Lighting Africa Program

Ethiopia Market Intelligence

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The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the view of the Lighting Africa Program, its affiliated organizations, or the governments they represent.

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ABBREVIATIONS AND ACRONYMS

CRGE	Climate-Resilient Green Economy
CSA	Central Statistical Agency of Ethiopia
DBE	Development Bank of Ethiopia
EEPCO	Ethiopian Electric Power Corporation
ENREP	Electricity Network Reinforcement and Expansion Project
ESCOs	Energy Service Cooperatives
ETB	Ethiopian Birr
FGD	Focus Group Discussion
FOB	Free on board
GEF	Global Environmental Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOE	Government of Ethiopia
GTP	Growth and Transformation Plan
GWh	Gigawatt hour
HH	Household
kWh	Kilowatt hour
LA	Lighting Africa
Masl	Meters above sea level
MFIs	Microfinance Institutions
MoFED	Ministry of Finance and Economic Development
MoWE	Ministry of Water and Energy
NGO	Non-Governmental Organization
PV	Photovoltaic
REF	Rural Electrification Fund
RWEBs	Regional Water and Energy Bureaus
RES	Rural Electrification Strategy
SEDA-E	Solar Energy Development Association of Ethiopia
SHS	Solar Home System
SLP	Solar Lighting Product
SME	Small and Medium Enterprise
SNNP	Southern Nation, Nationalities and People's Region
UEAP	Universal Electrification and Access Program
UNDP	United Nations Development Programme
WMS	Welfare Monitoring Survey

CURRENCY EQUIVALENTS

Exchange Rate Effective Date: June 26, 2013
Currency Unit = Ethiopian Birr (ETB)
US$1 = ETB 19

Executive Summary

This report presents the results of the Study on the lighting products market research in Ethiopia commissioned by the Lighting Africa Program. The main objectives are "to provide key stakeholders with market insights and data for their strategic/marketing plans and inform the design and implementation plan for a Lighting Africa program". Through the provision of targeted activities designed to overcome market barriers and facilitate market entry on behalf of industry interest, the Lighting Africa program is addressing the gaps across the supply chain with the ultimate objective of facilitating access to modern off-grid lighting options, which offer superior quality and safety, at affordable prices for consumers across the African continent. Ethio Resource Group was contracted to undertake market research in Ethiopia.

The study analyzed the Ethiopian lighting products market looking at available lighting sources, consumption and expenditures, consumer preferences and willingness to pay. This study additionally provides estimates on the market size for appropriate off-grid lighting products; an analysis of the lighting products competitive landscape, distribution channels, and existing barriers to off-grid lighting products; and maps out key stakeholders and their roles and potential contributions.

The market survey covered consumers (households and small/micro enterprises) in off-grid rural, peri-urban and gird connected urban areas; lighting products manufacturers, importers, distributors and retailers; and other key stakeholders.

The market research was undertaken in three interrelated phases. These are (i) the inception phase, during which the objective and scope of research was defined and the research methodology including sample design, instruments (questionnaires, focus group interview checklists, and stakeholder checklists were developed); (ii) the data collection phase, which included extensive documentation review, conducting household and enterprise surveys, interviews and discussions with stakeholders, and (iii) the analysis and report writing phase, during which the team synthesized and analysed all the collected data and prepared this report. The survey methodology is detailed in Annex A.

Main Findings and Conclusions

Current Lighting Sources and Expenditures

- More than 85 percent of rural households rely on fuel-based light sources, predominantly kerosene. On average, rural households use kerosene for 3 hours per day and spend ETB 38 (US$2) per month on kerosene[1].

- The total annual expenditure on fuel-based light sources is estimated at approximately ETB 6,300 million (US$331 million), of which about 75% is spent on kerosene and the remaining on dry cell batteries. Based on the current price of kerosene, it is estimated that over 235 million liters (or 180,000 tons) are used each year for lighting by rural households. The retail price of this energy is over US$245 million. The amount of dry cell batteries used and discarded annually by the rural households is estimated at 278 million units (or 25,000 tons). Kerosene and dry cell battery

[1] Unlike prices of other petroleum fuels, price of kerosene does not have excise and value added taxes.

consumption for lighting by rural households not only erodes the household budgets but also has significant negative environmental implications. The amount of black carbon and carbon dioxide emitted annually from burning kerosene for lighting by rural households is estimated at about 15,000 tons and 580,000 tons, respectively. Similarly, a significant amount of hazardous heavy metals and chemicals escape into the environment from unsafely disposed of dry cell batteries by rural households.

- The majority of households expressed a high degree of dissatisfaction over the adequacy, cost, convenience, and quality of lighting received from kerosene lamps.

Interest in Purchasing Solar Lighting Products

- A substantial proportion of the off-grid rural households surveyed is interested in buying solar lighting products. Solar lanterns are cheaper in the long term than kerosene and batteries. The accumulated savings would repay the initial cost long before the end of the system's useful life of 2 to 3 years. The availability of credit for solar lanterns would make it possible for poor rural households to afford them. Overall, the solar lighting market potential in off-grid rural areas can be as high as ten million units.

Estimates of Aggregate Market Size

- The overall potential market size for solar lighting in the off-grid and grid-connected areas is estimated at about 14 million units. About 76% of this demand would come from off-grid rural households and 18% from grid connected urban areas. The share of small and micro enterprises (mainly retail shops, cafes, and restaurants) is estimated at 8% of which 6% will be from those in off-grid rural areas and 2% from those in urban areas.

Solar Lighting Products Supply Chain

- The supply chain is developing fast with improving relations between importers in the city and distributors at region and zone capitals. Distributors need sufficient backup service, warranties, and adequate information on performance, warranties, and replacement for consumers.

- Generally, at the consumer level there is low trust of private retailers operating in rural areas. Potential consumers in rural areas feel private retailers charge high mark-ups, provide low quality products, inadequate backup service, and don't honor warranties. Rural consumers appear to have more trust in local associations such as cooperatives that supply goods to members and local communities.

Major challenges for solar lighting products marketing

- Logistics and marketing - the marketing, branding and promotion of solar lanterns to low income consumers at the Base of the Pyramid is very difficult, as well as, time

and resource consuming. Most distributors and retailers at Regional and Woreda levels are not financially capable of effectively distributing products to end-users.

- Lack of effective distribution channel/ network for products - this includes the limitations of existing or potential distributers for products, both in terms of technical and financial capacities.

- Poor quality products are affecting the market. Some low quality products look similar to solar lantern products that have been tested and meet Lighting Africa's Minimum Quality Standards.

- Prices of solar lighting products are still high for the great majority of rural dwellers and other consumers at the bottom of pyramid. Without appropriate credit facilities the majority of off-grid communities cannot access modern lighting services.

Stakeholder roles

- There is strong political will and commitment for the wide-scale dissemination of solar lighting products to off-grid consumers. However, strategies adopted in the past were not effective enough in continuously engaging the private sector as a key driver for marketing off-grid lighting products. The dissemination strategy for solar lighting products was tender based and not continuous. Even though it helped to create awareness about solar lighting products in project areas, it was location specific and did not help to build a sustainable market chain. Federal and regional government energy sector organizations, and non-governmental organizations active in the energy sector should work more on awareness creation and technical capacity building, and help link market channels to end consumers. Promoters of the solar lighting products should recognize that the private sector is the ultimate market driver.

Sector support services

- Sector support activities are not available widely or systematically. An effective after-sale structure needs to be put in place by the key stakeholders. The basic alternatives are (a) maintenance and replacement of parts for lanterns versus (b) replacement of the whole system after the warranty period (end of life) of the system. Financing for region, zone, and district level distributors is essential to develop the market further. Some importers provide supplier credit to such distributors but the importers point out that their resources are too limited to address the large market.

Information to Consumers

- The general awareness of the rural population of solar lighting products is a challenge. Consumers need to be informed about the choices available to them, their costs, and what quality assurance and warranties they can expect. Although products that have met LA's Minimum Quality Standards are now relatively more important in the solar lantern market as compared to products that have not, the popularity of the systems that have met LA's Minimum Quality Standards is attracting the interest of some importers and distributors for similar (and in some cases almost identical looking), but cheaper systems.

Protection (warranties)

- Two-year product warranties are available from manufacturers of solar lighting products distributed in Ethiopia, that have met LA's minimum quality standards. For these warranties to be effective they should be written in local languages and w*arranty labels on products should be indelible and last for the warranty period*. *Warranties must be traceable to the supplier*.

Recommendations:

Private solar energy suppliers:

- Strengthen policy dialogue with government and other stakeholders through the Solar Energy Development Association of Ethiopia (SEDA-E)
- Importer/wholesalers expand distribution partnerships into more region and zone capitals
- Distributors in region and zone capitals expand links to Woreda retailers
- Increase distributor/retailer financing (supplier credit) from importer/wholesalers
- Importer/wholesalers must make sure that their products are traceable to them so that warranties can be effective

Government:

- The Ministry of Water and Energy should develop a program of long-term support for the sector in areas such as capacity building, financing, disseminating information and regulating quality
- Government and NGOs should strengthen sector support activities, particularly building the network of distributors and retailers at zone and Woreda levels
- Duty free privileges for solar lighting products should be effectively implemented without lengthy and costly administrative delays
- The REF approach for dissemination of PV lighting systems should strongly promote and ensure local private sector participation in procurement, installation and service. REF in its current approach, organizes electricity user co-operatives in rural areas; these co-operatives receive financing for 95% of the SHS cost they receive which they pay over 7 years. One international company provides the equipment and one local company does the installation. This is done once every couple of years. REF PV lighting procurements, generally, were too large in size for local companies to participate in the procurement and supply. It mainly attracted international companies whose interest mainly lied on getting the profit from a single tender as opposed to using the opportunity to develop the market. REF has issued 3 to 5 international tenders for SHS in the past 10 years. These

tenders ranged from a few thousand SHS to the last one which was for 27,000 units

- Provide specific strategies and activities to achieve the targets set for dissemination of 3 million solar lighting systems in the Growth and Transformation Plan, (GTP) and find ways of complimenting them

- Facilitate access to finance for distributors and retailers in rural areas. This could be through capacity development for business plan development for distributors

- Government agencies should continually collect, document and disseminate sector information

- Regional government agencies (through their zone and Woreda level offices) should be part of the consumer information and education activity. They are close to consumers

- Consumer protection – Existing government agencies (Ethiopian Standard Agency, Ethiopian Energy Authority and similar regional energy agencies) have the mandate to protect consumers through regulations. Regional level agencies will also be important in making sure consumers get the warranties and services for the products they purchased. Already, the regional agencies are registering distributors. Regional and local government energy bureaus are well placed to address this issue

- Increase the market for solar lighting products by increasing access to finance through MFIs, local credit and saving associations

1. Introduction

This report presents the results of the Ethiopia Market Intelligence study commissioned by the Lighting Africa (LA) Program. LA is a joint World Bank-International Finance Corporation (IFC) program and is supporting the private sector in building and growing new markets for solar off-grid lighting. It is based on the hypothesis that a commercial consumer products market can be developed for superior modern lighting products, with the potential to displace fuel-based lighting and enable poor consumers to leap into the modern world.

Through the provision of targeted activities designed to overcome market barriers and facilitate market entry on behalf of industry interest, the Lighting Africa Program is addressing the gaps across the supply chain with the ultimate objective of facilitating access to modern off-grid lighting options which offer superior quality and safety, at affordable prices for consumers across the African continent.

The report is structured as follows: Chapter 2 provides a description of the objective, scope and methodology of the market research. Chapter 3 presents the findings of the market research including the state of electrification in Ethiopia; the prevailing policy environment for solar and other renewable energy development, and an analysis of policy trends; mapping of the distribution channel for solar lighting systems; consumers (households and small and micro enterprises in off-grid and grid-connected areas) including an analysis of their current lighting options and expenditures on lighting services, opinions and preferences, and willingness and ability to pay for solar lighting products; and mapping of stakeholders. Finally, Chapter 4 presents conclusions and recommendations.

2. Objectives, Scope and Methodology of the Market Research

2.1. Objectives of the Market Research

The main objectives of the research was "to provide key stakeholders with market insights and data for their strategic/marketing plans and inform the design and implementation plan for a Lighting Africa program". To meet those objectives, the research work provided a comprehensive analysis of the Ethiopian lighting products market including lighting sources, consumption and expenditures, and consumer preferences and willingness to pay. It also estimated the market size for appropriate off-grid lighting products, analysed the lighting products competitive landscape, distribution channels, and existing barriers to off-grid lighting products, and also mapped out key stakeholders and their roles and potential contributions.

2.2. Scope of the Market Research

The market research focused on the type, quantity and cost of lighting services in households and SMEs in rural areas, the supply chain for solar lighting products, and the policy environment for wider and more rapid dissemination of solar lighting products in Ethiopia. The assessment encompassed the following main tasks:

- Evaluate grid access in Ethiopia;
- Characterize the existing lighting solutions, their challenges and their cost (financial, economic, and social);

- Summarize market potential and its key characteristics, and distribute information to potential manufacturers and distributors of off-grid lighting products;
- Evaluate existing distribution models for solar lighting products and identify the most promising distribution models;
- Analyze the competitiveness of the SLP markets for prices, types, functions, performance, and quality;
- Map out the key stakeholders in the country's off-grid lighting market (the commercial sector, NGOs, and national/local government), areas for collaboration among stakeholders, and the best institutional arrangements and engagements;
- Define the key implementation areas for the LA program; and
- Define the monitoring and evaluation framework.

In terms of target regions, the market research was conducted in the four major regions of the country (Amhara, Oromiya, SNNP and Tigray), and in Addis Ababa. These regions jointly account for 86% of the country's total population. The selection of these regions was also dictated by the need to focus on areas that represent a big commercial opportunity as well as to coincide with the presence of MFIs eligible under the World Bank's Electricity Network Reinforcement and Expansion Project (ENREP) project.

The market survey covered consumers (households and small/micro enterprises) in off-grid rural, peri-urban and gird connected urban areas; lighting products manufacturers, importers, distributors and retailers; and other key stakeholders.

2.3. Methodology

The market research was undertaken in three interrelated phases. These are (i) the inception phase during which the objective and scope of the research was defined and the research methodology including sample design and instruments (questionnaires, focus group interview checklists, and stakeholder checklists) was developed; (ii) the data collection phase, which included extensive documentation review, conducting household and enterprise surveys, interviews and discussions with stakeholders, and (iii) the analysis and report writing phase, during which the team synthesized and analysed all the collected data and prepared this report. The survey methodology is detailed in Annex A.

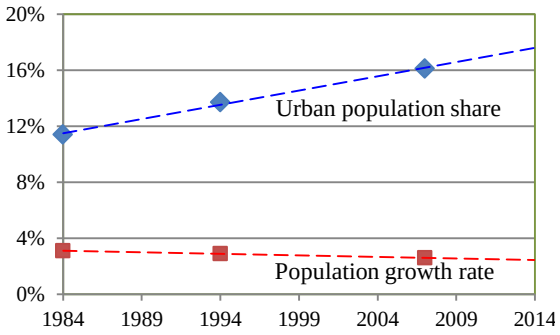
3. Findings and Discussions

3.1. Status of grid access in Ethiopia

A. Population

Ethiopia had 86 million people in 16 million households in 2012, growing at 2.6% annually. The large majority of the population, 83%, resides in rural areas. About two-thirds of the population is settled in the highlands (above 1500 masl), which constitutes only about a third of the total land area. Population densities are therefore high in the highlands and very low in the lowlands. Population density overall is rising rapidly: it has doubled over the past 25 years from 34 to 67 persons per square km. Figure 1 shows trends of population growth and urbanization.

Figure 1. Trends of population growth and urbanization



The population is growing at 2.6% annually - this rate has declined over the past thirty years by about 0.02% annually. Urbanization in Ethiopia is increasing gradually by 0.2% annually; the urban population share has increased from 11% in 1984 to 16% in 2007 (CSA, 1984, 2007).

Ethiopia follows a federal form of government with nine regional states and two city administrations. The largest three regional states (Oromiya, Amhara and Southern Nations and Nationalities) account for 80% of the population. The distribution of the population in urban and rural areas and by regional state is shown in Table 1.

Table 1. Population and household distribution by region and type of settlement

	Population (2012)	Households (2011)		
	Total	Total	Urban	Rural
Country Total	**86,496,987**	**16,144,657**	**3,437,158**	**12,707,496**
Tigray	5,061,991	1,048,075	264,194	783,881
Afar	1,649,999	113,173	36,828	76,343
Amhara	19,211,994	4,197,714	718,346	3,479,368
Oromiya	32,220,001	6,081,010	1,067,422	5,013,587
Somali	5,318,000	348,830	63,169	285,662
Benishangul-Gumuz	1,027,994	185,895	28,840	157,052
SNNP	17,887,005	3,236,722	415,530	2,821,194
Gambella	406,004	70,252	22,795	47,457
Harari	215,000	46,355	26,335	20,021
Addis Ababa	3,103,999	729,664	729,664	-
Dire Dawa	395,000	86,967	64,035	22,931

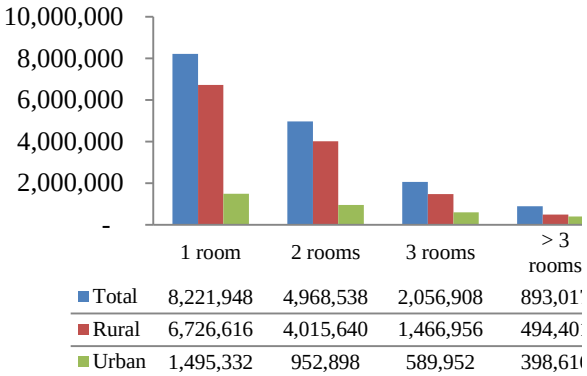
Source: CSA, National Abstract 2012; CSA, Welfare Monitoring Survey, 2012.

The Ethiopian Regions are further subdivided into 68 zones, and the zones are subdivided into approximately 550 Woredas. A Woreda is managed by a local government and is equivalent to a district. The Woredas are composed of the smallest unit of local government, the Kebeles. "Kebele" is Amharic for neighbourhood, and can be considered as such. Each Kebele consists of at least five hundred families or households. Figure 2 shows the average sizes of household dwelling units..

Figure 2. Size of dwelling units, 2011

The large majority of Ethiopians, 82%, live in 1 or 2 room dwellings. Just above fifty percent of the population lives in dwellings of 1 room and 30% live in dwellings of 2 rooms.

CSA, WMS, 2012.

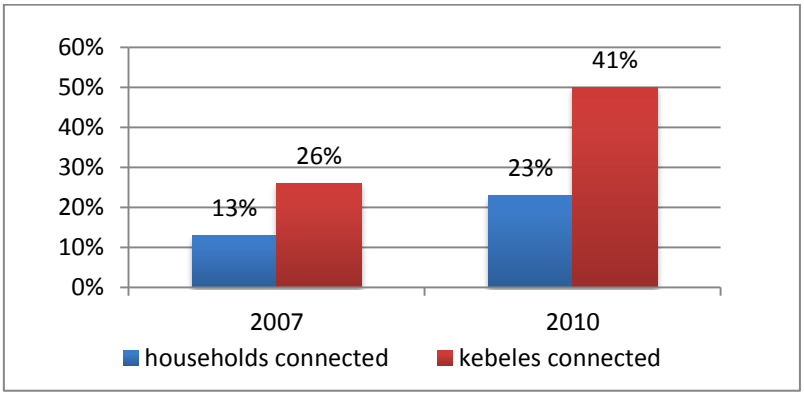


B. Grid access

According to the most recent national statistics 3.7 million households in Ethiopia were using grid electricity for lighting in 2011 (WMS, CSA, 2012). The electrification level was 23% nationally; 88% in urban areas, and 5% in rural areas. The 3.7 million electricity connections reported in the Welfare Monitoring Survey (WMS) contrasts to the Ethiopian Electric Power Corporation's (EEPCO's) domestic customer number of only 1.65 million in 2011. The difference is explained by meter sharing – the WMS indicates that for every two power utility customers connected through meters, there were 3 additional households sharing meters with them.

The national population and housing census indicated that 26% of the total number of 15,687 Kebeles[2] (neighbourhoods) in the country were electrified in 2007 (CSA, 2007). A closer review of the census result shows, however, that only 13% of households within those Kebeles were connected to the grid. In 2010, about 41% of the Kebeles were electrified with about a quarter of the households (23%) within the Kebeles having a connection. In 2010, the rural electrification program not only expanded coverage but also intensified connection rate The correlation between electrification of households versus Kebeles is shown in Figure 3:

Figure 3. Electrification of households vs. kebeles in 2005 and 2010



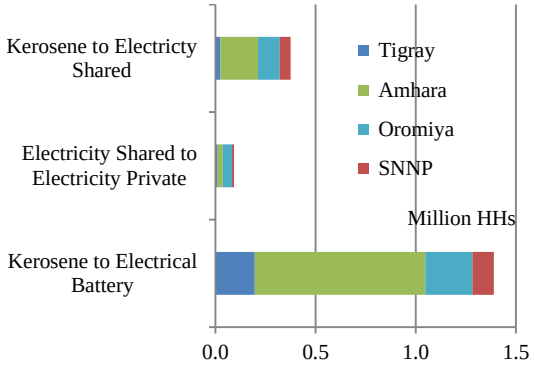
[2] A Kebele is the smallest administrative unit. On average, there are about one thousand households in a Kebele.

C. Trends and projections for the near future

According to the WMS, 1.86 million households shifted from using kerosene to using electricity or electrical batteries between 2006 and 2011: 1.45 million switched from kerosene to electrical batteries while 0.41 million shifted to electricity. The four largest regions (Oromiya, Amhara, SNNP and Tigray) accounted for 95% of this shift away from kerosene.

Figure 4. Switch in lighting sources used, 2011 vs. 2006

Among the regional states, Amhara accounts for 58% of the shift from kerosene to electrical batteries and 46% of the shift from kerosene to electricity.

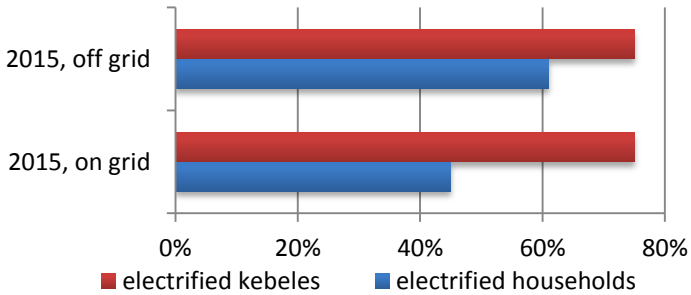


CSA, WMS, 2012.

The current power sector plan projects 75% of Kebeles will have electricity access from the grid by 2015. The same plan projects an increase in the number of electricity customers from 2 million in 2010 to 4 million in 2015 (GTP, MOFED, 2010). No breakdown is provided for projection of customer additions by customer class; the expectation is that customers in every class will double. This implies there would be 3.3 million domestic customers in 2015, compared to 1.65 million in 2010. In 2011, there were 1.42 households connected with shared meters for every private meter connection (CSA,WMS, 2012). Similarly, when including households that share meters with power utility customers, the number of potential household connections in 2015 could increase to 8 million, or 45% of households.

The energy sector plan also includes an off-grid component, which is envisaged to distribute 3 million solar lanterns and solar home systems by 2015 (Strategic Plan, MOWE, 2010). This increases the total number of households that will use electricity for lighting to 11 million or 61% of households in 2015. The expected development of electrification of households versus Kebeles in 2015 is shown in Figure 5:

Figure 5. Projected on and off grid electrification of households vs. Kebeles in 2015



Both the on-grid and off-grid targets are very ambitious, requiring an annual connection rate of 0.3 million households to the grid and 0.6 million households off-grid. Achievements for grid connection for the first two years of the plan (2011 and 2012) have not reached this

level, which means that connections will have to exceed this level in the remaining three years if the target is to be achieved.

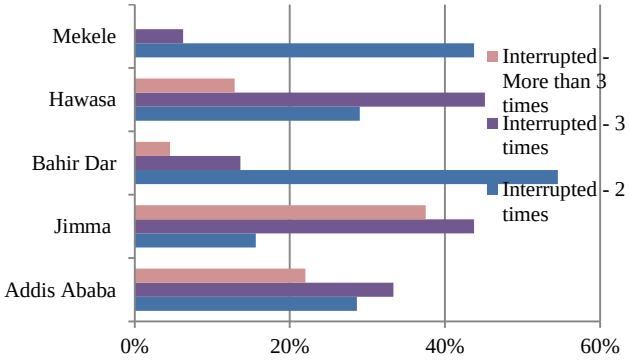
D. Reliability of power supply for domestic customers

The power supply reliability for domestic customers already online, in terms of uninterrupted and consistent quality electricity, appears to have worsened in the past five years. According to the WMS survey in 2011 more than 85% of households reported having suffered power interruptions at least once in the previous week and more than 50% reported having suffered power interruptions 3 or more times in the week prior. There is also the issue of poor power quality for domestic customers who receive lower voltage levels than is standard (220V with ±10%).

Figure 6. Power interruption frequency, selected cities, May 2013

Eighty-five percent of electrified households reported power interruptions in the week prior to the survey. About twenty percent reported 3 or more power interruptions in the same period.

LA Lighting Market Survey (June 2013)



Power blackouts have increased in frequency and depth not only because of supply constraints (generation and transmission capacity shortfalls) but also due to limited distribution infrastructure capability to meet rapidly increasing connections and demand levels. Electricity sales to domestic consumers actually fell in 2008 and 2010 from previous years, despite an increase in the number of customers. Power blackouts were and are still common in all the major cities (Figure 6). Power blackouts often occur during peak hours (in the evening for domestic customers) and usually last 4 to 6 hours.

As a consequence of blackouts that are frequent and often long-lasting (sometimes lasting several days) customers on the grid have taken up several types of backup lighting devices. The more common types include:

- Candles, which cost ETB3 - 4 (US$0.16 - US$0.21) each, and last 3 to 4 hours;
- Dry cell battery operated hand torches (flashlights), which cost approximately ETB25 (US$1.32) for the torch and ETB10 (US$0.53) for the D-type dry cell batteries used, with a useful life of about a year; and
- Mains charged LED lamps, which range in cost from ETB40 (US$2.11) to ETB80 (US$4.21), which last a few months.

3.2. Policy and Trends

A. Policy Environment and Government Strategies for RE

Sector development policies for Ethiopia emanate from the Government of Ethiopia's (GOE) main development agenda, which focuses on poverty eradication through rural and

agricultural development. Believing in the importance of electricity as a driver of the rural economy, the Ethiopian Government issued the Rural Electrification Strategy (RES) in 2002 with the overall goal of stimulating rural economic growth and poverty reduction.[3]

In line with the RES a twin track rural electrification strategy has been developed to increase access to electricity in rural parts of the country. The power utility, Ethiopian Electric Power Corporation (EEPCO), with a continuous extension of the national electricity grid electrifies major towns and villages while the private sector provides access to electricity in off-grid areas with stand-alone and mini-grid systems. This strategy was the basis for the formation of the Rural Electrification Fund (REF) in 2003 that aimed at promoting the off-grid component of the rural electrification program[4].

Assessment of the effectiveness of the rural electrification strategy shows that through EEPCO's grid expansion, the number of households connected to the electricity grid increased from about 800 thousand in 2005 to about 1.7 million in 2012[5]. This strategy also increased the rural connection rate from about 1% to 5% in the same period[6]. EEPCO's performance in rural electrification was remarkable even though the last-mile connection rate was declining as the additional number of households connected to the grid decreased. On the other hand, the off-grid electrification through the REF was able to electrify about 30,000 rural households and 400 rural schools and health posts providing consumers' finance through energy service cooperative[7].

The strategy REF followed succeeded in promoting solar PV systems and channeling financial leverages to consumers through energy service cooperatives. However, the organization and formation of energy service cooperatives is a slow process, which does not allow REF to be able to increase the off-grid electrification rate as required. The approach REF followed did not succeed in including the private sector to lead rural electrification. REF's contribution to overcome the main challenges and barriers to the wide scale commercial dissemination of solar lanterns and solar PV systems was limited. Retrospective analysis of the REF approach shows that 1) the project based approach which REF followed involved single large scale tender based procurements as opposed to a continuous supply of solar lighting products, 2) for each project a different company supplied solar lighting products, having no interest in developing the market for a sustainable business, 3) the sizes of most procurements were too large for local companies to become involved in the supply, 4) sufficient financing was not available for local private companies to respond to large tenders, and 5) the dissemination strategy did not help to build a sustainable commercial network for solar lighting products. Lessons learned in the past ten years show the need for a strategy which helps to develop and stimulate market-based commercial dissemination channels to effectively and efficiently provide affordable electricity to the rural off-grid communities through alternative technologies such as solar lanterns and PV systems.

[3] The Federal Democratic Republic of Ethiopia, Rural Development Policies and Strategies (Amharic), October 2002.
[4] Federal Democratic Republic of Ethiopia, Federal Negarit Gazeta No. 35, 9th year, 6 February 2003, pp 2098-2104, Rural Electrification Fund Establishment Proclamation No. 317 of 2003,
[5] Ethiopian Electric Power Corporation, Facts in Brief 2005/06 and 2011/12
[6] Central Statistical Agency, Ethiopian Welfare Monitoring Survey 2011, April 27, 2012
[7] Achievements and status of the Rural Electrification Fund, May 2014

B. Electrification Strategies and Programs

The Growth and Transformation Plan (GTP) of Ethiopia outlines the five-year strategic development plan for all sectors from 2011 to 2015[8]. The strategic directions for the energy sector during the five-year period are development of renewable energy, expansion of energy infrastructure, and creation of institutional capacity that can effectively and efficiently manage energy sector development. The current five-year strategic plan of the Ministry of Water and Energy sets the direction and targets for energy for the period 2011-2015:

- Increase hydropower generation capacity from the current 2,000 MW to 10,000 MW,
- Increase coverage of electricity service from 41% to 75%[9],
- Double the number of grid-connected customers from about 2 million to 4 million,
- Improve cook stove distribution,
- Development of biofuels for household cooking fuel and transportation fuel,
- Alternative energy resources development which includes solar, wind and micro hydropower resources, and
- Capacity building and awareness creation.

Sector organizations have also outlined their respective strategies and programs to meet the national development plan. The Ministry of Water and Energy through the REF has planned to electrify off-grid households and businesses through solar PV systems. The strategic plan for 2015 indicates dissemination of 150,000 Solar Home Systems, 3,000 institutional solar PV systems and 300 solar pumps. The REF has also planned to disseminate 3 million solar lanterns in rural areas of the country. The required investment outlay to achieve the anticipated target is over US$50 million[10].

Another recent strategy that has relevance to the energy sector is the Climate Resilient Green Economy (CRGE) strategy (2011). The greenhouse mitigation actions proposed in this strategy are mostly energy related including the scaling up of energy efficient cookstoves, increased use of renewable energy sources, and displacement of fossil fuels. In this regard, wide scale dissemination of solar lanterns and solar PV systems in off-grid areas will displace kerosene use for lighting.

To meet the Growth and Transformation Plan (GTP) target and go beyond it in a sustainable manner, market channels for solar lanterns, solar PV systems and other appropriate renewable energy technologies must be developed. As it stands now, the market and the market channels are not well developed for these products, technical and financial capacities of the private sector are low, and the awareness levels of stakeholders and consumers is low.

[8] MoFED, November 2010, Growth and Transformation Plan 2010/11 – 2014/15, Addis Ababa.
[9] Access or coverage, according to the definition of EEPCO, does not mean connection but access to electricity services nearby. This is equivalent to saying about 41% of the Kebeles are connected to the grid.
[10] Ministry of Mines and Energy, Investment Plan for 2011 to 2015.

C. Policy Issues, Strategies, and Recommendations for Solar Lighting Products Dissemination

Current sector strategies and programs indicate that there is a strong political will from the government to scale up dissemination of solar lighting products to off-grid rural consumers. However, to ensure sustainable dissemination of solar lighting products appropriate strategies that primarily involve the private sector need to be devised. Major challenges and barriers that need strategic support and policy consideration to ensure sustainable commercialization of solar lighting products are listed below.

i. **Technical support –** The capacity of the private sector is low in terms of technical skills to develop the market and provide reliable services. Technical capacities of product suppliers and retailers must be built to ensure that consumers will get proper after sales service. Provision of after sales service currently is very low. Many consumers who adopted solar lighting products are not getting the expected benefits from their investments. Products which have been quality tested and meet Lighting Africa's Minimum Quality Standards come with manufacturer warranties. Yet, the warranty often is not passed on to the end users through the supply chain. Many consumers complained that no technical support for minor maintenances such as fixing loose wires or replacing batteries is available in many of the market outlets. Furthermore, it is not uncommon for solar lanterns to have their batteries damaged because of self-discharge during shipment and storage. This was also observed during this market study assessment.

   Technical skill support to the private sector that is needed includes training technicians for proper sizing and installation of off-grid electricity systems such as solar home systems, and provision of after sales services; training of efficient promoters and marketing experts so that the private sector becomes capable of developing market channels for sustainable commercialization of solar lighting products.

   Government organizations, particularly the Rural Electrification Fund, should focus on the provision of technical capacity building. Importers and wholesalers of solar lighting products should also be responsible for building the capacities of the retailers that channel their products to end users.

ii. **Import tax exemption privileges for solar lanterns and PV systems:** - Clarity and consistency in the procedures on import tax and tax exemptions for solar lanterns and PV systems are improving. However, there are still unresolved issues with the approval of products by the Ethiopian Conformity Assessment Enterprise, which usually cause delays on clearing the products from customs.

iii. **Promotion of solar lighting products** - Effective promotion about the financial, social and environmental benefits of solar lanterns and PV systems is strongly needed. Rural development extension agents in the health and agriculture sector are effective channels for promotion of solar lanterns and their benefits. Non-governmental organizations that are working in the promotion of modern energy technologies need also to work together with government organizations and the private sector to effectively promote these products..

iv. **Users' guides prepared in local languages** – Users' guides for products should be prepared in local languages, and supported by pictorial descriptions to ensure that consumers know how to handle the products appropriately.

v. **Introduce minimum standards and benchmarks** – Minimum standards and benchmarks for solar lanterns in terms of performance and durability should be introduced. Low quality solar lighting products are also imported and have infiltrated the market. A system must be put in place to ensure that the certifications and labels on products are genuine. It is also necessary to ensure that the standards of solar lighting products imported into the country, that have not met the Lighting Africa Program's Minimum Quality Standards, should meet a certain minimum requirement. Care should be taken so that stringent requirements and high standards do not preempt market uptake.

vi. **Proper collection of lanterns** – The government should promote collection and recycling of lanterns and their components after the end of their useful life to reduce potential damage to the environment. Recycling projects can also include electronic waste.

3.3. Distribution Channel Mapping

This section of the report provides an overview of the solar lighting product market channels. It describes the characteristics of major actors in the market, their distribution models and evaluates the effectiveness. The layout of the discussion for the distribution channels is as follows:

A. Distribution Actors and their Activities for Solar Lighting Products
B. Distribution Models for Solar Lighting Products
C. Evaluation of the Distribution Models for Solar Lighting Products
D. Consumer Services
E. Sector Support Services
F. Potential Distribution Partners for Solar Lighting Products
G. Distribution Volume and Value through the Private Importer-Distributor Model
H. Issues for Participants in the Chain

A. Distribution Actors and their Activities for Solar Lighting Products

Solar lighting and other solar energy services were first initiated by the government and international NGOs in the mid-1980s as demonstration projects. The first solar systems were for lighting (homes and schools) and water pumping in rural areas. The first solar lighting system in Ethiopia, installed in 1986 by the government, was based on a mini-grid that served 300 households in a rural community 240km south of Addis Ababa.

There were other demonstration projects by the government and NGOs in the 1990s but no significant initiatives before 2003 when the Rural Electrification Fund (REF) was established. The REF itself only began project implementation in 2009 when it installed the first round of solar PV systems for institutions such as schools and health clinics in rural areas. The REF has since installed more institutional systems and home systems, the most recent being the distribution of 28,000 home systems currently being distributed through energy service cooperatives in the four regional states of Oromiya, Amhara, SNNP and Tigray.

Government and NGO initiatives are still important in the solar lighting market, mainly in support activities; however, their role has declined and that of private actors has increased over the past five years. Today, importers and distributors in the private sector are responsible for 70% or more of the total number of households served with solar lighting. The solar home lighting market today is essentially for solar lanterns and solar home systems although other models are also being piloted including mini grids, solar kiosks and solar charging stations.[11]

The main solar lighting product distributors have been consulted for this assessment. The volume of solar lighting products distributed, based on their records and recollection, is estimated at 0.15 to 0.20 million units for 2012 and a total of 0.5 million units over the past four years. Distribution in recent years has been mostly through private actors who have been responsible for 70% of total sales.

According to the importers consulted, the volume of sales has picked up in the last three years and most feel that they have not been able to meet the demand. Their sales have grown very rapidly over the past two years; a few new entrants to the market have reached sales volumes of more than a hundred thousand a year in less than five years. The general opinion among the main importers is that current demand is at least twice as large as the volume of sales. They have identified the main reasons for not being able to meet this demand as lack of availability of foreign currency for imports, limited market reach of retailers and huge price mark-ups by retailers (see the section on Stakeholder mapping for details).

B. Distribution Models for Solar Lighting Products

The more important solar lighting system distribution channels, in terms of the volume of systems distributed, are (a) private sector solar system importer-distributors, (b) distributors of other products incorporating solar lighting products into their product offerings, (c) the Rural Electrification Fund (REF) distributing solar home systems through consumer cooperatives, and (d) the Solar Energy Foundation (SEF) distributing solar lighting products through its own micro financing scheme. These four distribution channels together are responsible for more than 90% of the total sales of solar lighting systems in Ethiopia.

Private importer-distributors

This is the largest and fastest growing model. In this model private sector importer-wholesalers import products and deliver these to consumers directly or through distributors in the main cities. In the past, distribution was mainly through the importer-retailer model where importers themselves were involved in retailing solar lighting and other products to consumers directly. This approach is now being abandoned (for solar lighting products but not for other solar systems such as solar water pumping) in favour of importers limiting their function to wholesale and providing products to distributors in the main cities who then deliver systems to consumers.

[11] *Solar mini-grids*. A local NGO, *Ethiopian Evangelical Church Mebane Yeses*, has piloted a small solar mini-grid in the SNNP Regional State (in the Yirgachefie area) in 2013.
Solar kiosks. A German NGO working with a local company has piloted 7 solar kiosks that provide services for charging solar lanterns, mobile phones and retail other consumer goods.
Solar charging stations. One such system has been implemented by the REF through its institutional systems in schools.

Private importer /wholesaler → Distributors in region and zone centres → Final consumers

This model is more important for solar lanterns as compared to solar home systems. The fact that distributors do not need to install solar lanterns (but do for solar home systems) and that the items are smaller and cost less (therefore, manageable inventories for distributors) are two of the more important reasons for the rapid development of this model.

The distribution link between importer-wholesalers and distributors has developed through a combination of actions by the distributors, importers, and government and non-governmental institutions supporting the sector. The demand for products from region and zone based distributors has, however, been the main driver for the rapid rise in such links.

For the majority of the region and zone based distributors solar lighting product distribution is additional to existing businesses. Electrical and electronic shops are the most common distribution partners for the importer-wholesalers. Business relations are getting stronger between the importers and distributors and today some of the importers supply solar systems to their distributors through supplier credit.

Although this model has proven successful in expanding the market for solar lighting products it still has trouble extending its reach to the large proportion of rural consumers that are far from regional and zone centres. Distributors are located in the main cities and can only serve the rural population around these cities; a second tier of retailers (located at district level and below) are required to address the wider rural market.

Existing distribution networks used to distribute solar lighting products

Use of existing distribution networks for other products for marketing solar lanterns has become one of the successful marketing models. Companies started distribution of solar lanterns through their distribution networks in 2010 to diversify and increase incomes[12].

Private importer-distributor → **Distribution networks already established for other product used for solar lanter distribution**→ Final consumers

One of the main success factors of this model appears to be the demand for mobile phone charging in rural areas. Since current distribution is limited to a fraction of the potential outlets but is expected to expand to all available outlets in a short period of time, this model will continue to be an important channel for solar lighting product distribution.

Rural Electrification Fund (REF)

The REF is a federal government agency established in 2003 to promote off-grid rural electrification in Ethiopia. The REF provides financial and technical assistance to private companies and Energy Service Cooperatives (ESCOs) for off-grid rural electrification. Although the REF was established mainly as a private led off-grid rural electrification

[12] These distribution stations are owned and operated by private companies affiliated to the parent company.

program its support has mostly gone to ESCOs rather than to private businesses.[13] The REF imports solar lighting products through international tenders, which it then distributes to ESCOs through long-term loans.

International tender import →**Rural Electrification Fund (REF)** → ESCOs → Final consumers

International tenders are made for bulk purchases and installations. One recently completed tender was for 28,000 home systems to be distributed to ESCOs in the four regional states of Oromiya, Amhara, SNNP and Tigray.

REF loans cover a maximum of 95% of the cost of solar systems with a minimum of 5% contributed by ESCO members. This model is popular with ESCOs because of the very attractive loan terms (up to a 7-year repayment period for the new systems).

Foundations / Social Enterprises

One foundation has been operational in Ethiopia since 2005, and employs two distribution models: (a) a charitable foundation developing rural service networks, as it began, and now combining this with (b) a for-profit social enterprise that trains solar technicians, provides user financing for solar system owners, and provides after sales service for owners. This foundation has distributed about 20,000 solar lighting systems since 2005; it has also provided solar power for 154 schools, 35 health centers and several water pumps in that same period.

Foundation→ Village/local committees → Final consumers

Social Enterprise → Solar entrepreneurs in rural areas → Final consumers

The foundation trains solar technicians and entrepreneurs that are stationed in areas they serve. User financing is made available through an affiliated microfinance provider. They report high rates of system acceptability by users and no user defaults on loans.

Solar System Support Networks and Institutions

Government and non-governmental institutions support solar system distribution through capacity building services to distributors and installers in rural areas. They mainly work to build the technical and business capacity of region and rural based potential distributors then link these to the city-based importer-wholesalers. The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in Ethiopia has an on-going program for networking between rural distributors and importers.

[13] Lending to ESCOs appears to be the preferred strategy for the REF: it has supported and is supporting the financing of 27,000 solar home systems through ESCOS in the past five years; it has not provided any loans to private companies over the same period.

Private importer-distributors → **Solar system promoter entrepreneurs** → Final consumers

These networks and support institutions provide technical support and quality assurance for their network of solar entrepreneurs. The entrepreneurs are responsible for finding their market (customers), sourcing the solar systems, and for installation and after-sales services.

C. Evaluation of the Distribution Models for Solar Lighting Products

Private sector importer-wholesalers with distribution partnerships form the most vibrant distribution model today. The reach of this model is expanding rapidly with new entrants both from above (importers) and below. This model employs two strategies; (a) importers linking to region and zone based small distribution businesses, and (b) importers linking with businesses with extensive national distribution networks.

The private sector importer-distributor model has managed to distribute more than 100,000 solar lighting systems annually in the past few years. This number is expected to double in the coming few years as more distribution partners enter the market and the distribution volume of existing distributors increases. The main challenge for this model is in developing the end of the supply chain, i.e. distribution and retail at district and Kebele levels. Currently, outlets at closest reach to end users are located in major cities and towns, which are still far away from rural consumers in Kebeles. Kebele level retailers need to be developed for increased sales and easier access to after sales services.

The REF organizes electricity service cooperatives and provides low-interest, long-term finance for them to purchase solar home systems. Although distribution has not gone as rapidly as initially foreseen, this model has proven very popular with cooperatives because of the very attractive loan terms. There are several shortcomings of REF's approach to solar system distribution:

- *The private sector-led strategy adopted at its inception has not been continued*: REF's initial strategy of off-grid rural electrification through the agency of mainly private actors needs to be re-engaged with. Private companies have not received the financing they need to promote renewable electricity (only one private company has received a loan from the REF since its formation in 2003).

- *Tender-based instead of sector development approach*: the REF has gone for large international tenders to provide solar systems for institutions and homes. This has bypassed local importers and distributors who do not have the scale required to compete in such tenders.

- *Distribution and installation with limited or no distribution and service experience*: Sufficient technical capability, experience, and reach is lacking among local sub-contractors and international suppliers.

The REF distribution approach can be linked to the private sector by addressing the drawbacks outlined above. More specifically, breaking tenders into smaller volumes manageable by local private companies with proven experience in the sector, and making such local companies responsible for installation, maintenance and service for consumer

cooperatives will build the local financial and technical capacity of suppliers and improve the sustainability of services for consumers.

The social enterprise model piloted by the REF was successful in reaching large groups of households rapidly. This model, with its focus on creating a local pool of technicians where products are sold commercially (with user financing through an MFI), fares better in winning consumer trust in products.

Solar support networks provided support functions through the training of technicians and retailers in regional and district centres and linked them with importers in the capital. This has helped build a pool of trained technicians and retailers for solar lighting products (and other solar systems) that the private sector can also link to. These activities have now ceased operation because funds have run out. These are useful functions, which can be taken up by NGOs and government agencies (which is carried out in limited scale by GIZ and some regional energy agencies).

D. Consumer Services

The supply chain is developing fast with improving relations between importers in the city and distributors in region and zone capitals. Distributors sell products to consumers directly or through district and Kebele level retailers and installers. One of the problems cited by distributors is the issue of warranties for products supplied – suppliers focus on product delivery but have been slow on setting up structures for meeting warranties and maintenance services for consumers. Distributors need sufficient backup service, warranties, and adequate information on warranties, performance and replacement for consumers.

At the consumer level there is generally low trust of private retailers operating in rural areas. Potential consumers in rural areas feel private retailers charge high mark-ups, provide low quality products, and offer inadequate backup service and warranties. Rural consumers appear to have more trust in local associations established through local government (Kebele) administrations. Therefore government has a role in this, especially on the SHS space. Here are samples of responses related to this from the focus groups:

> Focus group participant in *Armachiho* Woreda in Amhara
>
> "*I am worried that after we buy this solar lantern spending a lot of money who will be able to fix it if something goes wrong or there is fault with the light. Who will come to the area to fix it? I should be able to know if it can be fixed and who will fix it within the Kebele*."
>
> Focus group participants in Goma Woreda and Lode Hitosa Woreda, Oromiya
>
> "*The best way to deliver solar lanterns to the community is through credit associations set up by the Kebele Administration. Such associations have taken credit from the Oromiya Credit and Savings Institution and are paying back their loan efficiently*."
>
> "*It is best if solar lanterns are distributed through our credit and saving association; [private] retailers add large mark-ups. We would prefer it if financing is channelled through micro finance institutions because those who cannot pay cash can take the lanterns on credit. Additionally, it is good if the provider signs legal agreement with our association and gives as warranty*."

E. Sector Support Services

Other issues in the solar lighting product distribution strategies and models include continuing and expanding support functions (technical and business training to zone and district distributors and installers), strategies for replacement and recovery of systems distributed after their useful life ends (both for market and environmental considerations), and financing for zone and district level distributors and consumers.

- Sector support activities are not widely or systematically available (for example, a database for trained and functioning distributors are not available at government and NGO support institutions). However, this role may be supported by the Ethiopia Solar Association.
- The strategy for the replacement of lanterns, whose warranties last only two years and their useful life three to four years, needs to be put in place by key stakeholders. The basic alternatives are (a) maintenance and replacement of parts for lanterns, versus (b) replacement of the entire system after warranty period (end of life) of the system. The private sector should do be able to provide warranty and after sales services for distributed products. Federal and regional governments, and promoters should develop strategies for effective delivery of services.
- Financing for region, zone and district level distributors is essential in order to develop the market further. Some importers provide supplier credit to such distributors but the importers point out that their resources are too limited to address the large market. REF and other support institutions should address this.

F. Potential Distribution Partners for Solar Lighting Products

Partnerships between manufacturers of solar lighting products that meet LA's Minimum Quality Standards and domestic importers are already well established. The main importer-wholesalers work with suppliers of products that meet LA's Minimum Quality Standards, and a few of the importers have links with more than one such product supplier. Importers of solar lighting products that have not met LA's Minimum Suality Standards are also moving towards importing products that have, because of the demand from customers for these products (including major tenders from government and non-governmental organizations).

The link between importers, mainly stationed in Addis Ababa, and distributors at regional and zone levels has expanded in the past three years. The dominant distribution model has evolved from one where importers also did retail, to importers focusing on supply to regional distributors. Today, although a few of the importers have retail shops in region or zone capitals most work with distributors stationed locally. This is one of the key reasons for the rapidly increasing distribution of solar lighting products in recent years.

Many electrical, electronic and mobile component distributors in region and zone capitals have expressed interest in distributing solar lighting products (see list of potential distributors in the Annex). Some are already doing so in limited volumes and wish to expand this side of the business. Some of them see solar system distribution (not only solar lighting but also larger systems) as complementary to their other businesses (for example, power for electronic equipment in rural areas, or mobile charging for mobile distributors). Existing and potential distributors see the main challenges to distributing solar lighting products as the following:

- *Uncertainty about demand*: although many of the interviewed businesses were interested in distributing solar lighting products, they had questions about the potential volume of sales (as compared to their existing businesses). They felt solar lighting is a new product that will need a lot of promotion in rural areas.

- *Assurance of quality for products supplied*: existing solar system distributors want firm guarantees for the products they will supply. Some have raised issues of systems that failed to deliver the services that were advertised; they also want warranties for products supplied.

- *Responsibilities for maintenance and service for products distributed*: most distributors are not in a position to provide maintenance and service for the systems they supply. They need to assure customers that the products they supply have warranties and can be maintained and serviced quickly.

Region and zone capital based distributors are still too far from consumers in rural areas (except those that are in the areas immediately surroundings these capitals). District level distributors need to increase reach and provide installation and services to consumers. Electrical and electronic distributors are generally not available at the district level but mobile phone maintenance and battery charging service providers are now available. These mobile phone service providers are aware of the potential of solar mobile charging – they are themselves a potential market for larger solar systems that have the capacity to charge several mobile phones simultaneously. Links between region and zone capital based distributors and district level retailers are needed.

District level retailers can link to Kebele based agents to promote their products, as region and zone based distributors are already doing. These agents can be individuals, rural businesses, or community groups, such as formal and informal savings and credit associations.

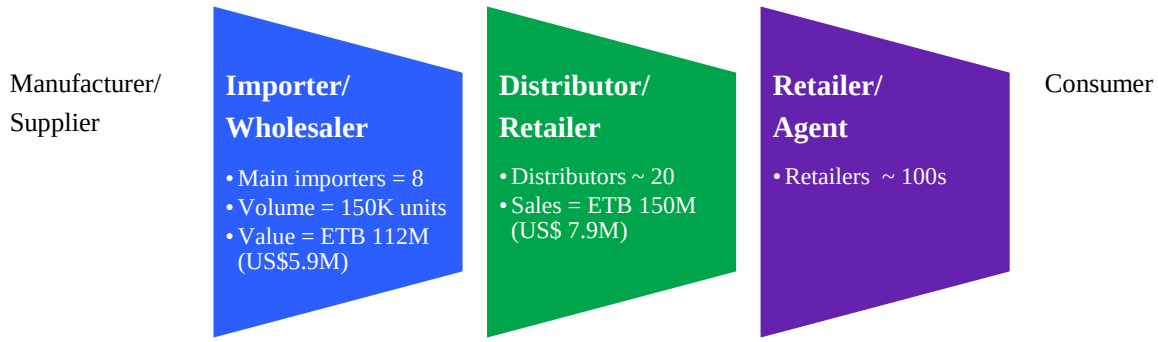
G. Distribution Volume and Value through the Private Importer-Distributor Model

The largest and fastest growing distribution model for solar lighting products in Ethiopia is the private importer-distributor-retailer model. The volume and value of sales through this channel (excluding sales to NGOs who give out systems for free, such as for refugees) is estimated to have reached 120,000 to 150,000 units of solar lanterns and sales of ETB75 million (US$3.9 million) in 2012.[14] Sales volume at the consumer level is estimated at twice as much, or ETB 150 million (US$7.9 million).

The local supply chain consists of three main actors: (a) importer-wholesalers most of whom are located in the capital Addis Ababa, (b) distributors at region and zone capitals, and (c) retailers (or agents) in district capitals and in rural areas. There are 8 main solar lighting product importer-wholesalers; there are about 20 distributors (excluding those selling SLPs as a add-on to their primary business) in region and zone capitals, and more than a hundred retailers (or agents) at the district and Kebele level.

[14] These figures are based on reports on sales volumes for some of the main importers and estimates for the remainder. Sales and value added for distributors and retailers are based on sales to distributors and their margins.

Figure 7. Estimate of volume and value for solar lighting products in Ethiopia, 2012



Main importers with annual import volume of at least 10,000 lanterns (and/or home systems)
Volume and value is estimated from sales of the main actors

The diversity of solar lighting products that have met LA's Minimum Quality Standards distributed in Ethiopia is increasing but three main suppliers dominate the market. Price build up across the supply chain for the most popular products (lanterns with one light and a mobile charger) are as shown in the following table.

Table 2. Price build up for LA approved solar lantern with mobile charger

	Typical		**Low**[15]		
Import	**ETB**	**%**	**ETB**	**%**	
FOB	350	27%	350	37%	
Insurance and freight, port charges	15	1%	15	2%	
Inland transport, un/loading, agents	10	1%	10	1%	
Taxes (VAT)	50	4%	50	5%	
Bank charges (interest)	25	2%	25	3%	
Importer margin	300	23%	250	27%	
Wholesale price	750	57%	700	75%	**Addis Ababa**
Distributor margin	450	34%	150	16%	
Distributor price	1,200	91%	850	91%	**Main cities**
Retailer margin	120	9%	85	9%	
Retail price	1,320	100%	935	100%	**Rural areas**

Notes: A 20 foot container holds about 4,000 solar lanterns
International transport cost = US$1,500-1,700 per 20 foot container, US$3,700 per 40 foot container
Inland transport (Djibouti to Addis Ababa) = ETB 25,000 (US$1,315) per 20 foot container; local transit agent fee = ETB 3,000 (US$158)
Unloading of container in Addis Ababa = ETB 5,000 (US$263) per container; container return to Djibouti = ETB 5,000 (US$263) per container; port charges = US$650/container (for first 8 days); extra US$15/container for each subsequent day

H. Issues for participants in the chain

Importer-wholesalers

The number of importer-wholesalers engaged in the solar lighting product market has increased over the past three years. Companies that are new to the solar energy business are now competing with companies that have been in the solar energy business much longer. Import volumes have increased overall and import volumes of individual companies have

[15] "Low" is the case for solar lanterns sold by businesses selling SLPs as add-ons rather than primary business

also grown. While a few years back solar lanterns were still imported in small volumes now all the major players import several container loads at a time (10,000 to 15,000 solar lanterns per shipment, i.e. 2 to 4 container loads).

One of the constraints identified by sector support organizations is the lack of diversity of lighting products available at the distributor and retailer level. Product choices are often limited to one model from one manufacturer, while there is a diversity of demands and capacities in rural areas. Focus groups held in rural areas confirmed this, where potential customers expressed their aspirations for larger home systems (in addition to the basic lanterns) and stated their capacity to purchase them with suitable financing.

Importers-wholesalers should expand their association with larger distributors. Similar arrangements can be made with other national or regional government and non-governmental organizations (such as regional and zone level development associations, agricultural cooperatives and unions, and NGOs with extensive local presence).

Distributors and retailers

The survey of solar lighting product availability conducted by this assessment indicates that solar lighting products are available from one or more distributors in the regional capitals and in most of the zone capitals visited (15 cities and towns outside Addis Ababa). Usually, the region and zone capital based distributors carry out the solar lighting business as an add-on to existing businesses (such as electrical or electronic product distribution). The range of solar lighting products carried and the volume of sales is relatively small compared to their other businesses.

However, although the geographical spread and number of distributors is growing it is still limited considering the potential market. The end of the supply chain is particularly limited, with distributors still tied to region and zone capitals with very few of them having connections to Woreda and lower level retailers and agents. Retailers and agents are the final link to the consumer and have significant impact in developing demand through promotion and demonstration of systems.

Financing is another important constraint for solar product distributors and retailers. Although a few of the importers provide supplier credit (products provided upfront, while payment occurs after it is sold) this is not widely available and where it is, it is usually limited to a few systems at a time. Distributors require substantially more credit (for example, for up to 200 systems per month or about ETB 150,000 - 200,000 or US$7,895 – 10,526), which the importers do not provide at present. Financing from banks (including MFIs) requires terms that businesses cannot meet (such as high collateral).

The LA program strategy is to address the financing issue from the top and the bottom. Funds are channeled to importers to address their constraints of access to foreign currency and loans (through the DBE which is doing on importers level only). Finance to consumer purchases can be channeled through participating MFIs. The expectation is that the market will organize itself to take care of intermediaries in the supply chain. The expectation is that importers will provide credit to their distributors or that retailers obtain financing through standard commercial channels. This is not happening at the moment creating retailers financing gap. The strategy may be feasible in the long term but it will take time to implement this to develop, and in the meantime distribution may be slow.

3.4. Consumers

A. Off-grid Rural Households

A1. Who are the BOP? Consumer Demographics and Characteristics

1,438 households responded to the rural household lighting market survey with an average family size of 5.4 members per household. Average family size varies across regions from 5 persons per household in Amhara to 5.8 members in SNNP. The average age of household heads is 44 years and varies significantly across regions, from 37 years in SNNP to 47 in Amhara. Overall, a little more than half (57 percent) of the sample population can read and write. As far as the tenure status is concerned, about 97 percent of respondents reported owning their dwelling units. On average, the dwelling units have 2.23 rooms.

The highest proportion of the sample households (92 percent) was smallholder farmers with land holdings of 1.3 hectares and 3.2 cattle, on average. The estimated average annual household consumption expenditure was ETB15,700 (US$826) of which about 75% was on food. The average household consumption expenditure was highest in SNNP and lowest in Tigray. The mean annual household expenditure in SNNP was about ETB6,000 (US$316) more than in Tigray. Comparisons of total expenditure by expenditure quintile groups[16] revealed that the average spending in the upper 20% (Quintile 5) is at least four times that of the average in the lowest 20% (Quintile 1). The average household spending among the expenditure quintiles varies more in Oromiya than in the other regions.

Table 3. Selected Socioeconomic Indicators of Sample Rural Households

Indicator		Region			
	All	Amhara	Oromiya	SNNP	Tigray
Sample Size (N)	1438	383	526	350	179
Sample distribution (%)	100	26.6	36.6	24.3	12.4
Average family size (N)	5.3	5.0	5.3	5.8	5.5
Average age of HH head (years)	43.7	47.0	42.5	37.0	45.2
Can read/write (%)	56.5	38.4	64.3	66.6	52.5
Housing ownership, Privately owned (%)	97.0	96.6	98.1	98.3	92.2
No of Rooms (N)	2.23	1.97	2.59	2.08	2.04
Main occupation of head of HH:	92.0	92.7	93.0	92.0	87.7
HHs farming (%)	92.0	92.7	93.0	92.0	87.7
Assets ownership:					
Land (ha)	1.3	1.8	1.6	0.7	0.9
Cattle ownership (N)	3.2	3.1	3.8	2.5	2.7
Cell phone ownership per household (N)	0.7	0.4	0.9	0.6	0.6
HH Consumption Expenditure:					
HH annual expenditure ETB (US$)	15,699 (826)	14,598 (768)	16,059 (845)	19,958 (1,050)	13,754 (724)
Expenditure on food (%)	76%	77%	71%	86%	84%
Expenditure quintiles (ETB):					
1 (Lowest 20%)	6,525	6,460	6,487	7,180	6,632
2 (second 20%)	10,197	9,965	10,280	10,138	10,364
3 (middle 20%)	13,651	13,941	13,506	13,670	13,651
4 (fourth 20%)	18,029	17,790	18,099	18,458	17,950
5 (highest 20%)	30,052	26,763	32,318	30,569	25,431

[16]The quintiles are calculated by first ordering all households in ascending order by value of household consumption expenditure and then dividing them into five equal parts such that the first group includes 20% of households with the lowest annual expenditure and the last group includes 20% of households with the highest annual household consumption expenditure.

Table 3 (Continued)

Indicator		Region			
	All	Amhara	Oromiya	SNNP	Tigray
Expenditure quintiles (US$):					
1 (Lowest 20%)	343.42	340	341.42	377.89	349.05
2 (second 20%)	536.68	524.47	541.05	533.58	545.47
3 (middle 20%)	718.47	733.74	710.84	719.47	718.47
4 (fourth 20%)	948.89	936.32	952.58	971.47	944.74
5 (highest 20%)	1,581.68	1,408.58	1,700.95	1,608.89	1,338.47

Source: Lighting Market Survey (June 2013).

A2. Current Lighting Sources and Expenditures

The vast majority of the approximately 12.6 million rural households in Ethiopia are not connected to an electric grid. More than 85 percent of households rely on fuel-based light sources, predominantly kerosene used with low quality wick lamps (Table 4). Kerosene wick lamps that are made from tin cans are usually purchased from rural markets. It is also quite common for households to make their own wick lamp using smaller bottles and metal corks punctured in the middle to let the wick through to the kerosene contained in the bottle. Better-off rural households use hurricane lamps, which have glass shields to let the wick burn brighter with reduced amounts of smoke.

While kerosene lamps are the most widely used source of light (85.7%), dry cell battery powered lighting devices, mainly hand torches, are also widely used by rural households. The lighting market survey revealed that about two-thirds of the rural households use dry cell battery powered hand torches and lanterns. Other sources of energy for lighting (candles, car batteries, etc.) are not common. The survey also indicated that the sources of lighting for rural households vary across regions. The percentage of rural households that use kerosene for lighting ranges from 72 percent in Amhara to approximately 95 percent in SNNP. Similarly, dry cell batteries are used by 76 percent of rural households in Amhara as compared to almost 60 percent in Oromiya and Tigray.

The rural households participating in the lighting market survey reported that they use kerosene for 3 hours per day on average. These households spent an average of ETB38 (US$2) per month on kerosene, and reported paying an average of ETB19.80 (US$1.04) per litre of kerosene. Spending on lighting from all sources including kerosene, dry cell batteries, and other sources constitutes 4.5 percent of households' total annual consumption expenditure, on average.

Table 4: Lighting Sources in off-grid Rural Households (Percent of households)

	Total	Region			
		Amhara	Oromiya	SNNP	Tigray
A. Energy source for lighting % of HHs					
1. Kerosene lamps	85.7	72.3	92.6	94.6	77.1
2. Candles	0.8	0.3	1.9	0.3	0.0
3. Dry cell battery lighting devices	65.0	76.0	57.8	66.0	60.3
4. Car batteries	0.3	0.0	0.6	0.6	0.0
5. Off-grid electricity	0.3	0.0	0.8	0.0	0.0
6. Diesel generator (private)	0.3	0.0	0.8	0.0	0.0

Table 4 (Continued)

	Total	Region			
		Amhara	Oromiya	SNNP	Tigray
B. Kerosene lamp types used:					
1. Tin Lamp					
HH using lamp (%)	75.4	66.3	71.1	92.3	74.3
Mean no. of lamps (N)	1.5	1.3	1.4	1.8	1.4
Average cost per lamp (ETB)	6.8	6.0	6.0	7.7	8.6
Average cost per lamp (US$)	0.36	0.32	0.32	0.41	0.45
2. Hurricane Lamp					
HH using lamp (%)	10.2	6.3	0.2	2.0	2.8
Average No. of lamps (N)	1.3	1.5	1.3	1.0	1.0
Average cost per lamp (ETB)	1758	132	200	30	36
Average cost per lamp (US$)	92.53	6.95	10.53	1.58	1.89
C. Kerosene consumption, expenditure:					
1. Kerosene consumption, litre/month	**1.9**	2.0	2.2	1.5	1.8
2. Price of Kerosene, ETB/litre	19.8	19.5	19.0	21.4	20.4
Price of Kerosene, US$/litre	1.04	1.00	1.00	1.13	1.07
3. Expenditure on kerosene for lighting ETB/month	**37.8**	38.5	41.1	32.9	36.0
Expenditure on kerosene for lighting US$/month	**1.99**	2.03	2.16	1.73	1.89
4. Expenditure on kerosene as % of HH Total Consumption Expenditure	**3.6**	3.8	3.9	2.4	3.6

Source: Lighting Market Survey (2013).

The comparison of monthly spending for lighting energy across expenditure quintiles reveals that the amount of money spent on kerosene ranges from ETB32.7 (US$1.72) among the poorest households to ETB45.6 (US$2.40) among the upper expenditure Quintile (Table 5). The percentage of households that use dry cell batteries for lighting rises from 49 percent among Quintile 1 to more than 70 percent in Quintile 5. The households in the lowest expenditure group spend an average of ETB12.00 (US$ 0.63) per month on these batteries while those in the highest expenditure quintile spend ETB17.00 (US$ 0.89), on average. Yet, households in the highest expenditure group spend a smaller proportion of their total monthly expenditure (2.5 percent) on purchased energy for lighting against 7.2 percent for households in the lowest-expenditure group. Thus, the share of household expenditures that was spent on kerosene for lighting declined as household income/expenditure rose. This suggests that kerosene meets a basic minimum need.

Table 5a. Rural Household Energy Use / Cost for Lighting by Expenditure Quintile

Expenditure Quintile	HHs using Kerosene for lighting (%)	Expenditure on Kerosene for lighting		HHs using dry cell batteries for lighting (%)	Expenditure on dry cell for lighting		Expenditure on Lighting as % of total Expenditure
		ETB/Month	US$ / Month		ETB/Month	US$ / Month	
1 (lowest 20%)	83.4	32.7	1.72	49.3	12	0.63	7.2
2 (second 20%)	79.4	37.0	1.95	65.1	14	0.74	5.4
3 (middle 20%)	83.5	38.0	2.00	65.6	14	0.74	4.1
4 (fourth 20%)	81.7	41.1	2.16	69.7	16	0.84	3.3
5 (highest 20%)	83.9	45.6	2.40	72.9	17	0.89	2.5
Total	82.4	38.9	2.05	64.6	15	0.79	4.5

Table 5b. Rural Households Energy Use/ Cost for Mobile Phone Charging by Expenditure Quintile

Expenditure Quintile	HHs using mobile phone charging service (%)	Expenditure on mobile charging		Expenditure on phone charging as % of total Expenditure
		ETB/Month	US$ / Month	
1 (lowest 20%)	29.6%	18.14	0.95	3.4
2 (second 20%)	48.1%	16.83	0.89	1.9
3 (middle 20%)	46.3%	18.68	0.98	1.6
4 (fourth 20%)	56.8%	18.22	0.96	1.2
5 (highest 20%)	62.7%	18.52	0.97	0.6
Total	48.6%	18.10	0.95	1.3

The off-grid rural household lighting market in Ethiopia is large. The total annual expenditure is estimated at approximately ETB6,300 million (US$331million), of which about three-fourths is spent on kerosene and the remaining on dry cell batteries. Based on the current price of kerosene, it is estimated that over 235 million litres (or 180,000 tons) are used each year for lighting by rural households. The retail price of this energy is over US$245 million.

Table 6a. Estimates of Rural Households Annual Expenditure on Lighting

Expenditure Quintile	Population represented by the sample (HHs) [1]	**Annual Expenditure on Lighting Energy**					
		Kerosene		Dry cell batteries		Kerosene and dry cell batteries	
		(ETB million)	(US$ million)	(ETB Million)	(US$ million)	(ETB Million)	(US$ million)
1 (lowest 20%)	2,929,265	960	50.5	208	10.9	1,168	61.5
2 (second 20%)	2,747,442	969	51	300	15.8	1,269	66.8
3 (middle 20%)	2,615,447	995	52.4	288	15.2	1,283	67.5
4 (fourth 20%)	2,394,320	964	50.7	320	16.8	1,284	67.6
5 (highest 20%)	1,861,514	855	45.0	277	14.6	1,132	59.6
Total	**12,547,988**	**4,832**	254.3	**1,394**	73.4	**6,291**	**331.1**
Percent		**77.0**		**23.0**		**100.0**	

Source: Lighting Market Survey (June 2013)

[1] Central Statistical Agency (CSA), 2012.

Similarly, the annual number of dry cell batteries consumed and disposed of by rural households is estimated at about 278 million D-Type batteries (equivalent to 25,000 tons). This is worth over US$77 million in the retail market.

Expenditure for mobile phone charging by the rural households is estimated at about US$70 million annually.

Table 6b. Estimates of Rural HHs Annual Expenditure on Mobile Phone Charging

Expenditure Quintile	Population represented by the sample (HHs) [1]	**Annual Expenditure on phone charging & Lighting Energy**			
		Mobile phone charging		Kerosene, dry cell batteries and mobile charging	
		(ETB million)	(US$ million)	(ETB Million)	(US$ million)
1 (lowest 20%)	2,929,265	189	9.94	1,357	71.41
2 (second 20%)	2,747,442	267	14.04	1,536	80.83
3 (middle 20%)	2,615,447	268	14.08	1,551	81.61
4 (fourth 20%)	2,394,320	299	15.75	1,583	83.33
5 (highest 20%)	1,861,514	257	13.51	1,389	73.09
Total	**12,547,988**	**1,319**	69.42	7,610	400.52
Percent		**17.3**		**100.0**	

Source: Lighting Market Survey (June 2013)

[1] Central Statistical Agency (CSA), 2012.

Use of simple kerosene wick lamps and dry cell batteries for lighting not only erodes household budgets but also has immense negative consequences on the environment. The emissions from kerosene wick lamps are mainly black carbon (soot) and carbon dioxide, both of which warm the climate. Kerosene wick lamps are now understood to be a significant source of atmospheric black carbon. A study indicated that 7% to 9% of the kerosene burned in these kerosene lamps is converted to black carbon particles[17]. The same study also indicated that kerosene wick lamps emit about 2.5 kg of carbon dioxide for every litre of kerosene burned. Accordingly, the amount of black carbon and carbon dioxide emitted from burning kerosene for lighting by rural households is estimated at about 15,000 tons and 580,000 tons, respectively.

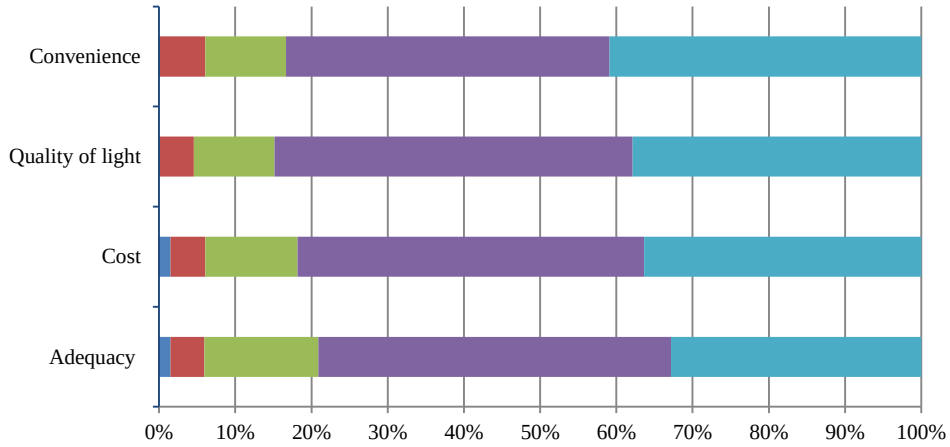
Likewise, environmental damages from unsafely discarded dry cell batteries is significant. Most of the dry cell batteries used by households for lighting purposes are low quality zinc-carbon batteries. This type of dry cell battery contains significant amounts of heavy metals, including mercury and other environmentally hazardous chemicals, which escape into the environment due to unsafe disposal.

[17] Lam, N.L, et al. (2012. Environmental Health, Part B: Critical Reviews, 15(6), 396-432. "Household Light Makes Global Heat: High Black Carbon Emissions From Kerosene Wick Lamps", Environmental Science and Technology, ACS Publication, November 2012

A3. Satisfaction with Kerosene Lighting

Households' satisfaction or dissatisfaction with their current lighting services is important for understanding whether households would be inclined to purchase solar lighting products. The survey indicated that the majority of the households expressed a high degree of dissatisfaction with their lighting services (Figure 8), because of several factors. From the survey it was found that between 80 and 85 percent of the households were dissatisfied or highly dissatisfied over the adequacy, cost, quality of light, and convenience of lighting received from kerosene lamps.

Figure 8. Satisfaction/Dissatisfaction with Kerosene Light by Rural Households



	Adequacy	Cost	Quality of light	Convenience
Highly Satisfied	1.5%	1.5%	0.0%	0.0%
Satisfied	4.5%	4.5%	4.5%	6.1%
Indifferent	14.9%	12.1%	10.6%	10.6%
Dissatisfied	46.3%	45.5%	47.0%	42.4%
Highly dissatisfied	32.8%	36.4%	37.9%	40.9%

The common disadvantages of kerosene lighting as expressed by the respondents include (i) smoke emitted irritates the eyes, (ii) kerosene lamp is unsafe, and (ii) kerosene lighting can cause fire. The participants of one of the focus group discussions conducted under this survey expressed their dissatisfaction with kerosene lighting this way:

> *'… Kerosene light can't be taken out to tend livestock because the wind will blow it out, the light is dim, and children can't study with it unless they keep it very close to their books'.*
>
> FGD in Rama Woreda, Tigray.

A4. Interest in Purchasing Solar Lighting Products

A substantial proportion (85%) of the rural households stated that they were interested in buying solar lighting products. The distribution of households willing to buy solar lighting devices across regions ranges from 83% in Amhara to 89% in Tigray. In terms of product categories, the demand is divided into four group: (a) those wanting the basic lantern without

mobile charging (22%), (b) those wanting a lantern with mobile charging (38.7%), (c) those wanting two or more lights with mobile charging and additional services (20.5%), and (d) those wanting two or more lights with charging for two mobile phones and a radio / cassette player (18.8%). The largest demand is for solar lanterns with mobile charging features.

Table 7. Willingness to Purchase Solar Products and preferred Payment Method by Rural HH

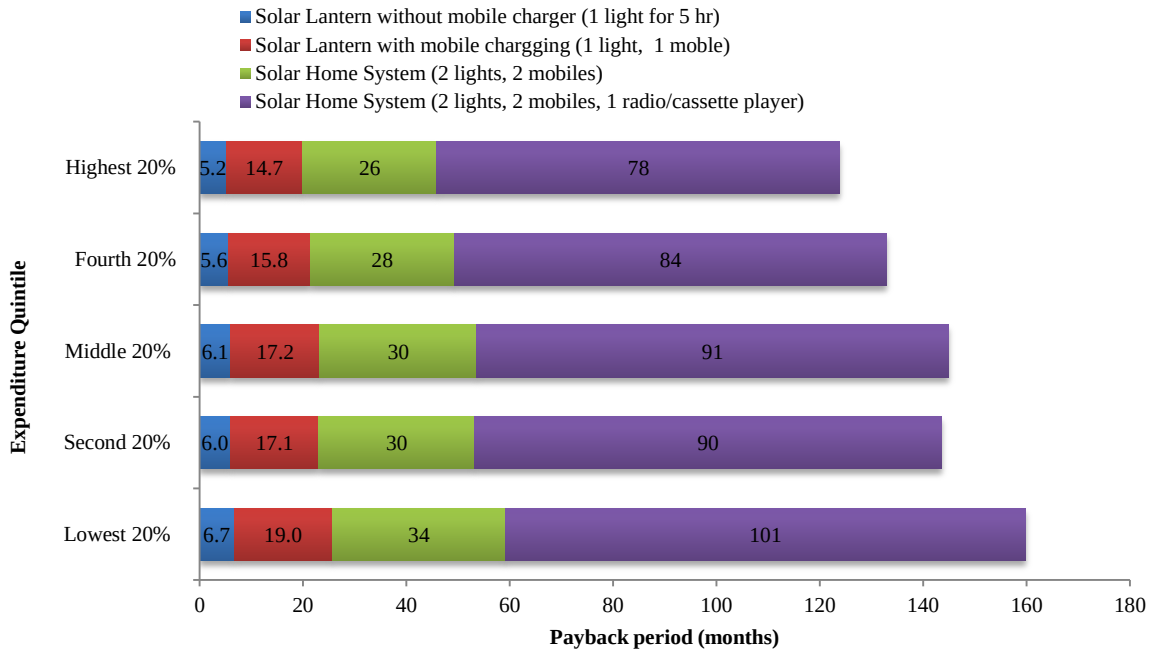
		Region			
	Total	**Amhara**	**Oromiya**	**SNNP**	**Tigray**
Sample size (N)=	**1438**	**383**	**526**	**350**	**179**
HHs interested to buy, %	85.5	83.3	84.6	87.4	89.4
No. of HH Represented by the sample	12,098,030	3,479,368	5,013,587	2,821,194	783,881
Number of HH interested to buy	10,306,321	2,898,314	4,241,495	2,465,724	700,790
Solar lighting Product category					
1. SLP Without mobile charger (1 light)	22.0%	15.9%	34.0%	18.5%	26.6%
2. SLP with charger (1 light, 1 mobile)	38.7%	30.1%	51.0%	32.6%	55.7%
3. SHS (2 lights, 2 mobiles)	20.5%	24.5%	8.8%	30.5%	8.9%
4. SHS (2 lights, 2 mobiles, 1 radio/cassette player)	18.8%	29.5%	6.2%	18.5%	8.9%
Preferred Payment method:					
1. Cash	15%	11%	26%	9%	20%
2. Cash and 6 month-credit	22%	21%	28%	20%	17%
3. Cash and 1-year credit	29%	32%	29%	25%	29%
4. Cash and 2-year credit	34%	36%	16%	45%	34%

A5. Affordability/Ability to Pay for Solar Lighting Systems

Households in the lowest expenditure quintile currently spend an average of ETB33 (US$1.74) per month on kerosene. Based on this level of expenditure, the payback period for the solar lanterns without mobile charging will be approximately 6.7 months. For households in the highest expenditure quintile (who on average are currently spending about ETB81.12 (US$ 4.27) per month on kerosene, dry cell batteries and cell phone charging), the payback period for a solar lantern with mobile charging will be less than 15 months. Estimates of the payback periods for different types of solar lanterns and solar home systems by expenditure quintile are shown in Figure 9.[18]

[18]Kerosene prices have shown an increasing trend in the past two decades. Retail price of kerosene at fuel stations, as of June 2013, the time that this survey was conducted, was about ETB13.8 (US$0.99) per liter against ETB0.65 (US$0.03) in 1990. Rural households, however, on average pay about ETB 19.8 for a liter of kerosene at rural retailers. This trend can be expected to continue partly because of increasing import and transportation costs and partly due to the continued depreciation of the Ethiopian currency. Thus, the payback periods for solar lanterns are likely to be even lower in the future.

Figure 9. Estimated Payback periods for Solar Lighting Products by Expenditure Quintile



Solar lanterns are cheaper in the long term than kerosene and batteries. The accumulated savings would repay the initial cost long before the end of the system's useful life of 2 to 3 years. The availability of credit for solar lanterns will also make it possible for poor rural households to be able to afford them. Overall, the solar lighting market potential in the off-grid rural areas can be between ten to twelve million units.

B. Off-grid Small and Micro Enterprises

B1. Enterprise Basic Information

Over half of the rural SMEs covered by the survey are retail shops and 25% are tea rooms (Figure 10). The weekly sales revenue of the majority (58%) of the sample enterprises was below ETB500 (US$26.32) while one-third had weekly revenues between ETB 500 and ETB 1,500 (US$26.32 – 78.95). About 91% of the sample enterprises had sales revenue of less than ETB 1,500 (US$78.95) per week.

When the respondents were asked if there was a need to extend their working hours into the evenings, one-third stated that it was not necessary for their enterprise to lengthen working hours, and another one-third expressed the need to extend their working hours but felt they were unable to do so due to the lack of adequate lighting solutions. Specifically, 22% reported that they didn't have alternative lighting solutions and 12% reported their current lighting source as inadequate.

Figure 10. Sample Enterprise Profiles of Off-grid SMEs

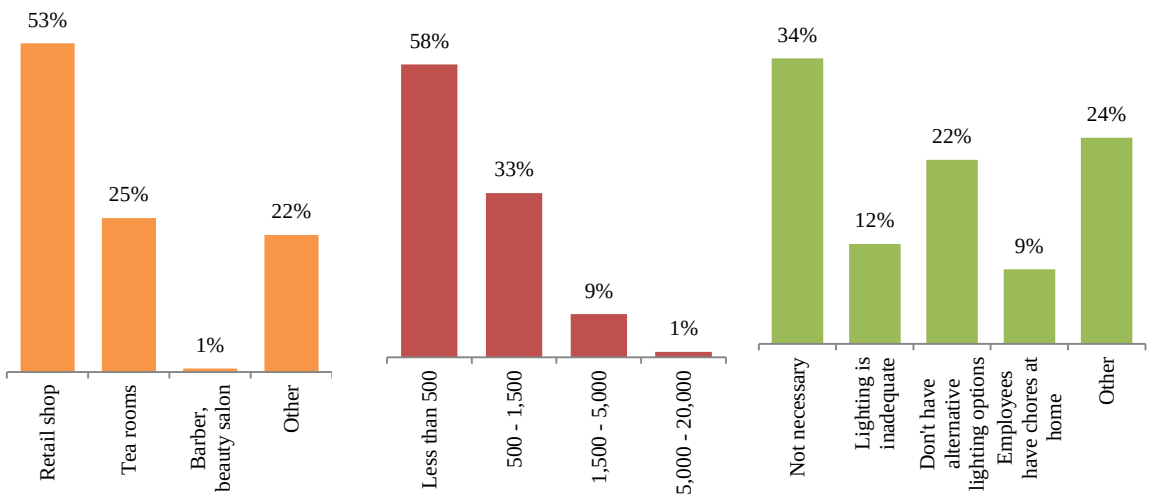


Figure 10 (a) Type of Business Enterprise

Figure 10 (b) Weekly Sales Revenue

Figure 10 (c) Need for extending working hours during evenings

B2. Current Lighting Sources and Expenditures

The lighting market survey revealed that 62% of the sample rural SMEs in the off-grid areas rely on kerosene for lighting with 80% using wick lamps and 20% hurricane lamps. The mean kerosene tin lamp ownership was 1.41 per enterprise.

As is the case with off-grid rural households, dry cell battery operated lighting devices, mainly hand torches, are widely used by SMEs. The survey found that the percentage of enterprises that used dry cell batteries for hand torches was the same as those using kerosene lamps (62%). Other sources of energy for lighting include solar lanterns (8.3%) and candles (5%). Among the solar lantern users, 86% acquired them through purchases and the remaining 14% received them as gifts from relatives.

B3. Satisfaction with Current Lighting Services

The survey indicated that the majority of the SMEs in the off-grid areas expressed a high degree of dissatisfaction with their main sources of lighting: kerosene lamps and dry cell battery operated hand torches. It was found that between 76 and 94 percent of the enterprises were dissatisfied or highly dissatisfied over the adequacy, cost, quality of light, and convenience of lighting received from kerosene lamps (Figure 11). Among the negative attributes of kerosene lamps, the highest percentage of the SMEs (42%) stated that smoke from kerosene lamps damages eyes, followed by 17% and 13% saying the smoke from the lamps damages ceilings and kerosene fuel is expensive, respectively.

The sample enterprises are unhappy with dry cell battery run lighting services as well, with 88% of them reporting dry cell batteries are expensive. About 55% stated light quality is poor and the same percentage of the respondents stated that lighting with hand torches is not convenient.

Figure 11. Degree of Statisfaction/Dissatifaction with Kerosene Lamps and Dry Cell Torches by Rural SMEs

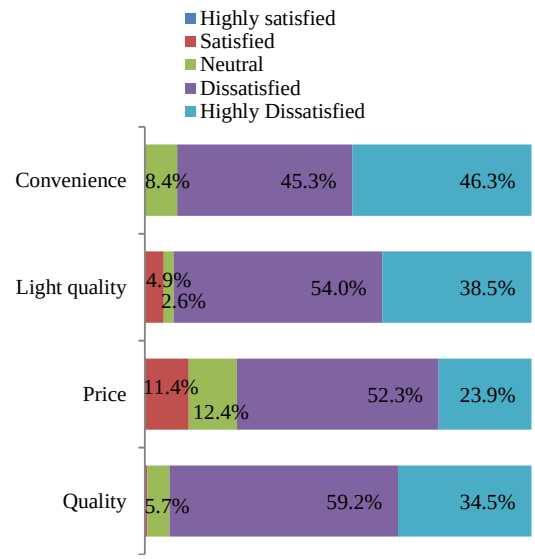


Figure 11 (a) Degree of Satisfaction/Dissatifaction with Kerosene Lamps (% of rural Enterprises)

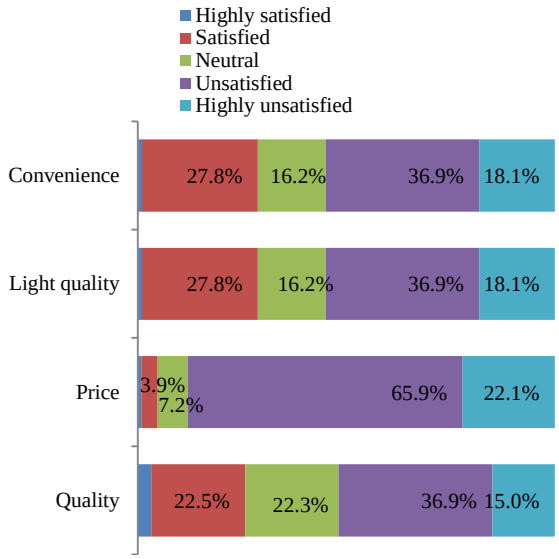


Figure 11 (b) Degree of Satisfaction/Dissatifaction with dry cell battery Torches (% of rural Enterprises)

B4. Interest in Purchasing Solar Lighting Products, Preferred Payment Arrangements

The survey indicated that over 85 percent of the SMEs in the off-grid areas are interested in purchasing solar-powered lighting devices. The majority of them (36%) preferred solar home systems capable of powering two light bulbs, charging 2 cell phones and running 1 radio/audio cassette player, 30% are interested in solar lanterns capable of charging 1 mobile phone and 17% would like solar lanterns with one light without mobile phone charging, and another 17% want a solar home system capable of lighting two bulbs for five hours per day and charging 2 cell phones.

Figure 12. Preferred SLPs, payment arrangements and attributes of solar lighting products

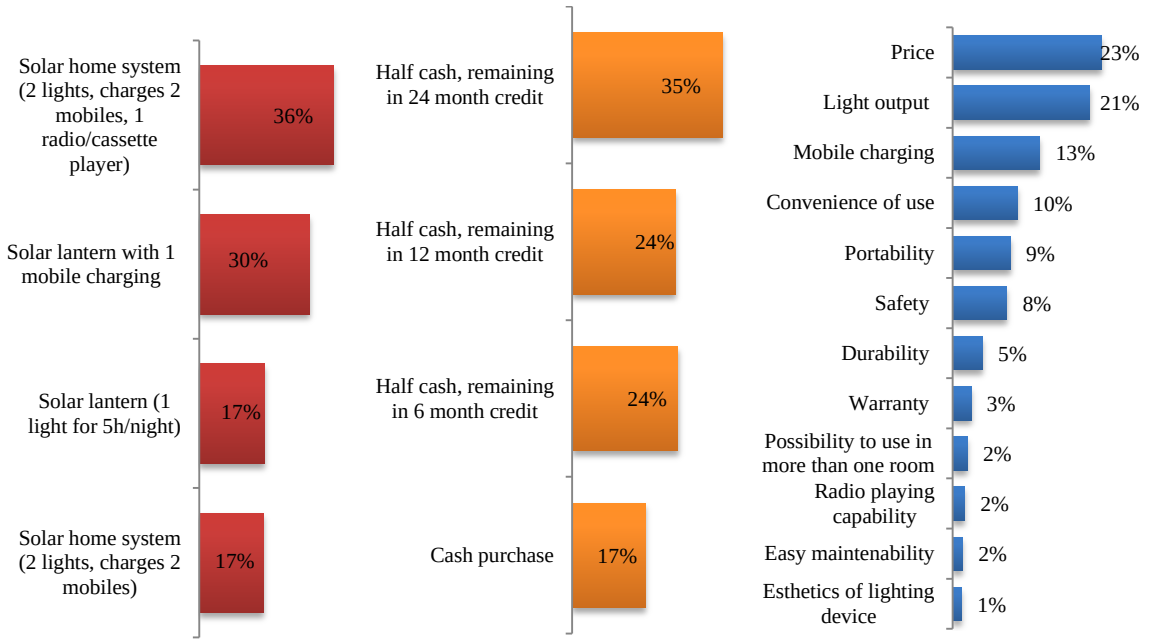


Figure 12 (a) Preferred Solar Lighting systems

Figure 12 (b) Preferred Payment Arrangements

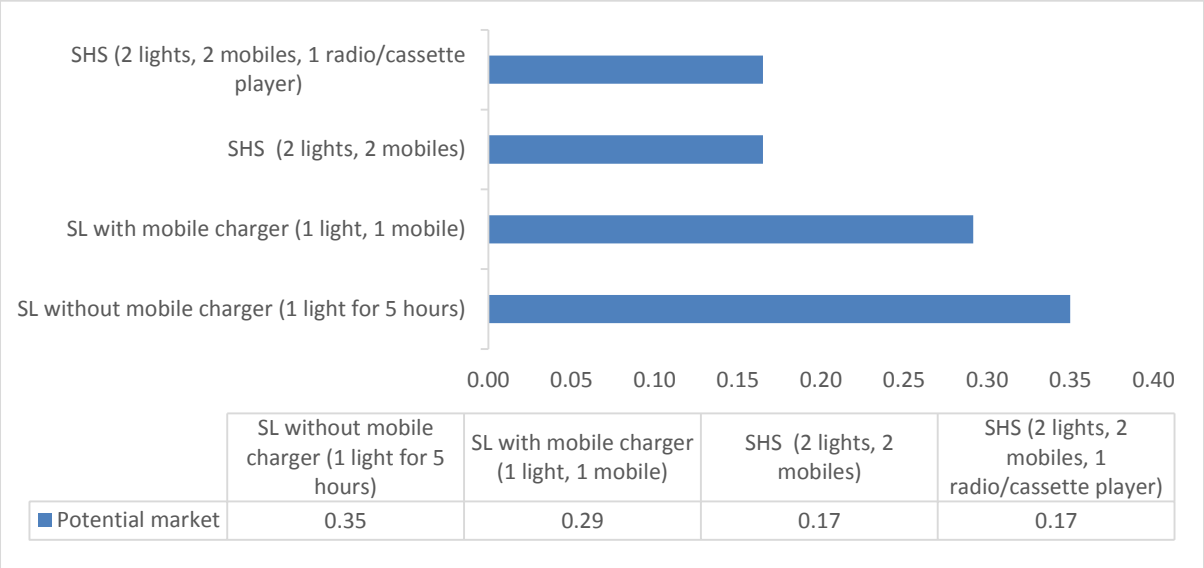
Figure **12 (c)**Attributes sought in Solar lanterns

Among those interested in purchasing solar lighting devices, preference for payment timescales differed. 17% preferred to pay cash while 24% preferred paying half in a down payment and the balance in 6 months credit. About one-fourth of the SMEs preferred half in cash and half in 12 months credit and the majority (35%) preferred to pay half down and the rest in 24 months credit. The most important attributes sought in SLPs by potential customers, in order of their importance are: price (23%), level of light output (21%), cell phone charging service (13%), and convenience (10%).

B5. Affordability and Estimates of Market Size

Data on the number and distribution of SMEs in rural areas in Ethiopia is not available. Accordingly, estimates are based on rural households' participation in non-farm enterprises. The market size for solar lighting systems is estimated for retail enterprises (not stalls/markets). The average rate of participation in non-farm enterprises in the survey areas was 25% and varies between 20% in Amhara to 40% in SNNP. Again, of the total rural non-farm enterprises 20% and 6% were retail trade and hotels and restaurants, respectively (CSA 2012). Based on these data, the number of retail enterprises and hotels and restaurants in the survey areas is estimated to be about 972,000.

Figure 13. Estimated Market Size for Solar Lighting Systems for Off-grid Rural Enterpirses by Product Category (Million units)[19]



The market size for solar lighting systems for off-grid rural enterprises is estimated to be 972,000 units. In terms of product category, solar lanterns without and with mobile chargers will account for 35% and 29%, respectively, solar home systems with 2 lights and 2 cell phone chargers 17%, and another 17% of demand would be for solar home systems capable of also running a radio/cassette player.

C. Grid Connected Urban Households

C1. Consumer Demographics and Characteristics

The lighting market survey in grid-connected urban areas covered a total of 647 households with an average family size of 4.3 members per household (Table 8). Overall, about 45% of the urban households owned their dwelling units and 53% rented; 26% from private owners and 27% from the government. About 36% of the dwelling units have two rooms and one-fourth of them have three rooms.

The highest proportion of the sample households (39%) are salaried employees and 8% are self-employed with hired employees and without (23%). The estimated average annual household consumption expenditure was ETB20,490 (US$1,078.42) of which, on average about 70% was on food. The average household consumption expenditure was highest in Amhara (ETB24,442 or US$1,286.42) and lowest in Tigray (ETB15,180 or US$798.95). The average consumption expenditure of the upper 20% (or Quintile 5) households was more than five times of those of their Quintile 1 counterparts, with the highest variation in Oromiya (5.8 times) and lowest in Tigray (3.6 times).

[19] This analysis is based on willingness to pay and affordability and does not factor in aspirational motivations or marketing that can significantly influence purchase decisions.

Table 8. Selected Socioeconomic Indicators of Sample Urban Households

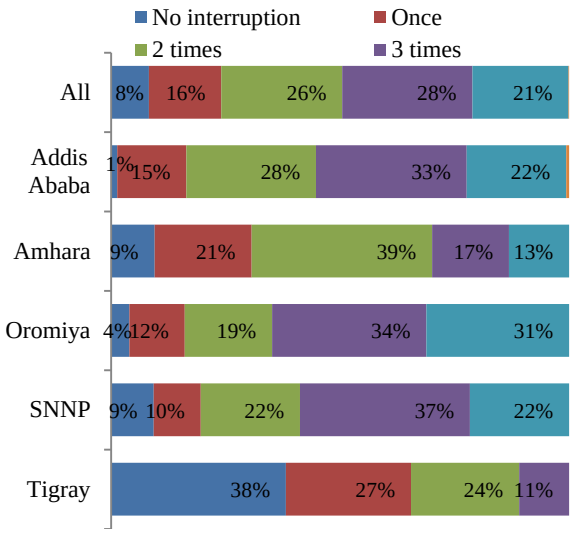
Indicator		Region				
	All	Addis Ababa	Amhara	Oromiya	SNNP	Tigray
Sample Size (N)	647	154	139	201	98	55
Sample distribution (%)	100	23.8	21.5	31.1	15.1	8.5
Average family size (N)	4.3	4.6	4.3	4.3	4.4	3.6
Ownership of dwelling unit						
Owned (%)	45%	36%	44%	61%	50%	29%
Rented from private (%)	26%	22%	23%	17%	29%	65%
Rented from Government (%)	27%	40%	31%	22%	18%	2%
No of Rooms						
One room	23%	20%	17%	18%	21%	65%
Two rooms	36%	42%	40%	30%	32%	25%
Three rooms	25%	20%	28%	26%	35%	4%
Four rooms	10%	9%	11%	14%	5%	5%
More than four rooms	7%	8%	4%	12%	7%	0%
Main occupation of head of HH:						
Salaried	39%	36%	37%	48%	41%	29%
Self-employed - w/o employees	23%	23%	22%	15%	28%	40%
Self-employed - w/ employees	8%	11%	8%	9%	6%	4%
Daily worker	8%	7%	11%	7%	7%	7%
HH Consumption Expenditure:						
HH annual expenditure (ETB)	20,490	23,378	24,442	16,898	20,641	15,180
HH annual expenditure (US$)	1,078.42	1,230.42	1,286.42	889.37	1,086.37	798.95
Expenditure on food (%)	70%	64%	60%	74%	68%	79%
Expenditure quintiles (ETB):						
1 (Lowest 20%)	7,937	8,495	7,849	7,754	7,498	8,427
2 (second 20%)	12,527	13,050	12,565	12,474	12,308	11,987
3 (middle 20%)	17,590	17,159	17,989	17,718	17,433	17,280
4 (fourth 20%)	23,450	23,727	23,476	23,409	22,923	23,628
5 (highest 20%)	40,984	40,234	45,432	38,556	38,897	30,246

Source: Lighting Market Survey (June 2013).

C2. Frequency of Power interruptions, Lighting Sources and Expenditures

Electric power interruptions in grid connected urban areas are frequent. Over 90% of the sample households reported power outages of at least once during the week prior to the survey and approximately 40% reported three or more outages during the same period (Figure 14). Power interruptions are more frequent in Addis Ababa with 99% of the households experiencing at least one, and 83% two or more, in the week prior to the survey. This is in sharp contrast with Tigray where 38% of the households reported no power interruptions. The mean number of power outages across the country is 2.38 times per week and the average duration of a single power outage ranges from 4.5 to 6.8 hours by region.

Figure 14. Frequency of Power Interruptions Last Week and Average Duration (hours)



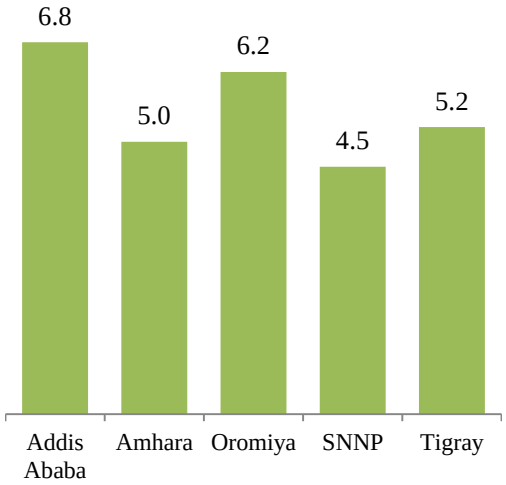
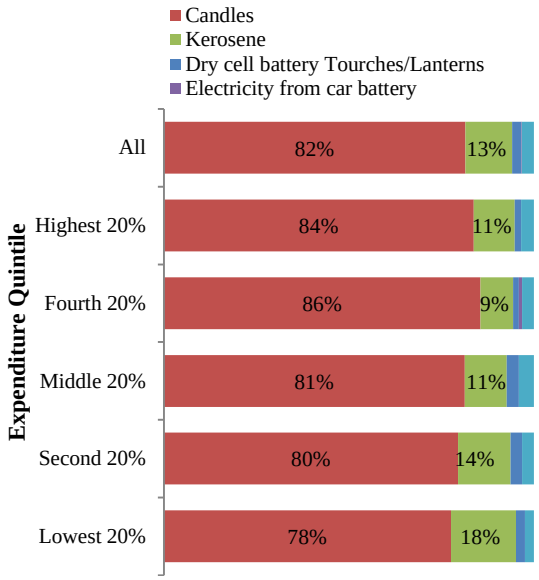


Figure 14 (a) Frequency of Power Interruptions during the week prior to the survey(Percent of households)

Figure 14 (b) Average duration of single interruption (Hours)

The overwhelming majority (82%) of urban households use candles for lighting during power outages, followed by kerosene lamps (13%). The use of other sources (dry cell battery operated hand torches and lanterns and electricity powered by car batteries) is insignificant. The survey also revealed that there is no significant difference in sources of lighting across expenditure quintiles: 78% and 84% of the households in the bottom and upper expenditure quintiles use candles, respectively. However, there are slight variations across regions.

Figure 15. Main source of lighting for Urban HHs during Power Interruption by Expenditure Quintile and Region



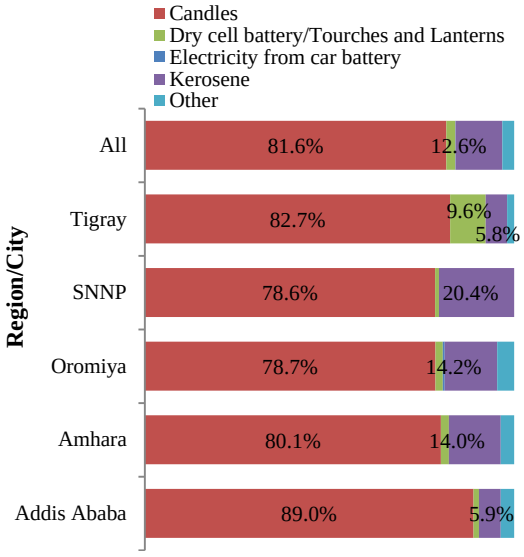


Figure 15 (a) Main source of Lighting of urban households during Power Interruptions by Expenditure Quintile (% HHs)

Figure 15 (b) Main source of Lighting of urban households during Power Interruptions by Region (% HHs)

In SNNP and Oromiya 79% of the households use candles in contrast to 89% in Addis Ababa. Kerosene use for lighting is the highest in SNNP (20%), followed by Oromiya and Amhara, with 14% each. On the other hand, use of dry cell battery powered hand torches and lanterns is relatively high (almost 10%) in Tigray.

The households using candles lit an average of 1.5 candles for 2.3 hours per single power interruption. The average time to completely burn out a candle is 3.2 hours. The purchase price per candle was ETB3.50 (US$0.18). This translates into an expenditure on candles of ETB3.80 (US$0.2) per single interruption, per household. Given that the average frequency of power interruptions is 2.4 times per week, the average weekly expenditure on candles is ETB9 (US$0.47), or ETB39.00 (US$2.05) per month.

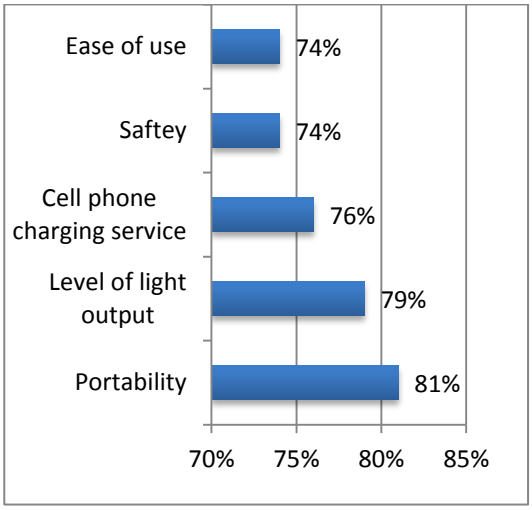
The total number of grid-connected urban households is about 3.43 million of which 82% use candles as their primary source of lighting during power interruptions. Thus, the annual expenditure on candles for lighting by those households is estimated at ETB1.31 billion (US$68.9million). The urban household lighting market in Ethiopia, therefore, offers significant opportunities for marketing solar lighting solutions in substitution to candles.

C3. Satisfaction with Current Lighting Services

The majority of the urban households expressed a high degree of dissatisfaction with candle light services. Approximately 80% were dissatisfied or highly dissatisfied over the price, quality of light, and convenience (Figure 10) and about 13% responded they were "indifferent" while only 7% to 9% were "satisfied."

The positive attributes of candles as expressed by the respondents included 'easy accessibility' and 'relatively cheaper price'. Reported negative attributes of candles included 'candle burns out too quickly', 'leaves wax' and 'are fire hazards'.
The five most important attributes of solar lighting products sought by urban households, and their relative importance are shown in Figure 16.

Figure 16. Five most important attributes of SLPs sought by urban households.



C4. Ability to Pay for Solar Lighting Systems and Estimates of Market Size

As mentioned earlier, grid-connected urban households currently spend ETB39 (US$2.05) on candles per month, on average. This translates into a payback period of about eight months for solar lanterns without a mobile charger and less than 2 years for the lantern with a charger. Solar lanterns are cheaper in the long term than candles and the savings would repay the initial cost long before the end of the system's useful life, and availability of credit would allow poor households to be able to afford them. Overall, the solar lighting market potential in the grid-connected urban areas is estimated between 2.6 to 3.2 million units.

In terms of product category, 23% of demand will be for solar lanterns without mobile charging, 37% for solar lanterns with mobile charging, 22% for solar home systems (2 lights and charging for 2 cell phones) and 18% for solar home systems with 2 lights, charging 2 cell phones and a radio/cassette player.

Table 9. Willingness to Purchase Solar Products and Preferred Payment Method, Urban Households

Indicator	All	Region				
		Addis Ababa	Oromiya	Amhara	SNNP	Tigray
Sample Size (N)	616	149	187	138	90	52
HH that want to purchase, %	81%	82.6%	84.5%	77.5%	87.8%	55.8%
HHs Represented by the Sample (N)	3,195,156	729,664	1,067,422	718,346	415,530	264,194
Type of Solar system preferred, %						
1. SLP w/o mobile charger (1 light)	23.0	26%	16%	28%	25%	23%
2. SLP with charger (1 light, 1 mobile)	37.1	24%	44%	44%	31%	47%
3. SHS (2 lights, 2 mobiles)	21.9	28%	19%	17%	25%	23%
4. SHS (2 lights, 2 mobiles, 1 radio/cassette player)	18.0	23%	21%	11%	19%	7%
Preferred payment modalities, %						
1. Cash purchase	23.0	30%	15%	44%	16%	48%
2. Cash and 6 month credit	37.1	34%	34%	32%	37%	32%
3. Cash and 12 month credit	21.9	22%	25%	15%	25%	16%
4. Cash and 24 month credit	18.0	15%	25%	9%	22%	3%

Source: Lighting Market Survey (June 2013).

D. Grid Connected SMEs

D1. Enterprise Basic Information

The distribution of SMEs in grid-connected cities and towns were as follows: 41% were retail shops, 25% were restaurants and cafes, and 12% were barber and beauty salons. The majority of the enterprises (41%) have weekly sales revenues between ETB500 and 1,500 (US$26.32 – 78.95) and 29% of them between ETB 1,500 and ETB 5,000 (US$78.95 – 263.16). Overall, about three-quarters of the enterprises have average sales revenues of over ETB500 (US$26.32) per week.

Figure 17. Sample Enterprise Profiles - Grid-connected SMEs

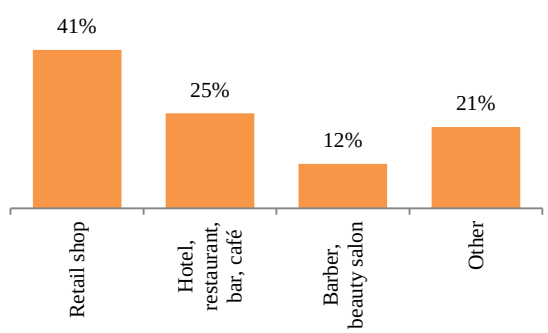


Figure 17 (a) Type of Business Enterprise

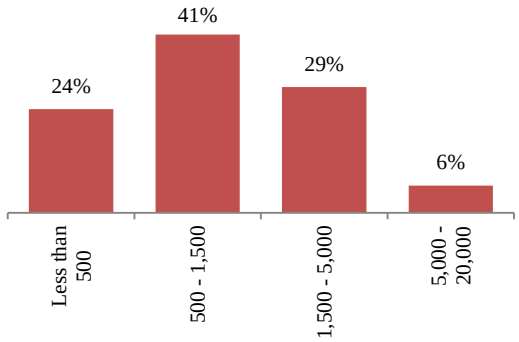


Figure 17 (b) Weekly Sales Revenue

D2. Lighting Options and Expenditures during Power Interruptions

About 60% of the sample enterprises reported that they face power interruptions about three or more times in a week. Two thirds of the respondents expressed that power interruptions occur during peak hours and that the average power outage lasts 5.3 hours. The majority of the enterprises (58%) use candles and 7% use kerosene and dry cell battery operated hand torches as their primary lighting source during power interruptions.

The main reasons reported for selecting these primary sources of lighting are 'easy accessibility' (56%) followed by 'don't know other sources of lighting' (23%). The enterprises normally light 3 candles for 2 hours and spend about ETB6.40 (US$0.34) per single interruption. This translates into a weekly expenditure of ETB15.30 (US$0.81) (based on an average 2.4 power interruptions per week). The monthly expenditure on candles by enterprises is, therefore, ETB60.00 (US$3.16) per month.

Figure 18. Frequency of Power Interruptions and Sources of Lighting - Grid-connected SMEs

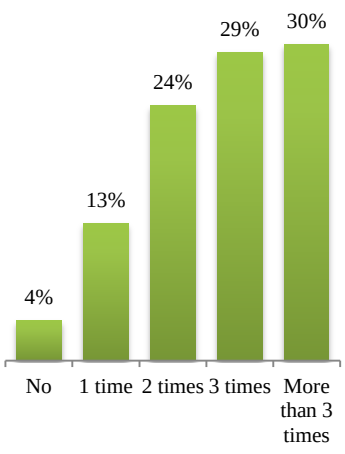


Figure 18 (a) Frequency of Power interruptions over the week before the Survey (% SMEs)

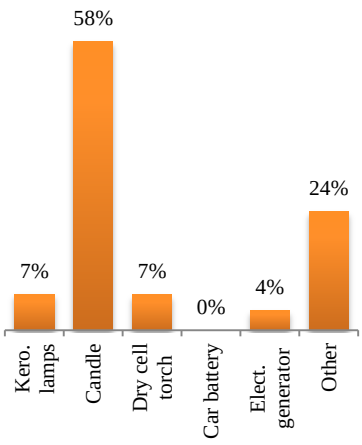


Figure 18 (b) Main source of lighting during power interruptions(% SMEs)

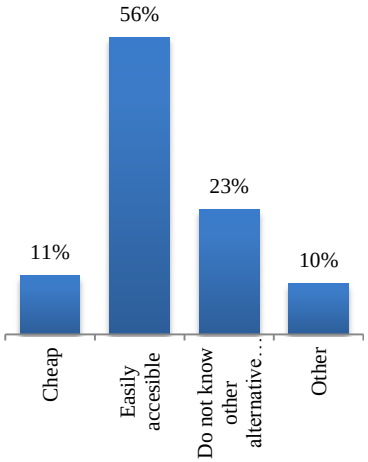


Figure 18 (c) Reason for selecting primary sources of lighting during power interruption (% SMEs)

D3. Interest in Purchasing Solar lighting Products and Preferred Payment Arrangements

Over 80 percent of the urban SMEs have expressed interest in purchasing solar-powered lighting devices. The majority of them (36%) preferred solar lanterns with mobile charging services and 28% were interested in solar home systems with the capacity of powering two bulbs, charging 2 cell phones and running 1 radio/audio cassette player. Nearly one-third preferred cash payment, and 27% preferred paying half-cash and the remaining half in 6 months credit.

Figure 19. Preffered Solar Lighting Products and Payment Arrangements

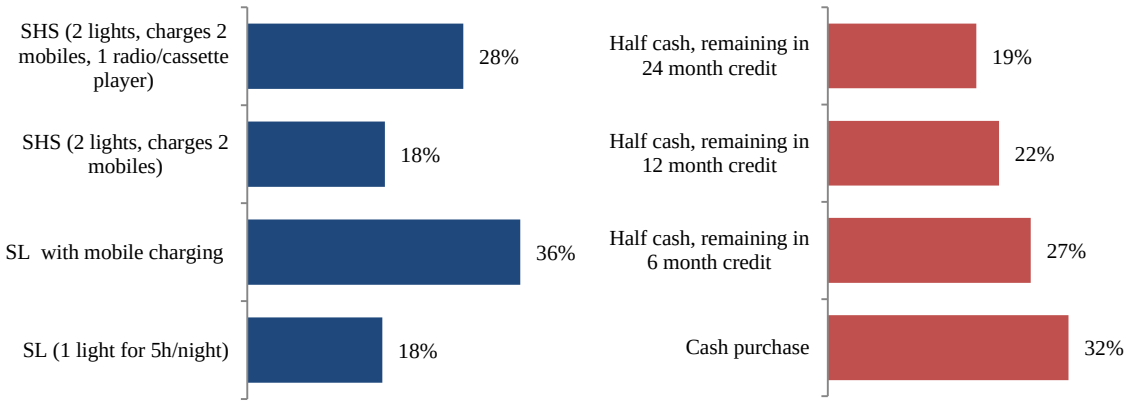


Figure 19 (a) Solar Lighting product Categories preferred by potential customers (% of Enterprises)

Figure 19 (b) Preferred Payment Arrangaments for Purchase of Solar Lanterns (% of Enterprises)

D4. Affordability and Estimates of Market size

The grid-connected urban SMEs currently spend, on average, ETB60 (US$3.16) per month on candles. At this level of spending, the payback period for the solar lanterns with or without mobile charging will be 6 months to one-and-a-half years, depending on the quality of the selected product. Also, over three-quarters of the enterprises reported having weekly sales revenues of over ETB500 (US$26.32) and a third of them more than ETB1,500 (US$78.95). It is clear from the data that the enterprises will be able to afford solar lighting systems.

The market size for solar lighting systems by the grid-connected urban retail enterprises is shown in Figure 19. The demand estimates are disaggregated by product category and region. According to the CSA, in 2008/09, there was a total of about 220,000 retail enterprises in the four survey regions and Addis Ababa of which approximately 50,000 (23%) were in Addis Ababa, 26% each in Amhara and Oromiya, 16% in SNNP and 10% in Tigray.

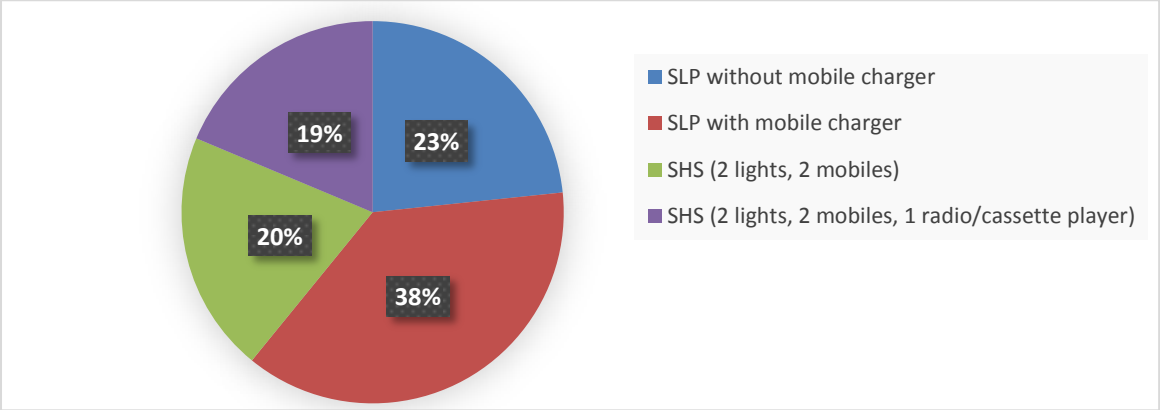
Based on these data, the demand by the retail enterprises will be in the order of 200,000 units of which the highest (34%) will be for solar lanterns without a mobile charger, while 31% of demand will be for SHSs capable of powering two lights, charging two cell phones and running a radio/cassette player. The market share for a solar lantern with mobile charging, and the SHSs running two lights with 2 mobile charging features will be about 17% each. In terms of regions, the highest demand (52%) will come from Oromiya, followed by 27% in

Amhara and 23% in Addis Ababa. Retail enterprises in SNNP and Tigray will account for 15% and 10% of the demand estimate.

E. Estimates of Aggregate Market Size

The overall solar lighting market size in the off-grid and grid-connected areas is estimated at 14 million units (Table 11). About 73% of this demand will come from off-grid rural households and 18% from grid connected urban areas. The share of small and micro enterprises (mainly retail shops, cafes, and restaurants) is estimated at 8%, of which 7% will be from those in off-grid rural areas and 1% from those in urban areas. The market share of the different product categories is shown in Figure 20.

Figure 20. Estimated share of SLP potential market by type



The market size in value terms is estimated at ETB 21,578 million (US$1,136 million) of which 38% will be for solar lanterns with mobile charging, followed by 23% for solar lanterns without mobile charging. Solar home systems without radio cassette players will have about 20% of the market share. Solar home systems with lights and charging for mobile phones and radio cassette players will have about 19% of the market.

Table 10. Estimates of Potential Market Size for Solar Lighting Systems by volume and value

Product Category	Off-grid areas		Grid-connected Areas		Total	
	Households	SMEs	Households	SMEs	Units	%
	Volume (units)					
1. SLP without mobile charger	2,271,150	349,920	597,034	60,496	3,278,599	**23.3**
2. SLP with mobile charger	3,986,259	291,600	961,079	32,032	5,270,970	**37.5**
3. SHS (2 lights, 2 mobiles)	2,114,519	165,240	567,910	29,847	2,877,516	**20.5**
4. SHS (2 lights, 2 mobiles, 1 radio/cassette player)	1,934,393	165,240	465,978	56,141	2,621,752	**18.7**
Total	**10,306,321**	**972,000**	**2,592,000**	**178,516**	**14,048,837**	**100**
%	**73**	**7**	**18**	**1**	**100**	
	Value (ETB, Million)					
1. SLP without mobile charger	681.34	104.98	179.11	18.15	983.58	4.6
2. SLP with mobile charger	3,388.32	247.86	816.92	27.23	4,480.32	20.8
3. SHS (2 lights, 2 mobiles)	3,171.78	247.86	851.87	44.77	4,316.27	20.0
4. SHS (2 lights, 2 mobiles, 1 radio/cassette player)	8,704.77	743.58	2,096.90	252.63	11,797.88	54.7
Total	**2,058.40**	**442.90**	**698.90**	**342.80**	**21,578.06**	**100**

			Value (US$, Million)			
SLP without mobile charger	35.86	5.53	9.43	0.96	51.77	4.6
SLP with mobile charger	178.33	13.05	43.00	1.43	235.81	20.8
SHS (2 lights, 2 mobiles)	166.94	13.05	44.84	2.36	227.17	20.0
SHS (2 lights, 2 mobiles, 1 radio/cassette player)	458.15	39.14	110.36	13.30	620.94	54.7
Total	**839.27**	**70.75**	**207.62**	**18.04**	**1,135.69**	100.0
%	**74**	**6**	**18**	**2**	**100**	

3.5. Stakeholders Mapping

The market uptake for solar lanterns and solar PV systems in off-grid areas greatly depends, among other factors, on how well key stakeholders play their roles. Government line agencies (at national, regional and local levels), private sector actors, financial intermediaries, non-governmental organizations and multilateral institutions need to work in a coordinated manner to make good quality solar lighting products available to the end-users at affordable prices. The roles of key stakeholders in the solar lighting product market development are briefly described below.

A. Ministry of Water and Energy

The Ministry of Water and Energy (MOWE) was restructured under Proclamation No. 317/2003 to promote the development of water and energy resources in Ethiopia. It is the government organization that leads and mandates development and utilization of energy resources including the power sector and electrification programs. MOWE also promotes the development of alternative energy sources and technologies with a primary objective of increasing access to modern and clean energy services. With regard to increasing access to electricity, the Government of Ethiopia devised an ambitious rural electrification strategy containing a continuous expansion of the national grid to un-electrified towns and villages, and promotion of renewable energy technologies such as solar PV and micro hydropower in remote and scattered rural villages. To accelerate increased access to modern lighting sources by off-grid consumers, the MOWE established the Rural Electrification Fund in 2003.

B. Rural Electrification Fund (REF)

The REF was established in 2003 with the objective of extending access to electricity to off-grid rural areas through stand-alone systems or mini-grids, mainly using renewable energy technologies. The REF was designed to provide technical support and financial leverages to the private sector to lead electricity access provision in off-grid areas.

Under the REF several solar PV systems were installed to rural households and social institutions including rural health institutions and schools. By 2011 over 15,000 Solar Home Systems (SHS) and more than 900 institutional PV systems had been installed in Ethiopia. In 2012 and 2013, the REF commissioned procurement and installation of 28,000 SHS from an international supplier with local PV companies participating in the installation of systems.[20]

[20] Ministry of Mines and Energy, The Rural Electrification Fund during the interview conducted for the Ethiopian Market Intelligence study.

The rural electrification model that has been used by the REF mostly required rural consumers to be organized in the form of cooperatives, unions or associations to present their requests for lighting services through the Woreda and Regional Energy Bureaus. Procurement of systems has been done by the REF. This approach by the REF could be strengthened by involving the local private sector and contributing to the development of the market for solar off-grid products.

According to MOWE, the REF's future role will be mainly in awareness creation, promotion, and technical support provision for consumers, developers, businesses and financial mediators such as banks and microfinance institutions. The REF, in collaboration with Regional Energy Bureaus, will provide support to identify and organize rural consumers, including households and institutions, and will facilitate the means to access off-grid electricity and lighting technologies and services through the private sector. The Development Bank of Ethiopia (DBE) and selected microfinance institutions will provide financial leverages to the private sector for importation and wholesaling, retailing and acquisition of alternative energy technologies including off-gird lighting products such as solar lanterns and solar home systems.

Through it's decade of off-grid lighting experience, the REF identified major barriers and challenges that need to be resolved or will otherwise hamper a wide-scale adoption of solar lighting products in rural areas. These are:

- Users, knowingly or not, tampering with products is one of the main causes of most system failures.
- Users trying to extend the services beyond the specifications of the products usually shorten the service life of the products.
- Infiltration of inferior quality products into the market usually results in consumers' dissatisfaction due to poor performance of the products, which ultimately causes serious negative impact on the market as a whole.
- Lack of after sales services renders products useless that could easily be maintained at low cost. Much of customers' frustration is due to early failure of products.
- High expectations by customers of solar lanterns usually leads to dissatisfaction with the services they obtain from the product.
- Most importantly, poor market distribution channels for solar lanterns and solar home systems make product prices very high and efforts by promoters unsustainable.

Many of the challenges mentioned above can be easily overcome by educating customers about the proper handling of products. A simple 'Users' Guide' with pictures and written in local languages will help avoid most of these problems. Recognizing the impact that the Lighting Africa program had on increasing the adoption rate of solar lanterns, the REF suggests that the Lighting Africa program support should be extended beyond solar lanterns to also include bigger solar home systems, particularly in relation to quality assurance of products. The REF also suggested that government line agencies such as the Ministry of Water and Energy, the Ethiopian Conformity Assessment Enterprise and the Ethiopian Standard Agency together with the private sector and promoters of solar technology need to develop standards and benchmarks that are appropriate to Ethiopia.

C. Regional Water and Energy Bureaus

The government organizations in the regions responsible for alternative energy technology promotion, including solar lighting products, are Water, Minerals and Energy Bureaus or Agencies. Activities and programs of the Bureaus are more or less similar in all regions. The main programs that are under implementation by the Regional Energy Bureaus include dissemination of improved cook stoves, domestic biogas plants, rural electrification in off-grid areas using stand-alone solar home systems, solar lanterns, and installation of institutional PV systems in rural schools and health posts. In areas where the resources and demand meet, micro hydropower development activities are also being promoted by the Regional Bureaus. In collaboration with the Ministry of Water and Energy, under the REF program, the Bureaus are implementing a Rural Electrification Program in off-grid areas using solar PV with funding sourced from the World Bank[21].

Energy Bureaus in all regions believe that solar home systems and solar lanterns are the most appropriate solutions to provide electricity and lighting for households and businesses in off-grid rural areas where grid connection will not be realized in the near future. The simplicity of the technology and the availability of the solar resource in abundance all over the country make solar lighting products a most suitable solution.

The most important challenges and barriers to solar PV and lantern marketing as identified by the regional energy bureaus include:

- Absence of credible solar home system or lantern suppliers in the regions that would provide warranties and after sales services for the products.
- Prices of solar home systems are still not affordable for the majority of households in off-grid areas.
- Replacement of parts such as batteries and other balance of system for Solar Home Systems are not easily available to users. This was confirmed by consumers who had adopted solar home systems and were interviewed during the study.
- Undeveloped market channel for solar lanterns - users have to travel to towns to obtain solar lighting products or services.

Suggestions made by the Regional Energy Bureaus to overcome the challenges specified above include:

- Develop a well defined aftersale structure.
- Develop local technical capacity for after sales services, mainly for minor maintenance and replacement of parts.
- Provide loans and grants for importers/wholesalers and retailers.
- Provide access to credit for end-users to enable them to acquire solar lighting products.
- Solar lighting products need to be durable.

[21] Water, Mines and Energy Agency of the Amhara National Regional Government;
Water, Mines and Energy Bureau, Tigray National Regional Government

D. Importers, Wholesalers and Retailers of Solar Lighting Products

Major market players including importers, wholesalers, distributors and retailers were interviewed to identify major challenges and barriers to the scaling up of solar lighting products in Ethiopia. The time that these companies have been in the solar lighting product business varies significantly from a low of one year to a high of about eighteen years. For the medium level solar lighting product importers, solar PV accounts for over 70% of their business. Most of the companies that fall under this category have an annual business turnover in the range of ETB 10 million to ETB 15 million (US$0.53 to 0.79 million). The primary business for the larger companies whose annual turnover is over ETB 50 million (US$2.63 million) is non-solar.

Medium level solar companies supply a range of solar PV products including solar lanterns, solar home systems, solar PV systems for institutions, and solar pumps. As reported by nearly all of the companies interviewed, the share of solar lanterns in their businesses has been overtaking other interests over the past two years. Each of these companies sells up to 15,000 solar lanterns annually. On the other hand, the larger companies are relatively recent entrants to the solar business and are currently wholesaling only solar lanterns.

The companies that sell solar lighting products have different marketing models for their products. Most of the companies channel their products through independent distributors and retailers. Few of them distribute their products through their own outlets distributed in different parts of the country.

Major challenges and barriers to scaled up distribution of solar lighting products as reported by the solar companies are summarized in Table 11.

Table 11. Summary of barriers identified and suggestions for scaling-up of solar lighting Systems Marketing by Companies in Ethiopia

Barriers	**Major challenges/ barriers**	**Suggestions for barrier removal**
Technical	▪ After sales service is poor or non-existent for solar lighting products. ▪ Many low quality products are spoiling the market. ▪ Product importers and distributers have little information regarding consumers' preferences for lighting products. ▪ International product suppliers and manufacturers may not be reliable in ensuring product warranties	▪ Distributors and retailers need to have some level of technical knowledge. Trained solar technicians must be available at Woreda/ district level. Regional Energy Bureaus in collaboration with the Rural Electrification Fund should provide technical capacity support to product distributors and retailers. ▪ Develop and promote standards for solar lanterns, solar PV products and installation of systems. ▪ Promoters of solar lighting products should be able to provide market information to businesses with regard to user preferences.
Financial	▪ Logistics and marketing - the marketing, branding and promotion of solar lanterns to low income consumers at the Base of the Pyramid is very difficult, as well as time and	▪ Provide access to finance to solar lighting product distributors and retailers through microfinance institutions ▪ Arrange credit facilities to make products affordable to low income consumers

	resource consuming. Most distributors and retailers at the Regional and Woreda levels are not financially capable of effectively distributing products to end-users. ▪ Foreign exchange limitation has been one of the major problems. ▪ Absence of financial support to lighting product suppliers and distributers ▪ The product price is still high for the great majority of rural dwellers. Absence of credit schemes for consumers to purchase solar lighting products	
Market	▪ Lack of effective distribution channel/ network for products. This includes limitation of existing and potential distributers for products both in terms of technical and financial capacities. ▪ Difficulty for importers to trace and track end users to ensure that products are providing the required services and that warranties for products are being effectively provided.	▪ Solar lighting product promoters including government organizations and major product wholesalers need to provide marketing training to distributors and retailers. ▪ Ensure that importers, wholesalers, distributors and retailers are effective in providing after sales services and product warranties. Costumers need to be informed about product warranties.
Awareness	▪ Low level of consumer awareness about solar lantern products and their benefits. ▪ The tendency of smaller companies to import products instead focusing more on wholesaling and retailing. Volumes of import will be smaller and import price per unit will be higher.	▪ Promoters of solar lanterns including concerned Federal and Regional offices should promote solar lanterns in remote rural areas ▪ Increase number of wholesalers and retailer as compared to importers ▪ Educate Regional and Woreda level government offices on how to provide support to businesses ▪ Government agencies should streamline bureaucratic procedures to provide required supports to business.
Policy	▪ Poor quality products are affecting the market. Low quality products look very similar to products that meet LA's Minimum Quality Standards ▪ Prices of solar lighting products are still high for consumers at the bottom of pyramid. Without appropriate credit facilities the majority of off-grid communities cannot access modern lighting services	▪ Government needs to control poor quality products ▪ Microfinance institutions need to be made aware of solar lighting products and encouraged to provide loans to consumers. ▪ Encourage local manufacturing of solar lanterns and other solar components through provision of access to finance, land and other necessary facilities.

E. Consumers

Information

The rural population's general awareness of solar lighting products is limited and can be further increased with mass information campaigns through TV and radio. However, the more effective channel for actually selling products is through demonstrations to consumers. Focus groups and household surveys for this assessment, as well as discussions with stakeholders have confirmed that the volume of sales is correlated with such demonstrations. Demonstrations can be made by retailers with assistance from importer-wholesalers and sector support organizations such as the REF and GIZ. Promotion and demonstration resources and methods should also be developed and distributed in cooperation with sector support organizations.

Consumers need to be informed about the choices available to them, their costs, and what quality assurance and warranties they can expect. Although products that have met LA's Minimum Quality Standards are now relatively more important in the market (for solar lanterns) as compared to products that haven't, the popularity of quality verified systems is attracting the interest of some importers and distributors for similar looking (and in some cases almost identical looking), but cheaper systems .[22]

Solar lanterns sold in Zone capitals (Debre Birhan town, North Shewa)

The LA program should work with the stakeholders to disseminate information to enable consumers to recognize lighting systems that have had their quality tested and meet LA's Minimum Quality Standards. This is easily achieved through the media (TV and Radio). Ensuring that retailers of products that meet LA's Minimum Quality Standards explain and

[22] Stakeholders need to inform the public about what constitutes good quality – for example, there are misconceptions about products which don't weigh much, which some consumers associate with poor quality (non durability) thus choosing lanterns with older batteries.

provide the 2-year warranty that accompanies them, will also give distinction to these products (these warranties do not appear to be properly explained and executed at present, see discussion below).[23]

Product descriptions and guidelines need to be translated into local languages. Currently, product descriptions and user guides are provided by manufacturers in English (on container boxes and in leaflets inside boxes). Translation will enable retailers to provide reliable and consistent information to consumers, and consumers will get the most out of their systems. Translations should be consistent for similar models distributed by several importers.

Consumer desire for solar lighting products is high in rural areas; yet actual demand for products will be lower than that expressed by potential consumers. Such demand information can be collected by retailers and their agents (through demonstration campaigns and other means) and passed up the supply chain to the importers. This information can be used to determine import and distribution volumes and for proper management of stocks by all in the supply chain.

Protection (warranties)

Two-year product warranties are available from manufacturers of solar lighting products that meet LA's Minimum Quality Standards and are distributed in Ethiopia.[24] There are several issues that need to be addressed for these warranties to be effective:

a. *Warranties should be written in local languages*. Warranty cards distributed with lighting products that meet LA's Minimum Quality Standards are now all in English; they are understood by neither the consumers nor the retailers. Translations of the warranty information must be consistent for each product (although they can originate from different importers). Translations should be available in at least in three languages: Amharic, Oromiffa, and Tigrigna (the official languages of the four regional states).
b. *Warranty labels on products should be indelible and last for the entire warranty period*. This should be consistent across products. The warranty label for one lantern, for example, is defaced after only a few months of use (printed ink on paper) whereas the label for another will easily last the life of the lanterns.
c. *Each customer must be told of the warranty and its conditions, and then each warranty form must be completed and presented to the consumer upon purchase*. It appears that purchasers are often not told of the warranties and their conditions. Warranty documents are generally not completed by the retailers upon sale.
d. *It is good practice to keep copies of the warranty information with retailers*. Some products have two warranty forms, one for the customer and the other for the retailer, while others have only one. Two forms are recommended; a consumer warranty card can be printed for products that do not have two forms. Warranty cards remaining with the retailer can include additional consumer data (such as reasons for purchase), which suppliers can use for marketing purposes.

[23]Exemption of duties for products which meet LA's Minimum Quality Standards is one protection for such counterfeiting (because duties for products that have not, will increase delivered costs making them less competitive).
[24]These warranties are for replacement of systems for manufacturing defects.

e. *Warranties must be traceable to the supplier*. Suppliers must keep serial numbers for each product they sell for warranties to be effective. Some importers are putting their labels on each product (name and contact address for importer) – this is good practice that other importers should follow.

f. *There are uncertainties about validity of warranties*. Warranties are provided by manufacturers for product defects for a period of two years. However, long import and distribution delays can result in a product reaching the consumer 6 to 12 months later. Thus, it is unclear when the warranty period of two years begins – upon leaving the manufacturer, or upon purchase by end user?

F. Microfinance Institutions

The major regional microfinance institutions in the survey regions have a wide presence in terms of geographic and client outreach. The major MFIs have branch and sub-branch networks in all Woredas and most of the Kebeles in their respective regions. Loan products, requirements for loan eligibility, and interest rates are very similar among the microfinance institutions operating in the survey regions.

The MFIs have expressed a strong desire to be engaged in the financing of solar lighting products. Nevertheless, they have identified challenges related to loans provided for technology adoption. Failure of products (such as farm machinery, water pumps) are the main causes of disagreements between product suppliers and users. It is not easy to determine whether product failures are due to improper handling by users or due to factory defects. These challenges usually result in delay or failure to repay loans. Similar challenges could be faced with the financing of solar lighting products. To overcome this challenge, the MFIs suggested:

- The Ministry of Water and Energy and Regional/Woreda level Energy offices and suppliers of solar lighting products should provide users information with regards to proper product handling;
- Suppliers and retailers should provide product warranties and after sales services;
- Support organizations, in collaboration with concerned government organizations, need to ensure that financing is made available to suppliers who would provide quality products and extend the warranties to end-users.

G. Promoters (Bilateral, multilateral and NGOs)

United Nations Development Program (UNDP)

The UNDP's energy initiative has three distinct objectives – ensure access to modern energy services, double the global rate of improvement in energy efficiency, and double the share of renewable energy in the global energy mix. In the last regard, Ethiopia is part of the UNDP initiative, but has not yet been selected as a pilot country for implementation. At a national level, the UNDP supports the Climate Resilient Green Economy initiatives of the Government by programmatizing levers that are identified as low-hanging fruits, which includes the Ministry of Water and Energy's cookstove program. The UNDP also provides general energy support to the Ministry of Water and Energy in reviewing the energy policy, which currently is under development.

The UNDP does not have a program specifically designed for promotion of solar PV systems or lanterns in Ethiopia. However, under the GEF small grant funds, which mainly were to support livelihoods, solar PV systems were installed in some areas of the country (Harar, Somali and Afar) to improve social services particularly in rural schools and health institutions, and also to power community water supply systems. Benefits were also extended to households in the form of a revolving fund with a matching equity from households, to adopt solar home systems. Another phased out project that the UNDP supported in the Metama area in the Amhara Region, released funds for households to acquire Solar Home Systems. It triggered increased adoption of Solar Home Systems by households in the communities. In the future, the UNDP under the GEF-5 program plans to support the Ministry of Water Energy in implementing the solar and cook stove programs. The program is not yet approved.

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

GIZ is a German bilateral organization that provides technical support to various sectors in collaboration with government ministries. The GIZ Energy Coordinating Office (ECO) works with the Ministry of Water and Energy, line Regional Government Organizations, local and international development organizations, communities and the private sector in market development and promotion for cooking, lighting and electrification technologies. With regard to rural electrification, interventions by GIZ ECO focus on institutional PV systems for rural health institutions and schools. GIZ provides support in the establishment of infrastructure for products and services. GIZ sees lack of skilled technical capacity for solar PV systems in the country. To fill this gap, the strategy GIZ follows is capacity development in the solar PV sector through pilot demonstrations.

4. Summary

The market for solar lighting products is quite high in Ethiopia as more than 85% of rural households rely on fuel-based lighting sources and better backup lighting sources are highly demanded by grid connected urban households and businesses. A substantial proportion of the off-grid and on-grid households stated that they were interested in buying solar lighting products. However, effective promotion and financing will be required to turn the potential market into effective demand.

The supply chain is developing but is still not adequetly providing sufficient services to consumers. Distributors need to provide sufficient after sales services and adequate information on warranties and product performance in order to gain consumers' trust in both the product and the services.

Product prices are still high for the greater majority of rural dwellers. Consumer financing through MFIs is being facilitated by the government of Ethiopia and the LA program but is not yet fully functional at the moment. Lack of adequate consumer financing is suppressing effective demand for lighting products particularly in off-grid areas. A financing gap among retailers was also observed in the product market chain. DBE finances at the supplier level and MFIs can finance consumers. Retailer fianancing does not seem to gain the attention of promoters at the moment.

For removal of observed challenges and barriers in the solar lighting produt market, all players including govenemnt, technology promoters, and private product suppliers and distributers need to play their level best to ensure product quality and standards, raise consumers awareness, provide support in building effective market chains, provide proper after sales services and inform consumers about the proper utilzaiton of products, and pass product warranty to consumers.

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ANNEX A
SAMPLING METHODS

SAMPLE SIZE AND DESIGN

The sample sizes of households and businesses was determined by considering both the need to have reasonable representativeness to make the market research valid and to meet the time schedule and budget.

A four-stage random sample selection process was employed for the market survey in rural and peri-urban areas. The first stage involved selection of sample **Zones** in the target regions (Amhara, Oromiya, SNNP and Tigray). The second stage was selection of **Woredas** (Districts) from the sampled zones in the first stage, the third stage was selection of **Kebeles** and the fourth stage was selection of **households**.

In order to ensure geographic representativeness of the market survey within the four regions, two or more sample zones from a region were suggested, with a mean of four zones per region or 16 sample zones in total. In the same way, two sample districts (Woredas) were suggested to be drawn from each sample zone. This gives a total of 32 sample Woredas. Similarly, two sample villages (Kebeles) were selected at random per sample Woreda.

Table 1. Sampling Assumptions and Estimates (Households without grid electricity)

Stage of Sampling Process	Assumptions	Sample Size Estimate
First	Depending on variation within a region, **two or more zones** can be selected from a region.	• 4 Regions, mean of four Zones per region • Sample**=16 Zones**
Second	**2 districts** (Woredas) to be selected from each zone.	• Sample Woreda per Sample Zone = 2 Woredas • Sample Woreda **= 32 Woredas** (2 x 16 Zones)
Third	**2 Kebeles** (Villages) to be selected from each Woreda/district.	• Sample Kebele per Woreda **= 2** Sample • Sample **= 64 Kebeles** (2 x 32 Woredas)
Fourth	From each Kebele about the same number of households will be selected. 20 households suggested.	• Sample 20 households/Kebele • Sample 22 households/Kebele (accounting for 1.10 non-response) • Sample Households = 1,408 (22*64 Kebeles)

From each Village (Kebele) a sample size of 22 households was estimated, accounting for a 10% non-response rate. The total sample size of the market survey in the rural and peri-urban areas is thus 1,408 households. The sample households by region will be selected with probability proportional to size (PPS) using the number of households who use kerosene as their primary source of energy for lighting as a measure of size. Table 2 gives the distribution of sample households by region, kebeles, woredas and zones.

Table 2. Sample household size in off-grid areas and breakdown by region

Region	HHs using kerosene for lighting		Sample Size (HHs)	Sample Kebeles	Sample Woredas	Sample Zones	Total Zones	Sample Zones as a % of total
	Number	%						
Amhara	2,643,525	29.23	396	18	9	4	10	40
Oromiya	3,652,229	40.39	528	24	12	6	14	43
SNNP	2,111,925	23.35	352	16	8	4	21	19
Tigray	635,604	7.03	132	6	3	2	5	40
Total	**9,043,283**	**100**	**1,408**	**64**	**32**	**16**	**50**	**32**

The sample households in each Kebeles or village are selected at random. The number of households in each sample village will be obtained from the local administration or from Agriculture or Health offices. The ratio of the sample of households will be calculated by dividing the sample size by the total number of households in the village. The survey enumerator will first select one household at random within the sample village, and then walk through the entire village taking every n^{th} household encountered.

The sample size for grid connected urban areas is estimated at 600 households. As is the case with the off-grid areas, the sample distribution by regions is based on the proportion of urban households. The sample size per sample town is set at 30 households. This gives a total of 20 sample towns.

Table 3. Sample household size in grid connected areas and breakdown by region

Region	Urban Households		Sample HHs	# of Sample towns	Selected sample towns
	Number	%			
Amhara	559,076	22.10	120	4	Bahir Dar, Gondar, Dessie, Debrebirhan
Oromiya	821,808	32.49	180	6	Adama, Jimma, Bishoftu, Shashemene, Assela, Nekemte
SNNP	336,104	13.29	90	3	Hawassa, Hosaena, Dilla
Tigray	199,455	7.88	60	2	Mekelle, Adigrat
Addis Ababa	613354	24.25	150	5	Bole, KolfeKeranyo, Yeka, Addis Ketema, Kirkos
Total	**2,529,797**	**100**	**600**	**20**	

The sample size for small and micro enterprises in grid-connected areas is estimated at 315. This sample will be distributed by regions and is based on the proportion of urban households.

QUESTIONNAIRE AND CONDUCT OF THE SURVEY

1. Different sets of questionnaires were developed for off-grid rural households, SMEs, and grid-connected urban households. The households questionnaire was designed to collect the following information:

- socioeconomic profile including household demographics, living conditions, asset ownership, consumption expenditure, sources of income, credit standing and history,
- current energy usage and expenditure for lighting,
- activities done using the current lighting sources,
- advantages and disadvantages of current lighting sources,
- satisfaction with current lighting solutions,
- awareness of photovoltaic home systems,
- consumer preferences,
- purchase decisions,
- willingness to purchase solar lighting solutions, and
- ability to pay for solar-powered lighting products.

2. After initial drafts the questionnaires were pre-tested both in the Ada'a Woreda of the Oromiya region and in Addis Ababa. The final questionnaire was revised based on lessons learned from the pre-tests. Adjustments and additions were made to various sections including on income and expenditure, energy consumption, expenditure for lighting, and awareness and willingness to purchase solar lighting systems. The final questionnaires were then translated into Amharic.

3. A total of six survey teams were organized to implement the field survey, and each team conducted interviews in the sampled rural un-electrified kebeles/villages. A survey coordinator at the national level provided technical and logistical support to the survey teams. The survey was conducted in May 2013. A total of 1,438 off-grid rural households were interviewed.

DATA PROCESSING

4. Completed survey forms were entered into the data entry system. Following the completion of the data entry, the national survey coordinator and the statistician checked the accuracy of data entry through means that included randomly reviewing the complete survey form and checking all records and variables in the data set against the original completed survey questionnaires. Further data cleaning was conducted using SPSS by identifying outlier values of variables by looking into frequency distributions and crosstabs. The cleaned datasets were organized in a modular structure the way the questionnaires were organized.

5. The data processing was done by first describing the data using simple frequency distributions and descriptive statistics of main outcomes. Further exploration of the data was done by carrying out appropriate statistical tools such as crosstabs.

6. The database is presented in SPSS format. The database includes identifiers for households and other survey units. The database is accompanied by a report on the overall organization and execution of the surveys, data entry, and data analysis as well as the organization of the output files. The report will contain tabulations of variables, basic

statistics of the variables including number of observations, number of missing values, mean and standard deviation, and overall results based on the collected information.

Annex B
Domestic and commercial electricity tariffs and service charges

Energy tariff – Domestic class

Range – kWh/month		Price Rate – ETB/kWh
From	To	
0	50	0.2730
51	100	0.3564
101	200	0.4993
201	300	0.5500
301	400	0.5666
401	500	0.5880
Above 500		0.6943

Service charge – Domestic class

Type	Range - kWh/month		Price Rate – ETB/kWh
	From	To	
Single Phase	0	25	1.4
	16	50	3.404
	51	105	6.82
	106	300	10.236
	Above 300		13.652
Three Phase			17.056
Active/Reactive			37.564
Minimum charge	0	20	34.197
	21	220	17.104
	Above 220		8.552
Power Factor Charge			68.369

Energy tariff – Commercial class

Active Energy Range – kWh/month		Price Rate – ETB/kWh
From	To	
0	50	0.6088
Above 50		0.6943

Service charge – Commercial class

Type	Range – kWh/month		Price Rate – ETB/kWh
	From	To	
Single Phase			14.494
Three Phase			22.558
Active Reactive			35.258
Minimum charge	0	20	34.197
	21	220	17.104
	Above 220		8.552
Power Factor Charge			68.369

Source: EEPCO, www.eepco.gov.et