virgin market such as PNG. Moreover, distribution of starter units can create a market for upgrades.

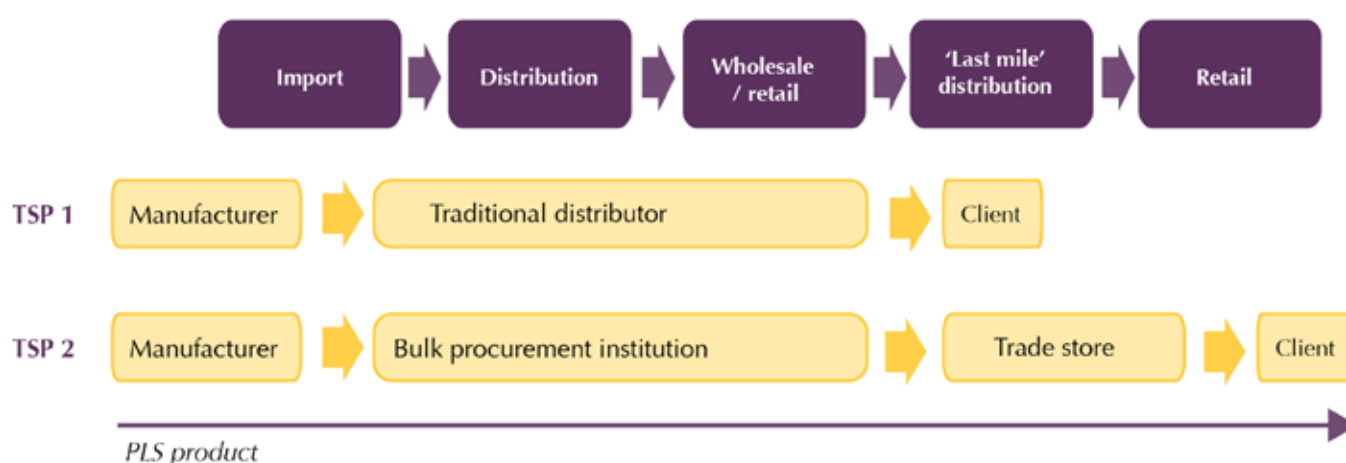
20. http://www.inapng.com/pdf_files/Maturing%20Landowner%20Companies%20-%20Blacklock%20&%20Bulman.pdf

Key benefits of bulk procurement	Key challenges / risks
<ul style="list-style-type: none"> • Significant order volume, making first entry into the market attractive • PLS benefits become available to low income, off-grid population • Opportunity to raise awareness and 'kick-start' the market, if in a defined geographical area. 	<ul style="list-style-type: none"> • One-off sale may not result in repeated sales (although it could also contribute to increased awareness and thereby 'kick-start' the market). • After-sales support needs to be provided to avoid the risk of spoiling the market by giving PLS a 'bad name'. • End-user expectations need to be realistic, and consumers need basic information on how to operate the product. • Risk of free hand-outs negatively affecting willingness to pay for PLS

Distribution Model #2: Traditional Supply Chain

Supermarkets, hardware and electrical goods suppliers, trade stores, and mobile phone retailers all have existing distribution networks in PNG. These networks can be expanded to reach many more potential PLS users.

Figure 20: Traditional distribution channel



The main shortcoming of traditional supply chains in PNG at this moment is that they provide limited service to the customer in terms of both education (on what to expect from the system and how to use it) and provision of after-sales services. Also, traditional supply chains have limited outreach to rural off-grid communities, although 'last mile' distribution models are being piloted through container-based outlets.

Key benefits of traditional supply chain

- Piggy backing on existing supply chain improves cost efficiency
- Some control of market price
- Leverage existing distributors' and retailers' market knowledge and networks
- Leverage experience of existing distributors in transporting and maintaining stock in challenging security and infrastructure context
- Can make stock available close to rural traders and retailers, who are the "last mile" infrastructure reaching rural off-grid communities
- Some supplier credit is offered to regular / trusted accounts

Key challenges / risks

- PLS 'competes' with other products traded by the distributor, and gets limited attention. Products are 'shelved' but not actively promoted or explained.
- Although 'last mile' distribution models are being piloted (eg container-based outlets), outreach of most distributors is limited to (peri-) urban centers and some larger rural towns.
- Limited product knowledge and limited sales and marketing skills hamper capacity of traditional distributor staff to actively sell PLS
- After sales service virtually not provided, warranty conditions printed on the box are generally not respected.
- The combination of limited customer awareness and no active promotion of the product may cause product to gather dust on the shelves.
- Supplier finance and end user finance is not common.
- Brand dilution risk, if inadequate training and oversight is provided alongside product sales

Distribution Model #3: Partnership sales

The main institutions that can play a role in promoting solar products to rural off-grid communities include utilities; NGOs and their service providers; mining companies; agricultural trading companies; banks; MFIs; and mobile phone companies.

Partnerships can initially be explored with organizations in the agricultural commodities sector, from which 85 percent of the population derives its income. Many large agribusinesses provide agricultural inputs to farmers through a network of retailers in farming communities. As such, agribusinesses have a vested interest in farmers having their mobile phones charged so that they are better able to communicate along the supply chain.

85 percent of PNG's population derives their income from agriculture.



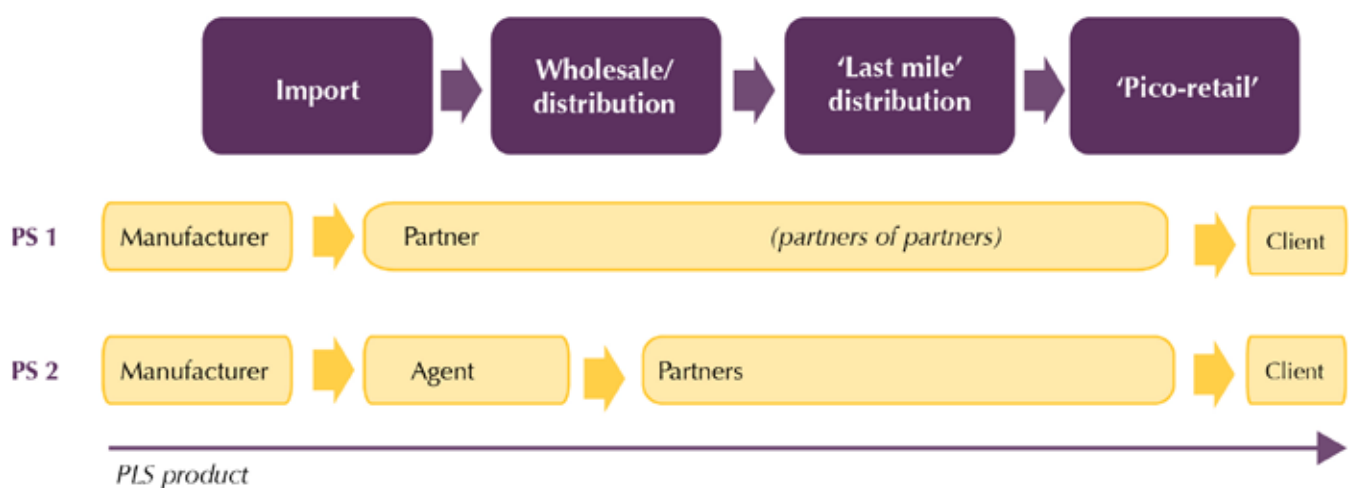
Table 13: Potential Agribusiness Partner Analysis

Crop	Provincial Reach	# Potential Partners	Potential Product Focus
Coffee/Tea	Eastern Highlands, Western Highlands, Simbu, Morobe,	20-30	Lanterns and Torches with Mobile Phone Charging Capacity
Coffee/Copra	East New Britain, East Sepik, West Sepik, West New Britain, Bougainville, New Ireland, Madang	8-12	Lanterns and Torches with Mobile Phone Charging Capacity
Palm Oil	Oro, West New Britain, East New Britain	2-4	Lanterns and SHS

Source: IFC PNG Agribusiness Strategic Review 2011-2015

There are other potential partnership opportunities leveraging current distribution chains including:

- **Mobile Phone Distributors and Flex Resellers:** Digicel is currently dominating the mobile phone market in PNG. Mobile phones are distributed in PNG primarily by a number of sub-distributors for Digicel, which sell through small trade stores.
- **Domestic Gas Cylinder Distributors:** Many urban, peri-urban and rural non-remote households use domestic gas for their cooking needs and there is potential to partner with these distributors to retail PLS products.
- **Leveraging Mobile Money Networks:** Mobile money networks are established by companies contracted to find sales agents and merchants. These contractors have the potential to be leveraged as potential wholesalers for PLS products.
- **Kerosene and diesel networks:** As in other markets, there are examples of kerosene wholesalers and retailers with an emerging interest in diversifying their product offering to include PLS as a way of becoming less reliant on kerosene for their income.

Figure 21: Partnership sales

Some partners could directly import PLS. However, it is more likely that a range of partnerships can be developed by a PLS supplier if it has a local presence or agent who has this mandate (see PS2 in the above model).

Key benefits of partnerships	Key challenges / risks
<ul style="list-style-type: none"> • Leveraging existing relationships with target group enhances effectiveness of marketing and improves cost efficiency • Some control of market price • Can make stock available close to rural traders and retailers, who are the “last mile” infrastructure reaching rural off grid communities • Can open end-user finance possibilities • Mobilizing and engaging with many different partners spreads risk 	<ul style="list-style-type: none"> • Partners are inexperienced retailers, and may lack stocking facilities and technical sales skills. • Product quality needs to be well controlled, as partners do not want to damage their existing relationships with target community • Limited product knowledge and limited sales and marketing skills also hamper capacity of traditional distributor staff to actively sell PLSs • Brand building possibilities may be limited • Mobilizing and managing many partners can be an operational challenge, and may spread resources thin.

Source: Enclude

A list of potential distribution partners under these business models can be obtained from IFC.



Partnerships could play an important role in getting solar technologies to remote areas in PNG



Mobile banking may provide incentives to invest in solar energy, due to the need to charge mobile phones

7. RECOMMENDATIONS FOR SCALING UP

7.1 RISKS AND MITIGATIONS

PNG is still largely a virgin market when it comes to solar products. The socio-economic and geographically challenging landscape of the country will require a targeted and leveraged approach for entering the market.

The table below outlines the main challenges for scaling up in the PNG PLS market, and gives suggestions as to how these can be addressed.

Table 14: Addressing challenges to scaling up

Main challenges	How they can be addressed
Poor physical infrastructure, security situation, high operational cost	Leverage and build on existing distribution channels; Mobilize new partners in PNG whose goals align with PLS benefits
Access to finance is limited	Mobile payment systems combined with international investors
Low income levels	NGOs and CSR initiatives can provide price subsidy or free distribution of PLS to low income households. As in other markets, manufacturers and distributors should seek to create high value and social status in ownership of PLS products and where possible avoid product subsidies or free handouts.
Low consumer awareness, widespread illiteracy, low outreach of printed media, cultural diversity (many languages spoken)	Customer awareness campaigns that focus on below-the-line marketing and word of mouth, eg. demonstrations at annual regional fairs.
Current knowledge of products, recommended product usage, after sales service is very limited	Build and strengthen supply chains with strong quality focus on: <ol style="list-style-type: none"> User education; After-sales service “Graduation” business-models.



7.2 FOR MANUFACTURERS

USE BULK PROCUREMENT OPPORTUNITIES AS MARKET KICKSTARTERS

In the virgin PNG market, a well-coordinated campaign that gives basic PLS products to low income rural households can have tremendous impact on customer awareness, and can create a market for upgrades.

To leverage bulk procurement opportunities for creating future PLS markets, the procurement institution and the PLS distributor ought to take the following into account:

- Stick to a quality approach, by setting up solar promotion teams for educating beneficiaries, as well as setting up after sales service points;
- Open retail outlets where products are for sale, and consider subsidized pricing for upgrade products;
- Communicate expected product life, and promote 'graduation' by offering a savings program towards the purchase of a next (larger) solar product. Suggest that savings on kerosene or other related expenses generated by the free PLS be deposited into the savings account.

DIVERSIFY DISTRIBUTION CHANNELS

In order to achieve scale and operate in a cost effective manner, given the specific challenges in PNG, PLS distributors are advised to develop partnerships that mobilize a range of institutions which already reach the target consumer groups.

- PLS manufacturers as well as existing and new distributors can work together to improve their service level in the 'traditional supply chain' and grow its outreach and therewith the PLS market.
- Manufacturers as well as distributors can mobilize and engage with new partners-such as utilities, NGOs, mining companies, agricultural trading companies, banks/MFIs and mobile phone companies-to enter the market and promote PLS.

KEEP INNOVATING

In the next phase of market development, business model innovations seem appropriate to support market scale up:

- **Network sales:** Tupperware / multi-level marketing model, where PLS are distributed and sold by independent agents who are encouraged to recruit and train other independent agents, can be an interesting model to further explore in urban markets because of strong networks in PNG society (wantok, extended family), and importance of word-of-mouth as main communication channel. The Issue with security can be overcome with mobile money and central stock point (urban).
- **Leasing / rental:** As mobile banking gains popularity, rural mobile money agents will need a (solar) power solution. Pay as you go' business model, with mobile-based payment plans, are likely to become increasingly feasible.

7.3 FOR DISTRIBUTORS

FOCUS ON QUALITY

One of the benefits of PNG being such a nascent market for off-grid solar lighting products is that poor quality products have yet to penetrate and cause market spoilage. Market development efforts should therefore emphasize the following components:

- **Quality products:** Raise awareness in the market (at all levels, from manufacturers interacting with distributors to retailers interacting with the client) on the economics of investing in durable, high quality products.
- **Customer education:** As most quality manufacturers of off grid lighting products know already, many issues that seem to be related to product functioning are actually related to customer education. There are a few important rules for product use that need to be communicated to the new solar product owner. For example, customers must give the product a full charge before starting to use it; they must place the panel fully in the sun (with no shading); and if the product malfunctions, they should allow it to charge fully for 2-3 days without usage. Such 'user guidance' needs to be provided to consumer by retailers. Manufacturers and distributions however can also play a role, both by contributing to retailer training and for example by distributing a leaflet bearing pictograms along with the product.
- **Service:** After-sales service will need to be delivered via the supply chain, as will communication and exercise of any rights under warranty. After sales service can potentially be made more viable by connecting it to 'graduation' from a small solar lantern to a larger system, for example by offering a part exchange (buying back the product against a certain % of the price) if clients decide on an upgrade.
- **Graduation:** The expected product life (2+ years) and the options people have for 'graduating' to a larger system after this time can be communicated to the end user when buying the PLS. This can be especially powerful when combined with a dedicated savings account.

FOCUS ON BUILDING CONSUMER AWARENESS

Product promotion will need to focus on below the line marketing, as radio and word of mouth are main communication channels in off grid PNG. Some suggestions include:

- Below the line (BTL) marketing campaigns eg. demonstrations in villages, rural fairs and festivals ('Singsings'), such as the Goroka festival stimulate word of mouth on off grid solar lighting products
- Using radio advertising campaigns within in blocks of news programming
- Discussing benefits of solar lighting on radio call-in programs including where to buy products and how and why to choose quality products
- Implementing a 'network sales' model, with appropriate incentive structure, may also work well in PNG and could be further explored.





Lighting will increase hours of trade for fresh food markets across PNG

8. CONCLUSION

PNG is a market with immense promise for PLS products and we expect transformative growth and evolution over the next 5 years.

At present, the small size of the market and the fragmented nature of the consumer base (geographically and culturally) means multiple distribution models will be required for the sector to thrive and we have attempted to reflect this in the report.

Different approaches will be more successful than others and growing the PLS market in PNG will require a high degree of innovation on behalf of manufacturers and distributors, learning from global experience as well as developing a healthy in country dialogue.

The report highlighted the following important trends that reinforce the importance of developing the market for PLS in PNG:

- Stagnant grid growth combined with increasing fuel costs and the growth of mobile phones have created an imperative to build the PLS market in PNG;
- A rapidly declining manufactured price means products are now more affordable than before;
- PNG has very low existing penetration but the capacity to sell 1.3m products over the next 5 years and potentially more if barriers are removed.

Removing these barriers will require some significant challenges:

- Distributing and servicing effectively;
- Improving consumer education;
- Avoiding potential development of market spoilage; and
- Addressing access to finance bottle necks along the supply chain.

In light of this IFC will intend to build the PNG PLS market and facilitate private sector growth through the following means:

1. Establish and promote minimum quality standards in PNG
2. Develop Market Intelligence on the PNG Market
3. Undertake B2B connections for quality manufacturers and strong distributors
4. Facilitate growth and experimentation in distribution models
5. Invest in consumer education.

ANNEX

LIGHTING GLOBAL QUALITY – VERIFIED PRODUCTS AS OF DECEMBER 2013

PRODUCT		PRODUCT	
	Azuri IndiGo		d.light S20
	Betta Lights - Betta One		d.light S3000
	Betta Lights - Betta Two		ECCODiva
	Barefoot Power Connect 600		Fosera Pico Solar Home System 7000
	Barefoot Power Firefly Mini G2.5		Fosera SCANDLE 200
	Barefoot Power Firefly Mobile G2.5		Global Telelinks Solar Ceiling Lantern 3W
	Barefoot PowaPack 5W G2.5		Global Telelinks Solar Home Lighting System
	Barefoot PowaPack Junior Matrix G2.5		Greenlight Planet SunK-ing™ Pro
	Deutrex 818 Solar Lantern		Greenlight Planet SunK-ing™ Eco
	d.light D20		Greenlight Planet SunK-ing™ Mobile
	d.light S2		Greenlight Planet SunK-ing™ Pro

PRODUCT		PRODUCT	
	Greenlight Planet SunKing™ Solo		Off-Grid Solutions Waka Waka Light
	India Impex JS30 Mobile		One Degree Solar Bright Box 2
	Little Sun		Orb Solectric 16
	Marathoner MB2-090		Pharos Great White Light
	Marathoner MB2-200		Philips Solar Home Lighting System
	Marathoner MB2-290		Schneider Electric In Diya 2
	Marathoner MB2-380		Shanghai Roy Solar Lighting Kit
	Micromark Compact LED Solar Light		Solar Works Solar Kit
	Minda LED Lantern 2W		Solar Works Solar Roof Kit
	Niwa Multi 300		Solux LED 105
	Nokero N200		Trony TSL01
	Nuru Light + PV Module		Trony TSL02



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