



## Snapshot Assessment of the Off-grid Solar Lighting Appliance Market Opportunity in Bangladesh

**LIGHTING ASIA**  
*Catalyzing markets for modern off-grid lighting*  
**B A N G L A D E S H**

AN INNOVATION OF  
 **IFC** | **International  
Finance Corporation**  
**giz** | Deutsche Gesellschaft  
für Internationale  
Zusammenarbeit (GIZ) GmbH



A child holding a Solar Lantern, Bangladesh

© Lighting Asia Bangladesh/IFC/2014

Photos by: Noor Ahmed Gelal



## Contents

1.	Introduction	6
2.	Energy Landscape of Bangladesh	7
	2.1 Primary Energy	7
	2.2 Electricity Generation	7
	2.3 Renewable Energy and the IDCOL Solar Home Systems Program	7
	2.4 Off-Grid Electrification in Bangladesh	8
	2.5 Illustrative Payback Calculation of Pico PV Systems in Bangladesh	9
3.	Survey of Existing and Potential Pico PV System Users	14
	3.1 Selection of Areas	14
	3.2 Household/Business Survey & Sample Size	16
4.	Insights from Existing Pico PV Users	19
	4.1 General Information	19
	4.2 Socio Economic Profiles and Preferences of Households	21
	4.3 Description of the Pico PV Systems	23
	4.4 Pricing Information	23
	4.5 Issues in Pico PV System Usage	24
5.	Insights from Potential Pico PV Users	29
	5.1 General Information	29
	5.2 Socio Economic Profiles and Preferences	30
	5.3 Fuel Consumption	31
	5.4 Communication	34
	5.5 Awareness and Willingness to Pay	35
6.	Conclusion	40

## List of Abbreviations

BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
B2B	Business to Business
BPDB	Bangladesh Power Development Board
CFL	Compact Fluorescent Lamp
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOGLA	Global Off-Grid Lighting Association
IDCOL	Infrastructure Development Company Limited
IDF	Integrated Development Foundation
KWH	Kilo Watt Hour
LED	Light Emitting Diodes
MFI	Micro Finance Institution
MMCFD	Million Cubic Feet per Day
NBFI	Non-bank Financial Institution
NGO	Non-Governmental Organizations
PBS	Palli Bidyut Samity
PL	Poverty Line
PV	Photo Voltaic
REB	Rural Electrification Board
SHS	Solar Home Systems
TCF	Trillion Cubic Feet
UNEP	United Nations Environment Programme
USD	United States Dollar



## Lighting Asia Bangladesh

### About IFC

IFC, a member of the World Bank Group, is the largest global development institution focused exclusively on the private sector. Working with private enterprises in about 100 countries, IFC uses its capital, expertise, and influence to help eliminate extreme poverty and boost shared prosperity. In FY14, IFC provided more than \$22 billion in financing to improve lives in developing countries and tackle the most urgent challenges of development. For more information, visit [www.ifc.org](http://www.ifc.org)

### About GIZ

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH is an international cooperation enterprise owned by the German Federal Government, operating in many fields across more than 130 countries for mostly technical cooperation with developing countries, commissioned by the German Federal Ministry for Economic Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung) to extend development cooperation to the Government of the People's Republic of Bangladesh. GIZ is working for sustainable development, with worldwide operations to promote complex reforms and change processes, often working under difficult conditions. One of its major objectives is to promote renewable energy and energy-efficient technologies in priority partner countries like Bangladesh. For more information, visit [www.giz.de](http://www.giz.de)

### About Lighting Asia Bangladesh Program

Lighting Asia Bangladesh, a joint IFC and GIZ program, aims to provide access to lighting in off-grid areas by catalyzing the private sector driven Pico PV systems market in Bangladesh. Lighting Asia Bangladesh forms part of the program partners' wider efforts to provide cleaner, safer and better lighting options to the off-grid communities across Bangladesh. Out of 160 million in Bangladesh, approximately 70 million people do not have access to grid electricity and another 60 million have unreliable grid connections. The off-grid and underserved communities are meeting their lighting needs by burning fossil fuels like kerosene and diesel that are inefficient, uneconomical, unhealthy, environmentally damaging and dangerous. Lighting Asia Bangladesh aims to address this problem by displacing the use of fossil fuels with quality Pico PV solar lighting devices and other appliances through the private sector.

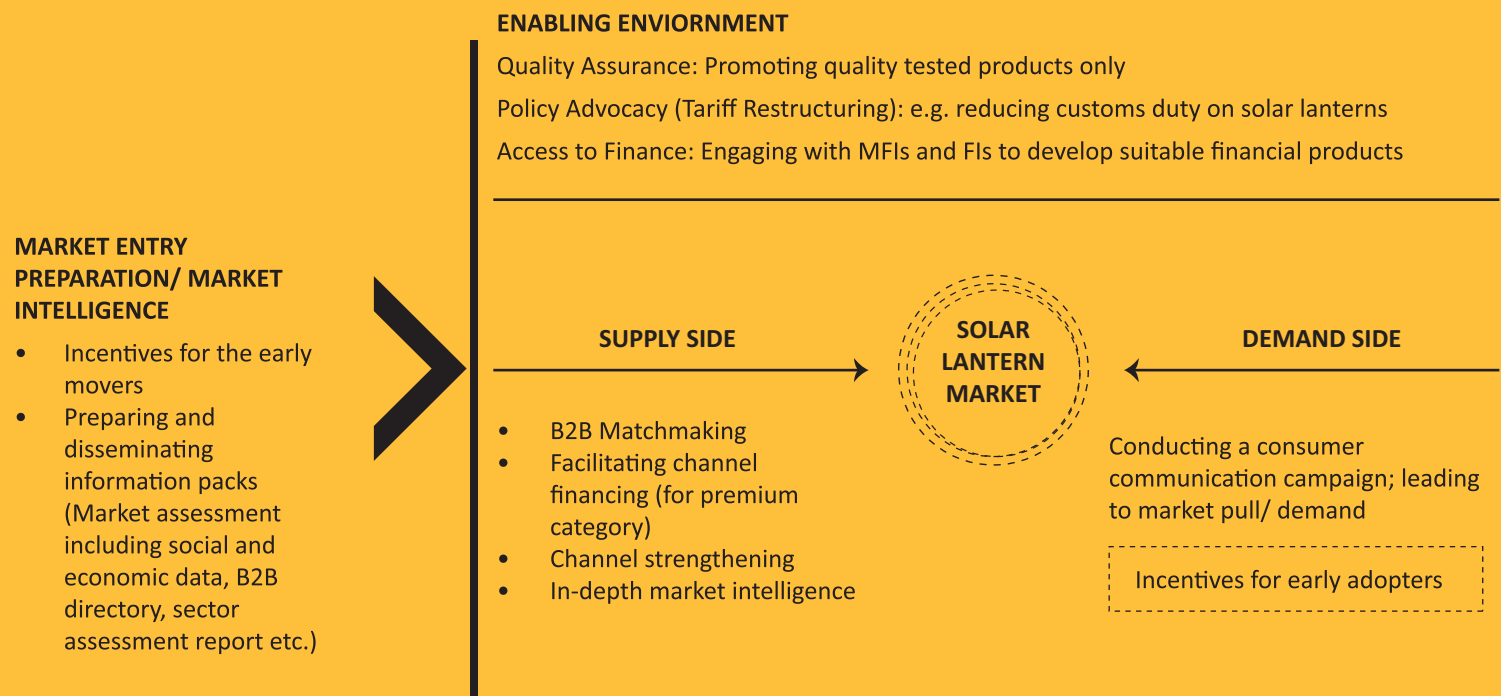
### About Lighting Global

Lighting Global is the World Bank Group's platform to support sustainable growth of the international off-grid lighting market. Through Lighting Global, the World Bank Group collaborates with the Global Off-Grid Lighting Association (GOGLA), manufacturers, distributors, and other development partners to support growth of the off-grid lighting market as a means of increasing access to energy. Lighting Global supports the regional Lighting Africa and Lighting Asia programs, which catalyze and accelerate development of markets for high quality, affordable, solar lighting products. The regional programs work along the supply chain to reduce market entry barriers and first mover risks. For more information, visit [www.lightingglobal.org](http://www.lightingglobal.org)

### IFC Disclaimer

This publication may contain advice, opinions, and statements of various information providers and content providers. IFC does not represent or endorse the accuracy or reliability of any advice, opinion, statement, or other information provided by any information provider or content provider, or any user of this publication, or other person or entity.

# Lighting Bangladesh Program Framework







## 1. Introduction

This snapshot assessment sets out both the great need for Pico PV solar lighting appliances in both off grid and under electrified areas of Bangladesh, as well as the significant market potential for these lighting appliances.

Pico PV solar lighting appliances or systems are characterized by the portability of the device with the battery in the same casing as the luminaries which are usually light emitting diodes (LEDs). They are sometimes referred to as solar lanterns. The typical wattage of Pico PV systems can range from 0.25 Watt peak to 10 Watt peak or more. Multifunctional Pico PV solar lighting appliances offer functions over and above lighting, like mobile phone charging or the capacity to power a small radio.



Figure 1a: dlight design



Figure 1b: Greenlight Planet Inc

This snapshot assessment has been arranged into two broad components. The first component provides a brief overview of the existing energy landscape in Bangladesh, summarizing the energy generation by type and the off-grid electrification status. This sets the context for where the gaps in electrification are and where the market potential for Pico PV solar lighting appliances may lie. An indicative high level analysis of the potential payback period for the appliances has been included for illustrative purposes.

The second component details the methodology and results of a consumer survey, which sheds light on possible consumer preferences for both existing and potential future users of Pico PV solar systems.

The Pico PV market in Bangladesh is at a nascent stage with only a couple of companies operating in a limited geographic and target market context. The market potential remains significant and more companies are likely to enter the competition. This snapshot assessment has been prepared to help stakeholders dealing in Pico PV solar lighting appliances in Bangladesh to better understand existing opportunities. It includes indicative consumer preferences for these products, which were assessed by way of a market survey in 2013.

## 2. Energy Landscape of Bangladesh

The energy sector in Bangladesh is capacity constrained both in terms of energy resources and energy commodities. A key natural resource of Bangladesh is natural gas, used for the generation of electricity, the production of fertilizer, for various industrial uses, for household cooking and to power vehicles. The country also has large and as yet unexploited coal reserves. Access to electricity (including to renewable energy) has increased from 45 percent of total population in 2008 to 62 percent in 2014 with the per capita generation (including captive) increasing from 225kWH in 2008 to 321kWH in 2014 (Ministry of Power, Energy and Mineral Resources). According to the Bangladesh Energy Regulatory Commission, in April 2013, 56 percent of total generation came from state-owned power plants and the remaining portion generated by the private sector.

### 2.1 Primary Energy

In Bangladesh, primary energy sources consist of natural gas, petroleum, coal, and hydro-electricity. Currently, the country is undergoing an acute shortage of primary energy and is not able to meet the growing demand across households, industrial and power sectors.

In 2012, natural gas accounted for 76 percent of the total consumption of commercial energy used. Natural gas is also the largest contributor as a source of fuel in the power generation of the country with a share of about 80 percent in the fuel mix in July 2012 to February 2013.

Currently, the demand for gas by all the sectors is more than 2,500 million cubic feet per day (mmcf), whereas the supply of gas is at just above 2,200 mmcf (December, 2012). While there are unconfirmed estimates that there are more gas reserves, even if these reserves were taken into account, they would only be sufficient to meet demand under existing consumption until 2020. Petroleum products constitute about 22 percent of the total commercial energy used in the country as of 2012. The total coal reserve in five coal fields in Bangladesh is estimated to be 2.9 billion metric tonnes. Assuming a modest recovery rate of 30 percent, the available reserve would translate to about 20 tcf of

natural gas equivalent. Currently, only 2 percent of total commercial energy comes from coal and about 3 percent of the total power generation capacity is based on coal.

### 2.2 Electricity Generation

The generation capacity of Bangladesh as of August 2014 was 10,445 MW (including 500 MW of imported energy). Total consumers have increased from 10.8 million people in 2008 to 14.2 million in November 2013. The distribution lines have increased from 256,000 km to 290,000 km. According to the Bangladesh Power Development Board (BPDB) master plan 2008, the total required power generation is estimated to be around 24,000 MW in year 2021, over twice the 2014 capacity.

Electricity coverage in Bangladesh is among the lowest in South Asia. Prices for electricity and gas services are generally set below the cost of provision.

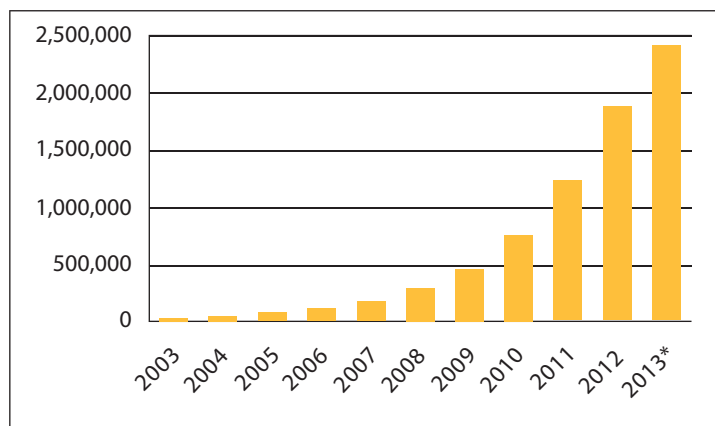
### 2.3 Renewable Energy and the IDCOL Solar Home Systems Program

The present share of renewable energy is only around 2.5% of generation. The country has made significant progress in promoting solar energy through the countrywide Solar Home Systems (SHS) program promoted by the Infrastructure Development Company Limited IDCOL and other solar energy-related endeavors. The majority of the renewable energy based power generations have mostly been initiated in the off-grid areas and have only met the need for basic electricity usage. The Renewable Energy Policy 2008 seeks to encourage renewable energy-based projects and envisions up to 10 percent of total power generation coming from renewables by 2020, which, based on the BPDB master plan of 2008, means approximately 2,400 MW electricity will have to be produced from renewable energy sources.

Among the renewable energy sources, solar energy is the most used and fastest growing source in Bangladesh. Solar energy has shown the most potential for growth in recent years as shown in the following figure.



Figure 2.3.1: Cumulative SHS installation 2003-2013(\* up to July)



Source: Infrastructure Development Company Limited (IDCOL)

The Solar Home Systems (SHSs) program led by IDCOL, a non-bank financial institution (NBFI), has proven to be successful in Bangladesh. Up to April 2014, about 3 million Solar Home Systems (SHSs) had been installed under the program. As the Figure 2.3.1 illustrates, the cumulative number of SHSs installation is exponential. As of September 2014, more than 65,000 SHSs were being installed every month under the program with an average year to year installation growth rate of 58%.

However, even the fast growing SHSs program is not sufficient to meet the energy access needs in Bangladesh.

#### 2.4 Off-Grid Electrification in Bangladesh

Bangladesh has a population of 160 million of which 90 million people are served with grid electricity. The remaining 70 million people remain unserved. Of these, 15 million people have access to SHSs (3 million households use SHS). While possible grid expansion in the next three to five years or the SHS program expansion may serve another 30 million, 25 million people are likely to remain off grid.

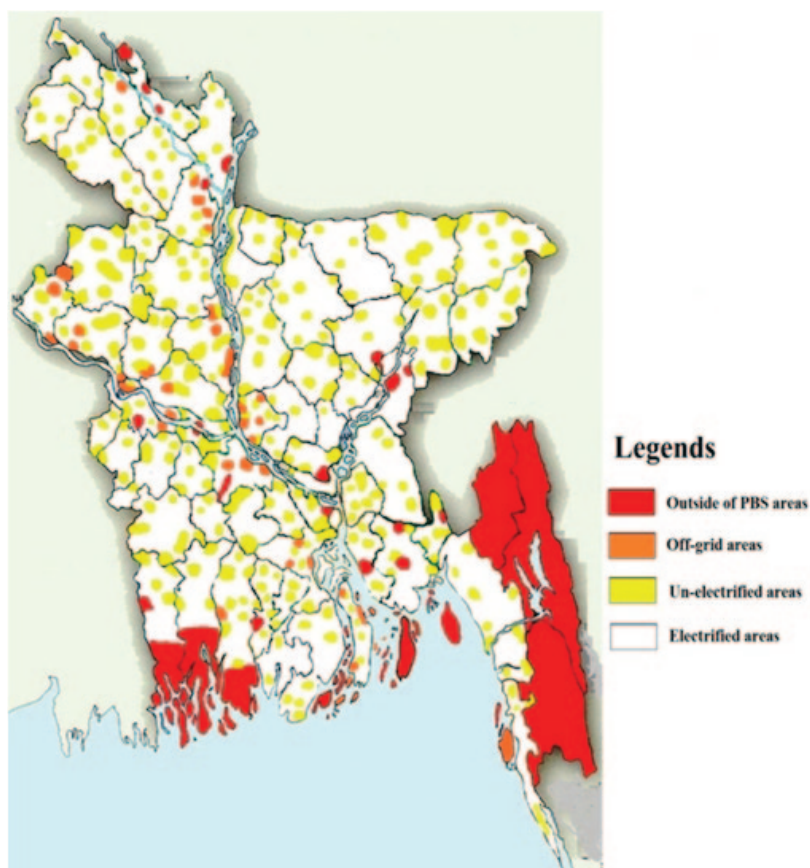
The survey methodology which was used by Lighting Bangladesh to identify the target market gives some geographical insight into the off-grid electrification status. Based on maps provided by the

Rural Electrification Board (REB) and generated by 72 operating rural electrification cooperatives, the Palli Bidyut Samity (PBS), four categories of areas can broadly be categorized as i) electrified, ii) un-electrified, iii) off-grid, and iv) outside of PBS remit (rural electrification cooperatives). Un-electrified, off-grid and outside of PBS remit areas were selected as potential areas for the field surveys.

Un-electrified areas are those where electricity grids are not currently available. According to REB officials, these areas are on the rural grid network and will get access to electricity in the near future (within two to five years). Electricity is also not available in off-grid areas which by definition are not on the rural grid network. This means that electricity is unlikely to be available in these areas in the near future. However, they are identified in PBS maps, suggesting that the REB may expand the grid to cover these areas at some point in time. Outside the PBS areas are areas which are not identified in PBS maps. This means that the rural grid network is unlikely to expand to these areas in the foreseeable future. The four categories of areas are shown in figure 2.4.1.



Figure 2.4.1: Outside PBS, off-grid and un-electrified areas in Bangladesh



Source: PalliBidyutSamity (PBS) and REB

## 2.5 Illustrative Payback Calculation of Pico PV Systems in Bangladesh

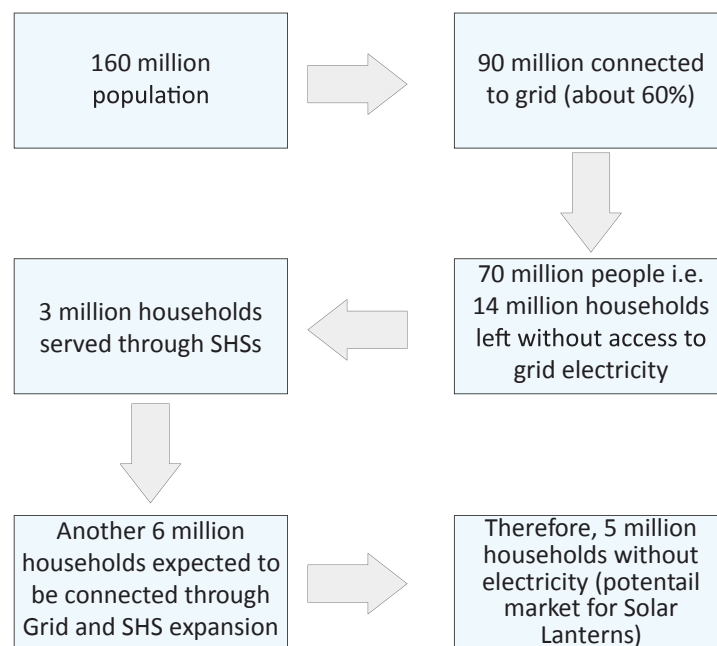
According to UNEP's 'Country Lighting Assessments', the pay-back period of solar lanterns is six months in Bangladesh although according to the calculation shown below, the weighted-average payback period may be as short as five months. The main reason for a quicker pay-back period in Bangladesh compared to, for example, India, is the higher cost and smaller

subsidy of kerosene in Bangladesh which is sold at USD 0.8 per liter. Assuming 1.5 liters of kerosene usage per month per kerosene lamp ("kupi" in Bangladesh) and two liters of kerosene usage per hurricane kerosene lamp per month, the pay-back period is given in the following table.

Table 2.5.1: Comparison of pay-back period of solar lanterns in Bangladesh and India

Product price range (USD)	Equivalence with kerosene lamps	Kerosene usage/ month (L)		
			Kerosene cost (USD)	Payback period (month)
Budget (8-18)	3 kupis	4.5	3.6	2-5
	2 hurricanes 4	3	.2 3	-6
Medium (35-40)	8 kupis	12 9	.6 4	
	5 hurricane	10 8	5	
Premium (90 - 100)	12 kupis	18 1	4.4	7
	8 hurricanes 1	6	12.8 7	
Weighted average 1			0.82 5	

Bangladesh has a population size of 160 million out of which, only 90 million people are served with grid electricity. That means, assuming around five members per household, another 14 million households are left unserved. Out of this, 3 million households are now served through the SHSs. Keeping in mind the possible grid expansion or SHS expansion might serve another 6 million households in the coming years, there is still a market of 5 million households that will be without electricity in the foreseeable future (without factoring in the present population growth rate in Bangladesh of 1.2% (World Bank Data 2013)). This is in addition to 60 million people who have intermittent access to energy due to unreliable grid access and are therefore also potential customers of Pico PV systems.





# **Survey Methodology**







### 3. Survey of Existing and Potential Pico PV System Users

The objective of the survey was to determine the potential size of the market and household level appetite for Pico PV systems including current energy usage and household expenditure on fuel for lighting. The survey was conducted to assess user satisfaction and experience amongst existing Pico PV Systems users as well as to identify the opportunities and difficulties associated for them with these systems. The survey with potential users explored willingness to pay, awareness and preferred payment methods. In summary, the survey sought to collect the following information:

- i) Socio-economic profile of the users of existing Pico PV systems
  - ii) Income, expenditure and savings particulars of the users
  - iii) Issues of the users with respective Pico PV systems
  - iv) Specifications and pricing terms of the existing Pico PV systems
  - v) Current energy usage and household expenditure on fuel for lighting
  - (vi) Household awareness of and attitude towards Pico PV systems
  - (vii) Expected facilities from solar lanterns
  - (viii) Preferred price, credit, payment method and warranty
- A total of 200 potential and 50 existing Pico PV users were surveyed from randomly selected households and businesses in the selected 21 areas out of 64 potential areas originally identified. The survey was conducted over several weeks in the first quarter of 2013.

#### 3.1 Selection of Areas

A systematic and comprehensive approach was adopted to select the areas for the study. As set out in the Off-grid section previously, 70 PBS key maps were collected from the Rural Electrification Board (REB). After thorough analysis of the maps, Bangladesh was

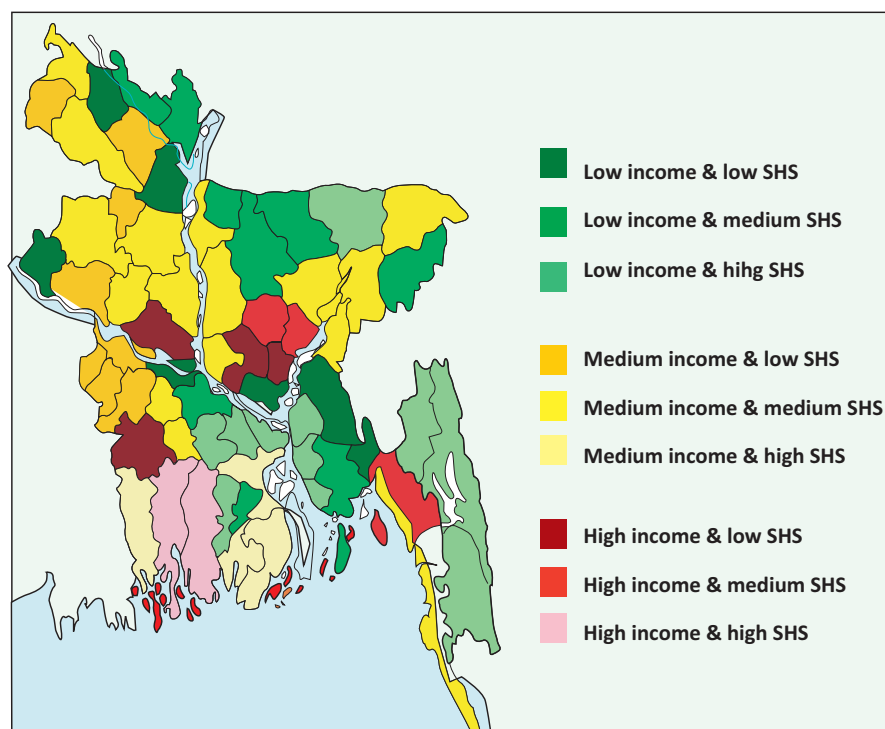
divided into four categories of areas for the purposes of the field surveys: i) electrified, ii) un-electrified, iii) off-grid, and iv) outside PBS remit. Un-electrified, off-grid and outside PBS remit areas were selected as potential areas for the field surveys. Each of these areas is explained in a previous section 2.4.

As a second step, SHS installation data were collected from the Infrastructure Development Company Limited (IDCOL) and population and income data were collected from the Bangladesh Bureau of Statistics (BBS). Income data for 2012 was then derived through projections from BBS's income data for 2005. Using SHS data provided by IDCOL and population data from BBS, SHS penetration ratios for 64 districts was calculated. The SHS penetration ratios in all the districts were divided into three categories: low (below 1.0 percent), medium (1-2.50 percent) and high (above 2.5 percent). District-wise annual per capita income data were also categorized into three categories for the purpose of the survey, which are: low (USD500-699), medium (USD700-899) and high (above USD900).

Based on the per capita income and SHS penetration, all 64 districts were divided into nine categories: (i) low income low SHS penetration areas, (ii) low income medium SHS penetration areas, (iii) low income high SHS penetration areas, (iv) medium income low SHS penetration areas, (v) medium income medium SHS penetration areas, (vi) medium income high SHS penetration areas, (vii) high income low SHS penetration areas, (viii) high income medium SHS penetration areas, and (ix) high income high SHS penetration areas. The districts with the above categories are shown in Figure 3.1.1. The low per capita income and low penetration can be viewed as the most potential areas for solar Pico PV systems.



Figure 3.1.1: Categorizing districts according to per capita income and SHS penetration



Source: PalliBidyutSamity (PBS) and REB

To determine the areas to be targeted for the survey for existing Pico PV users, the distribution of existing users was established. Though SHSs are popular in Bangladesh (about 2.25 million households and businesses are already using them), the use of Pico PV systems remains limited. GIZ has promoted about 2,000 solar lanterns in Satkhira, Khulna, Tangail and Mymensingh area. A total of 189 SHSs (10 Wp) have been installed under IDCOL's program in 42 districts. About 3,500 Pico PV systems were sold by d.light in 15 different subdistricts (upazilas) of Comilla, Noakhali and Tangail. In addition, GIZ has installed about 1,500 Pico PV Systems in Tangail, Mymensingh, Khulna and Shatkhira. Based on the level of existing users, Bhola, Satkhira and Mymensingh areas were selected for the survey.

Based on REB's classification of areas, SHSs penetration ratios, and per capita income, 21 districts were chosen out of 64 districts. While selecting the areas, it was ensured that districts were scattered evenly throughout the country in order to make the survey as reasonably representative as possible of all national regions and to avoid possible regional biases. The number of selected districts according to per capita income and SHSs penetration is provided in the following Table 3.1.1.

Table 3.1.1: Districts surveyed according to per-capita income & SHS penetration

SHS Penetration Per capita Income	Low	Medium	High
Low	1	3	2
Medium	1	6	4
High	1	2	1

### 3.2 Household/Business Survey & Sample Size

There were two broad respondent groups for this survey: existing and potential Pico PV users. A total of 200 potential and 50 existing Pico PV users were surveyed from randomly selected households and businesses in the selected areas.

Item	Existing Pico PV Users	Potential Pico PV Users
Objectives/ Information Area	<p>A questionnaire survey was conducted to analyze the impressions of the existing Pico PV Systems and to identify the opportunities and difficulties. Findings from the survey were used to assess the prospects of Pico PV systems in Bangladesh. The survey sought to collect information on the following topic areas :</p> <ul style="list-style-type: none"> <li>i) Socio-economic profile of the users of existing Pico PV systems</li> <li>ii) Income, expenditure and savings particulars of the users</li> <li>iii) Issues of the users with respective Pico PV systems</li> <li>iv) Specifications &amp; pricing terms of the existing Pico PV systems</li> </ul>	<p>The objectives of the survey with respect to potential Pico PV users was to determine the potential size of the market for solar lanterns, household attitude towards solar products, current energy usage and household expenditure on fuel for lighting. The findings from the questionnaire survey were used to assess the prospects of solar lanterns in Bangladesh. Data on the following was the focus of the survey:</p> <ul style="list-style-type: none"> <li>(i) Current energy usage &amp; household expenditure on fuel for lighting</li> <li>(ii) Household awareness of &amp; attitude towards Pico PV systems</li> <li>(iii) Expected facilities from solar lanterns</li> <li>(iv) Preferred price, credit, payment method and warranty</li> </ul>
Survey Area	<p>Until 2013, about 6,000 Pico PV systems had been sold in Bangladesh. To date, there has been no significant increasing trend in sales. Under a 10 W<sub>p</sub> PicoPV installation program led by IDCOL, a total of 189 Pico PV systems were installed in 42 districts. The highest number of Pico PV systems installed by IDCOL was in the Bhola district (32 systems, about 17 percent of total installations). Initiatives by GiZ led to the installation of a total of 1,400 Pico PV systems in Satkhira and Khulna districts; around 100 such systems have been installed in Tangail district. Furthermore, d.light design sold Pico PV systems in Tangail, Comilla and Noakhali districts. To reach the highest number of existing users of Pico PV systems through the survey, <b>Bhola, Satkhira and Tangail</b> districts were selected as survey areas for the “existing users” category.</p>	<p>To ensure that the data captures regional differences, the country is divided into two regions: the Western Region consisted of Nilphamari, Borguna, Magura, Faridpur, Sirajganj, Natore, Pabna, Gaibandha, Bogura, Bagerhat, Satkhira and Kushtia districts and the Eastern Region consisted of Chittagong, Rangamati, Potuakhali, Bhola, Barisal, Mymensingh, Narsingdi, Sylhet and Moulvi Bazaar.</p>
Methodology	<p>A total of 48 households and two businesses in three districts were approached for the survey. Each of the households/businesses was first categorized based on whether it belonged to the eastern or western part of the country. Households and businesses were then categorized into one of three groups depending on whether the area of the household and business was in then-electrified, off-grid or outside of PBS regions electrification categorization. The regions were identified as per the information collected from REB. Furthermore, households were categorized into three income groups: below lower poverty line, between lower and upper poverty line and above upper poverty line. This division was based on the income levels identified by household income and expenditure survey (HIES Report - Bangladesh Bureau of Statistics), 2013.</p>	<p>The methodology used for the survey on prospective Pico PV customers is consistent with the methodology for the survey for existing Pico PV users (regional categorization followed by electrification status categorization followed by an earnings categorization). The survey findings are summarized in the next section.</p>



# **Insights from Existing Pico PV Users**

A total of 48 households and two businesses (existing Pico PV users) in three districts were approached for the survey. Of these, 13 households did not participate as they had already returned their respective Pico PV systems due to unsatisfactory performance. The total number of responses was reduced to 37. The 37 surveyed households/businesses can be broken down into categories defined in the previous section and as shown in the table below.

Sample Distribution

Frames		Total count
Un-Electrified Areas	Below lower poverty line	0
	Between lower and upper poverty line	0
	Above upper poverty line	2
Off-Grid Areas	Below lower poverty line	0
	Between lower and upper poverty line	1
	Above upper poverty line	8
Outside PBS Areas	Below lower poverty line	3
	Between lower and upper poverty line	15
	Above upper poverty line	8
Total	Below lower poverty line	3
	Between lower and upper poverty line	16
	Above upper poverty line	18
Grand Total		37
No response		13
No. of households approached		50

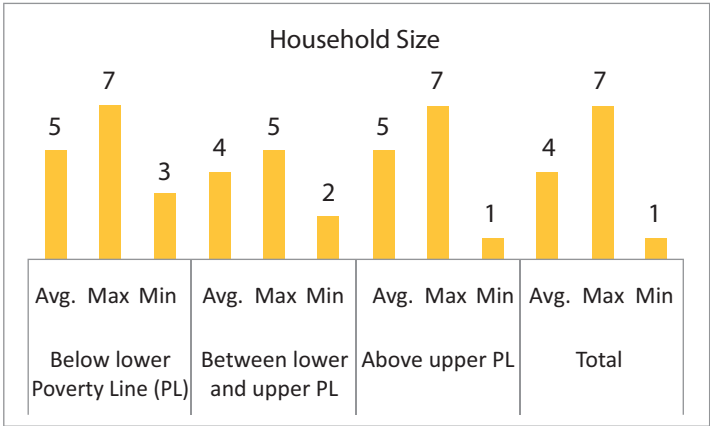
## 4. Insights from Existing Pico PV Users

### 4.1 General Information

#### Gender and Age of Respondents

43 percent of the respondents in the survey conducted were male and 57 percent of the respondents were female. The percentage of female respondents was highest between the lower and upper poverty line income groups; the percentage of male respondents was highest in the above upper poverty line income group. The average age of the respondents was about 38 years while the maximum and minimum ages were 65 and 18 years respectively. The average age of 39 years in the above upper poverty line income group was the highest among the three groups, while that of 34 years in the below lower poverty line income group was the lowest.

#### Household Size

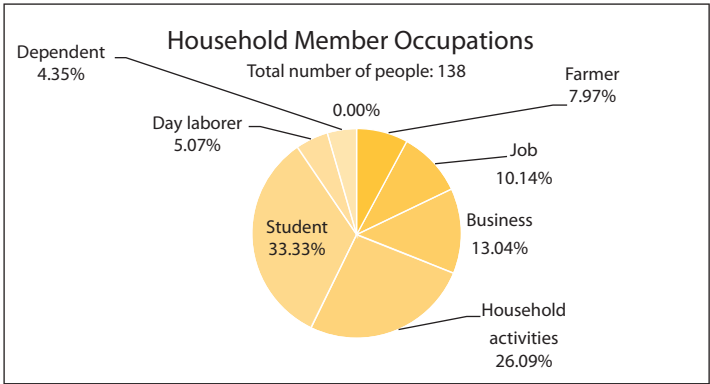


Household size particulars are shown in the graph. The average size of the surveyed households was about 4 people per household; the largest and smallest households had 7 people and 1 person respectively. The average size of households was similar across the three income groups.

#### Age Groups in Households

The 37 surveyed households comprised of a total of 138 people. The highest number of these individuals (64 percent) belonged to the working population age group (aged 17-55 years). 30 percent belonged to the dependent population age group (aged 0-16 years) while about 8 percent belonged to the senior-citizen age group (aged above 55 years). The above upper poverty line, between lower and upper poverty line and below lower poverty line age groups had respectively 33 percent, 28 percent and 4 percent of the individuals in the working population age group. Occupation of Household Members

Among the 138 people in the surveyed households, 36 percent were involved in income generating occupations (percentage of farmers, job holders, businessmen and day laborers are respectively 8 percent, 10 percent, 13 percent and 5 percent). About, 33 percent were students while 26 percent were only engaged in household chores. The above upper poverty line income group was found to have the highest percentage of income generating individuals (about 17 percent).



#### Decision Makers in the Family

In most of the surveyed households (70 percent), decisions are taken mutually by both husband and wife, while in the remaining 30 percent households, decisions are taken by the husband alone. Male dominance in decision making (about 24 percent) is comparatively higher in the above upper poverty line income group.





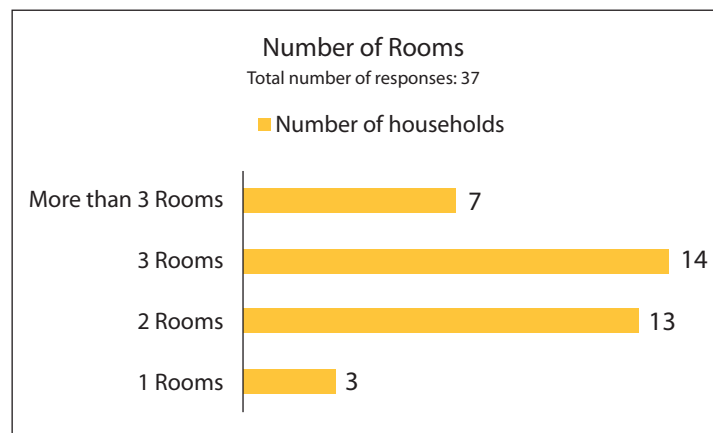
#### 4.2 Socio Economic Profiles and Preferences of Households

Socio economic profiles of the households have important implications on their decision makings and behavioral patterns toward solar lanterns. For example, most of the households that bought solar lanterns (about 89 percent) lived in houses with 1-3 rooms. This suggests that people living in smaller housing are potential customers of solar lanterns, possibly because SHSs are expensive and may be beyond their lighting needs. About 92 percent of the households that bought solar lanterns have separate kitchens and need portability for their lighting arrangements. This may suggest that customers prefer the mobility of solar lanterns over the fixed lights of SHSs.

A total of 23 households bought premium category solar lanterns; more than 52 percent of these households had high incomes (high in the context of this study-above BDT 10,000 per month) while the remaining 48 percent had medium incomes (BDT 5,001 to 10,000 per month). Most of the remaining households (13 households out of 14,) of the total sample of 37 households bought budget category lanterns; all of these households had low income (BDT 5,000 or less per month). This suggests that premium category solar lanterns are affordable for households with high and medium incomes while budget category lanterns are affordable for households with low incomes. Out of the 37 households that bought solar lanterns, 22 had monthly savings; most of these households (about 91 percent) saved more than BDT 500 per month and bought premium category lanterns. This suggests that premium category lanterns, which are more expensive, are suitable for households that have some amount of monthly savings. However, the precise choices of budget and medium category solar lanterns was not discernable from the monthly savings amounts by households, in other words, there seemed no correlation or purchasing pattern among the household's choices of either the budget or the medium category of solar lanterns based on their monthly household savings.

##### Number of Rooms in the Household

The graph below shows the number of rooms in the surveyed households. Most of the households (about 73 percent) had 2 or 3 rooms. Only 8 percent of the households had only a single room while the remaining households (about 19 percent) lived in houses with more than 3 rooms.



##### Construction Materials of Households

The survey found 70 percent of the household floors to be made of clay and 84 percent of household roofs to be made of tin. The walls of the households were made of tin (35 percent), clay (9 percent) and concrete (approximately 16 percent) with the remaining of other materials. Household construction patterns were similar across the three income groups.

##### Separate Kitchens in Households

92 percent of the surveyed households had separate kitchens; the remaining 8 percent did not.

##### Household Monthly Income and Expenditure

The table below shows the monthly household incomes of the surveyed households. About 35 percent households earned BDT 5,000 or lower each month, 32 percent households earned between BDT 5,001 to BDT 10,000, and the remaining 32 percent earned above BDT 10,000 each month. The average monthly household expenditure for all income level was BDT 8,481. The average household expenditure for the three income groups were BDT 3,000, BDT 5,250 and BDT 12,267 respectively.



Monthly household income	Number of households	Percentage of total households
5,000 or below	13	35.14
5,001-10,000	12	32.43
Above 10,000	12	32.43
Number of responses	37	100
No response	13	
No. of households approached	50	

### Household Monthly Savings

Above 59 percent of the surveyed households were found to have some amount of savings while 41 percent had no savings. Instances of savings were highest in the above upper poverty line income group while respondents of below poverty line income group had no savings. About 59 percent of the households had monthly savings above BDT 1,000. 32 percent households had monthly savings between BDT 501 and BDT 1,000 while only 9 percent had monthly savings below BDT 200. Most of the households with savings above BDT 1,000 belonged to the above upper poverty line income group; 18 percent of the households with savings between BDT 500 and BDT 1,000 belonged between lower and upper poverty line income group while about 14 percent of such households belonged to the above upper poverty line income group as shown in the following table.

Household savings ranges	Income level				Total	
	Between lower & upper PL		Above upper PL			
	Count	%	Count	%	Count	%
< BDT 200	0	0	2	9.09	2	9.09
BDT 200-BDT 500	0	0	0	0	0	0
BDT 501-BDT 1,000	4	18.18	3	13.64	7	31.82
>BDT 1,000	1	4.55	12	54.55	13	59.09
Number of responses who saved					22	100
No savings					15	



### 4.3 Description of the Pico PV Systems

#### Sources of Awareness of Systems

51 percent respondents had come to know about the Pico PV systems from Non-Governmental Organizations (NGOs) or PBSs, about 30 percent of the respondents from neighbors or relatives while the remaining 20 percent heard about the systems from local businessmen or shopkeepers. In the above upper poverty income group, the main sources of knowledge about the systems were NGOs/PBSs and local businessmen/shopkeepers (about 41 percent). In the between lower and upper poverty line income group, the major sources of awareness were NGO, PBSs and neighbors/relatives (about 41 percent).

#### Features of the Installed Lights

About 38 percent of the households had portable lights while about 57 percent had a combination of one portable and one fixed light. Only 5 percent of the surveyed households had fixed lights. About 62 percent of the households had systems with two lights while the remaining 38 percent had systems with one light. Most of the systems, about 70 percent, provided the additional feature of mobile charging. The remaining 30 percent systems did not provide any additional features, not even radio charging. 81 percent of the households were found to have LED based systems while about 19 percent of surveyed households had CFL based systems. About 68 percent of the surveyed households had systems with a capacity of 5 watts or less. The remaining 32 percent had systems with a capacity above 5 watts. About 68 percent of the surveyed households were seen to have Pico PV systems supplied by Integrated Development Foundation (IDF) while 27 percent had systems supplied by d.light; the remaining 5 percent had systems supplied by Grameen Shakti.

Most of the respondents, about 46 percent, had solar panels with a warranty period of three to five years. Only 5 percent had solar panels with a warranty above 5 years. However, about 49 percent of the respondents failed to provide any information on the warranty terms of solar panels. About 51 percent of respondents had system batteries with a warranty period of three to five years and the remaining 49 percent of the respondents failed to provide any information on the warranty terms of system batteries.

Most of the respondents, about 95 percent, failed to provide any information regarding the warranty terms of the light systems. The remaining 5 percent had lights with warranty periods of less than three years. About 24 percent of the respondents had less than three years warranty on the whole system while about 8 percent had a warranty period of three to five years. However, about 68 percent of the respondents failed to provide information regarding warranty terms on the whole system. The summarized responses are shown in the table below.

Component		Warranty terms				Total
		Less than 3 Years	3 to 5 Years	More than 5 Years	No response	
Solar Panels	Count	0	17	2	18	37
	%	0	45.95	5.41	48.65	100
Batteries	Count	0	19	0	18	37
	%	0	51.35	0	48.65	100
Lights	Count	2	0	0	35	37
	%	5.41	0	0	94.59	100
Whole system	Count	9	3	0	25	37
	%	24.32	8.11	0	67.57	100

### 4.4 Pricing Information

#### Prices of Systems Used

The following table shows the total prices paid by the respondents for their lighting systems. About 68 percent of the Pico PV systems in the surveyed households were using two light premium quality systems supplied by IDF and the systems had cost between BDT 2,000 and BDT 5,000. About 8 percent of such systems had prices above BDT 5,000 while the remaining 24 percent had prices below BDT 2,000. Households of all three income groups were seen to own a comparatively higher number of Pico PV systems with price range of BDT 2,000 to BDT 5,000. About 22 percent of the households in the above upper poverty line households had systems with prices below BDT 2,000. The overall higher penetration of Pico PV systems in the price range from BDT 2,000

to BDT 5,000 is due to the high number of subsidized Fosera lights (BDT 2,500) from GIZ and S300 from d.light in the sample of surveyed households. This does not necessarily reflect the preferred models or price range of the households.

Price range	Income Level						Total	
	Below lower poverty line		Between lower & upper PL		Above upper PL			
	Count	%	Count	%	Count	%	Count	%
<BDT 2,000	0	0	1	2.7	8	22	9	24.32
BDT 2,000-5,000	3	8.1	14	37.8	8	22	25	67.57
>BDT 5,000	0	0	1	2.7	2	5.4	3	8.11
Number of responses							37	100

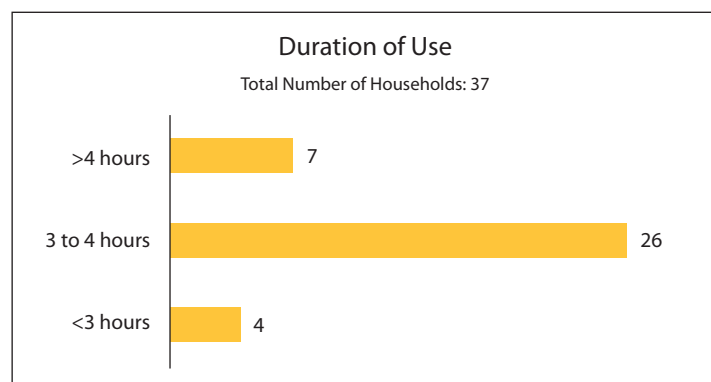
#### Payment Methods for the Systems in Use

81 percent of the respondents paid for their Pico PV systems in cash while 19 percent paid in installments. 71 percent of those who paid in installment made a down payment of between BDT 500 and BDT 1,000 while the remaining 29 percent made a down payment of more than BDT 1,000. No one paid less than BDT 500 for a down payment. On average, it took three installments to pay the remaining amount and about 57 percent of them made monthly installment payments of BDT 500 or less. 29 percent made monthly payments above BDT 1,000 and the remaining 14 percent made monthly payments between BDT 500 and BDT 1,000.

#### 4.5 Issues in Pico PV System Usage

##### Typical Hours of Usage

70 percent of the surveyed households used their Pico PV systems for three to four hours daily according to their need. About 19 percent of the respondents use the systems for more than four hours while the remaining 11 percent used it for less than three hours. Households in three income groups used their systems in a similar pattern.



#### Opinions Regarding Light Sufficiency and Ownership Duration

About 73 percent of the respondent said that light from their respective system was sufficient for their usual purposes. Although no respondent said that light was insufficient, about 27 percent did not respond to the question. Most of the surveyed respondents were new users of these systems; about 89 percent of the respondents had been using the systems for less than one year. A small number of respondents (about 8 percent) had been using the systems for one to two years while very few (only 2 percent) had been using it for more than two years.

#### Problems during the Use of System and Suppliers' Response

The range of problems faced by respondents during use of Pico PV systems are summarized in the following table. It was found that most respondents (about 59 percent) had experienced some problem related to battery charging. 16 percent of the respondents complained about flickering light while 13.51 percent complained that the light started to dim after use. Respondents also pointed out problems such as light overheating, poor wiring, switch problems, running out of battery etc.

Problems during usage of systems	Total	
	Count	%
Light overheats	4	10.81
Light blackens (dimming)	5	13.51
Light flickers	6	16.22
Switch	4	10.81
Mobile/Radio charging	2	5.41
Loose connections	2	5.41
Battery runtime	4	10.81
Battery charging	22	59.46
Poor wiring quality	4	10.81
System is flimsy	1	2.7
Number of respondents	37	

When asked whether the suppliers took necessary actions to resolve problems related to battery charging, 95 percent respondents did not give any answer and 5 percent said suppliers took no action at all. 50 percent of the respondents said suppliers did not do anything about the problem of the flickering light while the other 50 percent did not comment. 60 percent of respondents said that suppliers did not resolve the problem of fading light while 40 percent said suppliers replaced their systems. It is evident that for almost all the problems faced by the users, the supplier's response was deemed to be inadequate by the surveyed respondents.

#### **Level of Satisfaction with System**

Most of the respondents (92 percent) were satisfied with their respective systems. Only 8 percent expressed dissatisfaction with their systems.

#### **Opinions Regarding Benefits**

The table below shows that 89 percent of respondents thought that their Pico PV systems had helped reduce their expenditure on fuel; 84 percent respondents said Pico PV systems offered better lighting while another 84 percent said that Pico PV systems reduced black fumes in their households. Respondents also marked 'increased working hours' (76 percent), 'improved

security' (76 percent) and 'higher earnings' (65 percent) as some of the benefits of Pico PV systems.

Opinion regarding benefits	Total	
	Count	%
Better lighting	31	83.78
Decreased expenditure on fuel	33	89.19
Increased working hours	28	75.68
Less black fume	31	83.78
Higher earnings	24	64.86
Improved security	28	75.68
Number of respondents	37	

#### **Points of Dissatisfaction**

Five respondents out of 50 had reasons for dissatisfaction with their Pico PV system. All of them were from the upper poverty line group. Among the five, three complained that their systems provided insufficient light. Four people complained about short run time while one person complained about the system being "flimsy".


#### **Respondents' Willingness to Recommend Pico PV Systems to Others**

Since most of the respondents were satisfied with the performance of the system, almost 92 percent said they would recommend their respective Pico PV systems to others while only 8 percent said they would not.

## Overall Findings from the Survey of Existing Pico PV System Users

Findings from the survey are summarized as follows:

- 26 percent of the respondents who were initially approached had returned their systems before the survey, stating dissatisfaction with respective Pico PV systems, and thus did not participate in the survey. These respondents stated two major points of dissatisfaction:
  - Systems were small and did not fulfill requirements
  - Installments to be paid were too high
- Most of the surveyed households, about 92 percent, had separate kitchens. On an average, each household had a total of three rooms.
- Users of existing Pico PV systems were found to be relatively affluent; average household income was BDT 8,481 monthly, above the upper poverty line set at BDT 8,000.
- About 51 percent of the surveyed respondents learned about Pico PV systems from NGOs/PBSs; about 30 percent heard about such systems from neighbors or relatives while the remaining 19 percent came to know about such systems from local shopkeepers or businessmen.
- About 57 percent of the households had movable lights in addition to fixed lights in their respective Pico PV systems; about 70 percent of the households had Pico PV systems that allowed mobile charging.
- About 68 percent of the respondents had purchased a Pico PV system within the price range of BDT 2,000 and BDT 5,000; most of the respondents, about 81 percent, paid for their system in cash.
- Most of the respondents typically used their systems for three to four hours a day; about 72 percent said their system provided sufficient light.
- Most of the respondents, about 90 percent, have been using their Pico PV system for less than a year; almost all of the users have had some problems with their systems and complained that suppliers did not take adequate action.
- Almost all of the respondents, about 92 percent, were found to be satisfied about 92 percent of the respondents said they would recommend their respective Pico PV systems to others.



# **Insights from Potential Pico PV Users**

The total number of households and businesses that were surveyed was 200. The number of households or businesses in each category from which the data was collected is given in the table below. The detailed methodology is explained in the previous section.

Sample Distribution

Frames		East	West	Total
		Count	Count	Count
Un-Electrified Areas	Below lower poverty line	4	5	9
	Between lower and upper poverty line	26	19	45
	Above upper poverty line	11	10	21
Off-Grid Areas	Below lower poverty line	1	7	8
	Between lower and upper poverty line	6	10	16
	Above upper poverty line	1	1	2
Outside PBS Areas	Below lower poverty line	8	4	12
	Between lower and upper poverty line	21	43	64
	Above upper poverty line	3	20	23
Total	Below lower poverty line	13	16	29
	Between lower and upper poverty line	53	72	125
	Above upper poverty line	15	31	46
Total				200



## 5. Insights from Potential Pico PV Users

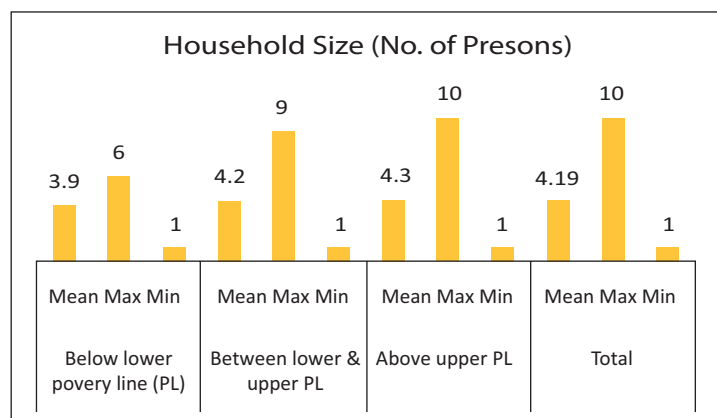
### 5.1 General Information

Data was collected from 200 households according to the criteria described earlier (by first dividing the country into two zones, then dividing households into three categories according to their electricity status and then a further subsection based on household earnings).

#### Gender and Age of Respondents

65.5 percent of the respondents in the survey were male and 34.5 percent of the respondents were female. The higher percentage of responses from male respondents is because in villages, women hesitate to talk with strangers and have less influence in household decisions. The average age of the respondents was 36.9 years; minimum age was 13 years and the maximum age was 70 years. The minimum age was noticeably low as in certain cases, young members of the family responded to the survey on behalf of the family in the absence of the adult members.

#### Household Size



The average household was found to comprise of 4.19 members (the national average is close to 4.85). Although the number of persons in each household varied according to income, this variation was insignificant: in households below lower poverty line, the average was 3.9 members; in households lying between lower and upper poverty line, the average was 4.2 members and in

households above upper poverty line, the average was 4.3 members. Differences between the maximum numbers varied considerably where the minimum number was one for all three groups.

#### Age Groups in Households

60.1 percent of the total household's population fell in the working age group (17-55 years). The rest of the surveyed households' population consisted of 34.1 percent dependent population (1-16 years) and 5.8 percent senior citizens (More than 55 years).

#### Occupation of Household Members

The following table shows that among the surveyed households, 31.8 percent of the members were students, 27.2 percent were engaged in household activities and 19.9 percent were farmers. It is clearly visible from the following table that farming is the key income generating occupation among the surveyed households.

Occupation	Below lower poverty line		Between lower & upper PL		Above upper PL		Total	
	Count	%	Count	%	Count	%	Count	%
Farmer	10	1.2	119	14.2	38	4.5	167	19.9
Job	9	1.1	21	2.5	16	1.9	46	5.5
Business	7	0.8	17	2	13	1.5	37	4.4 p
Household Activities	35	4.2	136	16.2	57	6.8	228	27.2
Student	29	3.5	182	21.7	56	6.7	267	31.8
Day Laborer	8	1	29	3.5	6	0.7	43	5.1
Dependent	14	1.7	25	3	12	1.4	51	6.1
Total							839	100

#### Decision Maker of the Family

In 51 percent households, important decisions were taken by the husband, while in 44.5 percent of households; it was done jointly by the husband and wife and in only 4.5 percent households, important decisions were taken by the wife. From the information above, the male dominance in the decision making is evident.

## 5.2 Socio Economic Profiles and Preferences

Socio economic profiles of the households have key implications on decision makings and behavioral patterns toward Pico PV systems. For instance, most of the households that were willing to buy Pico PV systems (about 74 percent) lived in houses with one to three rooms. This suggests that households with smaller housing are the potential customers of Pico PV systems, possibly because SHSs are too expensive for them or beyond their lighting needs. About 75 percent of the households that were willing to buy Pico PV systems have separate kitchens and need mobility of lighting arrangement. This shows that customers prefer the mobile lights of Pico PV systems over the fixed lights of SHSs.

Among the 200 surveyed households, about 35 percent had low incomes (“low” in the context categorized for this survey, of BDT 5,000 or less per month) and are potential customers of budget category Pico PV systems; 57 percent households had medium incomes (BDT 5,000 to 10,000 per month) and are potential customers of medium category Pico PV systems. The remaining 9 percent households had high incomes (above BDT 10,000 per month) and are potential customers of premium category Pico PV systems. Out of the 200 surveyed households, about 55 percent had some monthly savings; these households may therefore be able to pay monthly installments and are likely to find the premium category Pico PV systems more affordable. However, the households with very low or no monthly savings may prefer either the budget or medium category of Pico PV systems, according to their lighting requirements.

### Number of Rooms in the Household

The table below shows the number of rooms in the surveyed households. Most of the households (about 68 percent) lived in houses with two or threerooms. Only 10.50 percent of the households lived in a single room house, while the remaining households, about 22 percent, lived in houses with more than three rooms.

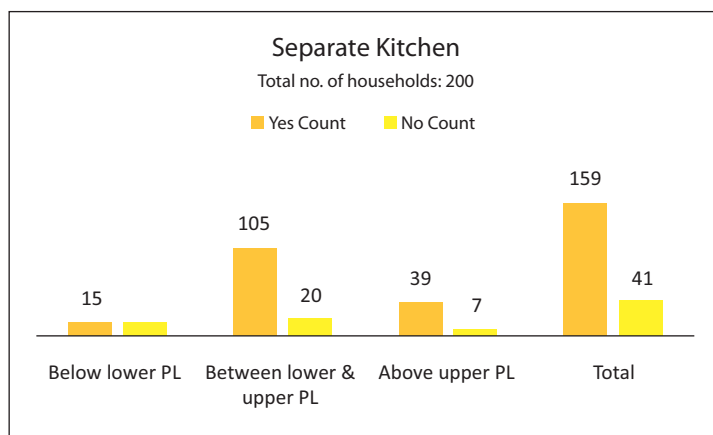
Number of rooms	Number of households	Percentage of total households
1	21	10.50
2	77	38.50
3	59	29.50
More than 3	43	21.50
Total	200	100

### Construction Materials of Households

The survey found that 94 percent of the household floors were made of clay and 96 percent of household roofs were made of tin. The walls of the households were made of tin (39 percent), bamboo (19 percent), clay (17 percent) and the remaining of other materials.

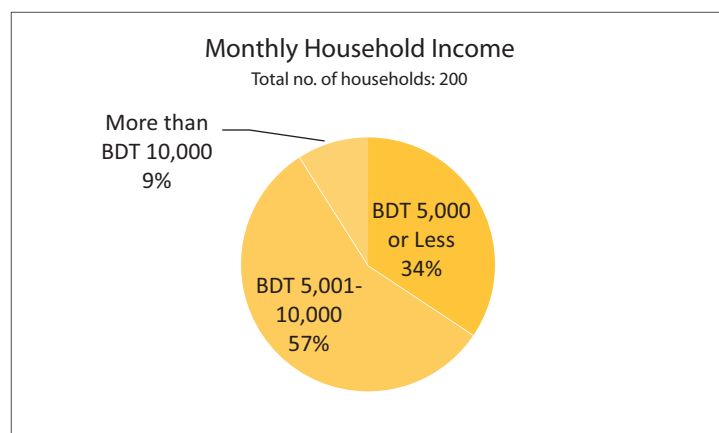
### Separate Kitchen in Households

As the chart shows, 79.5 percent of the households had separate kitchens. Among the 41 households without separate kitchens, 20 of them were between lower and upper poverty line.



### Household Monthly Income and Expenditure

As the chart indicates, it was found that about 35 percent households earned BDT 5,000 or lower each month, while 57 percent households earned between BDT 5,001 to BDT 10,000; the remaining 9 percent earned above BDT 10,000 each month.



In 54 percent of the households, adults spent more than five hours per day in income generating activities. However, in 23 percent households, the adults worked irregularly to earn their living. The average household expenditure for all income level was BDT 6,211. The average household expenditure for the three income levels were, respectively, BDT 2,559, BDT 5,554 and BDT 10,298.

### Household Monthly Savings

56 percent households, across the three income groups, saved a part of their income for future. The percentage of savers increased with household income. For instance, in the group below lower poverty line, only 8 people out of 29 were able to save.

Among all income groups, the average amount of savings was approximately BDT 650. A maximum of 41 percent of the households saved between BDT 200 and BDT 500 per month. However, the amount of savings varied among the three income groups. For instance, the highest numbers of households that saved more than BDT 1,000 per month were found in the above upper poverty line respondents.

This is shown in the following table.

Savings		Below lower PL	Between lower & upper PL	Above upper PL	Total
<BDT 200	Count	0	19	1	20
	%	0	17	1	18
BDT 200-500	Count	3	35	8	46
	%	3	32	7	41
BDT 501-1000	Count	4	12	10	26
	%	4	11	9	23
>BDT 1000	Count	1	7	11	19
	%	1	6	10	17
Total Number of Savers	Count				111
	%				100

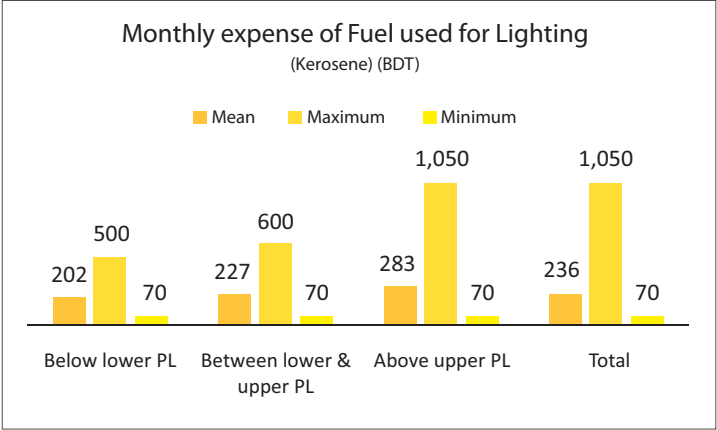
## 5.3 Fuel Consumption

### Quantity of Fuel purchase

Each household used 3.2 liters of kerosene per month on average for hurricane lamps with a daily average of 4.0 hours and 3.3 hours of kupis (a type of kerosene lamp each day. The usage pattern of kerosene for lighting was different among the three income groups. The average usage of kerosene for lighting in below lower poverty line (as defined for the survey) households was 2.4 liters, between lower and upper poverty line, 3.1 liters and above upper poverty line, 3.9 liters per month.

For cooking purpose, households mainly used kerosene and wood chips. Households on average used 5.3 liters of kerosene and 6.4 mounds of wood chips for cooking per month. There was also a visible difference of fuel usage pattern among the three income groups. For Instance, the average kerosene usage in the households below lower poverty line was 2.0 Liters whereas in the households above upper poverty line, the average was 7.4 liters.

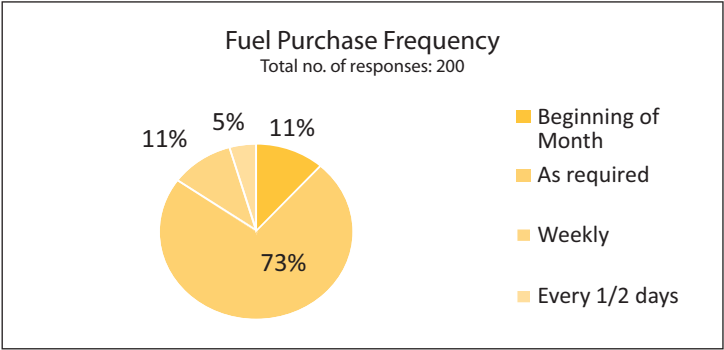
### Fuel Expense



The chart shows that the average fuel expense for lighting across all three groups was BDT 236 per month with a highest amount of BDT 1,050 per month and lowest amount of BDT 70 per month. Moreover, there were visible differences in the expenditure on fuel among the three income groups. The average fuel expense for kerosene for cooking was BDT 375 and for wood chips was BDT 568 per month per household.

### Frequency of Fuel Purchase

As fuel is one of the most necessary ingredients for lighting and cooking purposes, the majority of the households (73.5 percent) preferred to buy fuel at the time when it was needed. By doing so, they distributed the cost of fuel throughout the month since very few could afford to spend a large sum at a time for only one commodity. The frequency of fuel purchase is given in chart below.



### Lighting Situation and Consumption Patterns

Respondents were asked about the usage of light source from the previous night and whether it was consistent with their regular usage pattern. 95 percent of the respondents said it was consistent, so the data represents their regular usage and consumption pattern.

### Usual Sources of Light

Among the 200 households, 150 households use kupis for lighting purposes during night, 133 households use hurricane lamps and a few of them use torch/LED lights and candles as shown in the table below. None of the household covered in the survey used hazard kerosene lamps (also known in Bangladesh as hazak).

Quantity of lighting used normally	Hurricane		Candle		Kupi		Torch	
	Count	%	Count	%	Count	%	Count	%
1	76	57	2	100	59	39	21	75
2	45	34	0	0	64	43	7	25
3	10	8	0	0	17	11	0	0
4	2	2	0	0	7	5	0	0
5 or more	0	0	0	0	3	2	0	0
Total responses	133	100	2	100	150	100	28	100

On average, there were 1.9 kupis, 1.5 hurricanes lamps, 1 candle and 1.3 torch lights used in every household. On average, every household used hurricanes for four hours, candles for two hours, Kupis from 3.3 hours and torches for three hours each day. The duration of light source use varied among the three income levels. For instance, average hurricane usage was 3.8 hours in below lower poverty line households while average hurricane usage was four for both above upper poverty line households and between lower and upper poverty line households.

**Frequency and Cost of Replacement of Usual Sources of Lighting**

On average, hurricane lamps need to be replaced after 202 days, kupis after 206 days, and torches after 177 days and candles after 8 days.

As the following table indicates, the cost of replacement is quite high. The average cost for replacing torches was BDT 181, for hurricane lamps, BDT 111, for kupis, BDT 38, and for candles, BDT 17.

Type of Connection	Below lower PL	Between lower & upper PL	Above upper PL	Total
	Mean BDT	Mean BDT	Mean BDT	Mean BDT
Hurricane	151	112	91	111
Candle	0	24	10	17
Kupi	26	41	39	38
Torch	110	199	181	181

**Distance Travelled for Replacement**

The process of replacement is time-consuming as lighting equipment is often not available in nearby stores. For replacing torches, the average distance covered was 3.3 km. For both hurricane lamps and kupis, the average distance covered to get replacements was 2.7 km.

**Light Insufficiency**

Most of the households depended on hurricanes, kupis, candles or torches for lighting at night. The survey found that among the 200 households, 61 households were getting moderately sufficient light from their light sources. 28 households were not getting sufficient light from their light sources.

Because of insufficient lighting, income generating activities are hampered. Better lighting can extend the usual working hours of a household. Moreover, with better lighting, women of the households can also engage in income generating activities during their free time. As expected, 97 percent households agreed that better lighting would increase their working hours.

**Extra Working Hours Facilitated by Better Lighting**

As shown in the table, 62 percent of the households responded that better lighting condition would add 2 extra hours to their daily working hours. 27 percent of the households responded that with better lighting condition, they would work more than 2 additional hours every day.

Hours of extra work		Below lower PL	Between lower & upper PL	Above upper PL	Total
1 Hour	Count	1	14	8	23
	%	1	7	4	12
2 Hours	Count	21	79	23	123
	%	11	40	12	62
> 2 Hours	Count	7	32	15	54
	%	4	16	8	27
Total responses	Count				200
	%				100

**Number of Extra People Working with Better Lighting Condition**

With better lighting conditions, in 51 households, 2 more people would be working extra hours; in 25 households, more than 2 people would be working extra hours and in 24 households, there would be at least 1 person working extra hours.

**Dissatisfaction with Current Light Source**

Along with the above mentioned disadvantages, usage of hurricane lamps, candles and kupis have various health and environmental effects on the user. Therefore, 95 percent of the hurricane lamp users were dissatisfied with their current source of light. Similarly, 89 percent torch users, 80 percent kupi users and 50 percent candle users were dissatisfied with their current source of light.

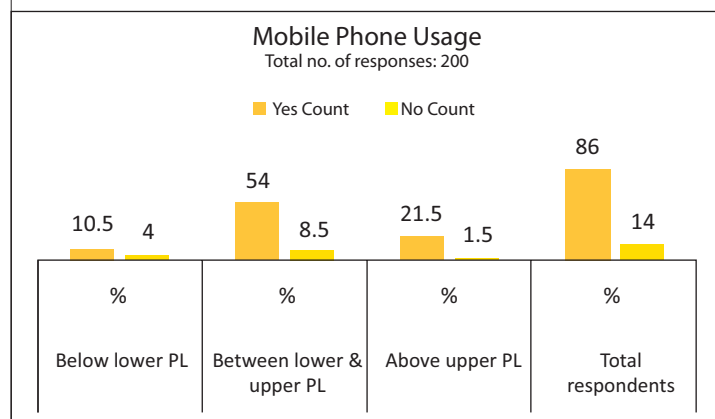




## 5.4 Communication

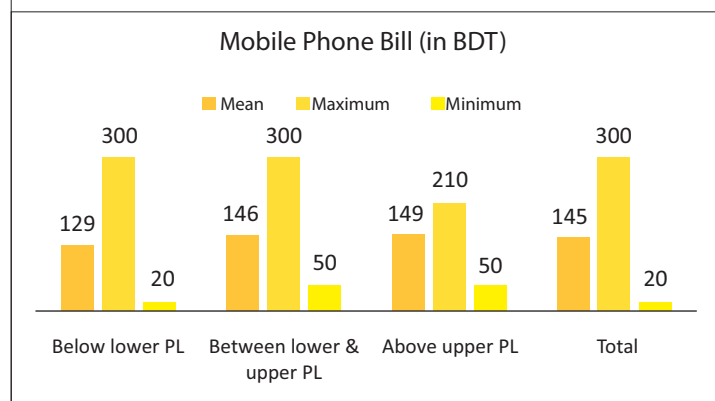
### Mobile Phone Usage

As table 5.25 shows, in the next page, 86 percent responded that some member of the household uses a mobile phone



The average prices of the mobile phone that the households used were BDT 2,236 and 98.8 percent mobile phone user opted for cash payments while purchasing mobile phones.

The households incurred BDT 145 per month for their mobile bill each month. Moreover, the average monthly mobile bill varied among the three income groups. For instance, households below lower poverty line incur an average of BDT 129 per month, where households above upper poverty line incurred an average of BDT 149 per month.



Usage of mobile phone as light and integrated radio was also pretty popular. 76.2 percent mobile phone owners used mobile phones for lighting in the dark. 48.8 percent owners had integrated radio with their mobile phones.

### Access to Mobile Charging

As the surveys were conducted in places with no electricity, getting easy access to mobile charging in those areas is difficult. Only 20 percent of the households had easy access to mobile charging when needed. In most of the households, above 65 percent, mobile phones were charged at bazaars/shops. However, 30.6 percent respondents said that they charged their phones at their neighbor's home and a few said they charged their phones at their offices. On average, households had to cover 2 km to access mobile phone charging facility with a maximum distance of 15 km and minimum of 0.2 km. The average time for charging mobile phones was 2.3 hours. The longest time taken to charge mobile phone was 4 hours and quickest time taken to charge was 0.5 hour. On average, every household charged their mobile phones at least once a day.

### Amount of Payment for Mobile Charging

51.2 percent of the households needed to pay for mobile charging while 48.8 percent households did not have to pay for charging their mobile phones. On average, the households had to pay BDT 4.8 for each mobile charge. While the highest amount of payment per charge was BDT 10, the lowest amount was BDT 2.

Amount of payment (BDT)	Below lower PL	Between lower & upper PL	Above upper PL	Total
Mean	4.7	4.8	5.2	4.8
Maximum	10.0	10.0	7.0	10.0
Minimum	2	5	5	2.0

### Convenience of Mobile Charging

Because of above mentioned reasons, 87.8 percent of the households reported that their mobile charging arrangement was not convenient for them while 12.2 percent household reported otherwise.

### Usage of Small Battery and Small Battery Charging Information

Only 6 percent of the households used small batteries for lighting purposes in non-electric areas. The households that were using small batteries charged their batteries at their nearest bazaar/shop. On average, households had to cover 6.7 km to access these charging facilities for the small batteries. 70 percent of the small battery users reported that they had to pay for charging their batteries. On average, households had to pay BDT 86 for each charge. While the maximum amount paid was BDT 100, the lowest amount paid was BDT 5. Unsurprisingly, all the small battery using households reported that their current battery charging arrangement was not convenient at all.

### Radio Usage

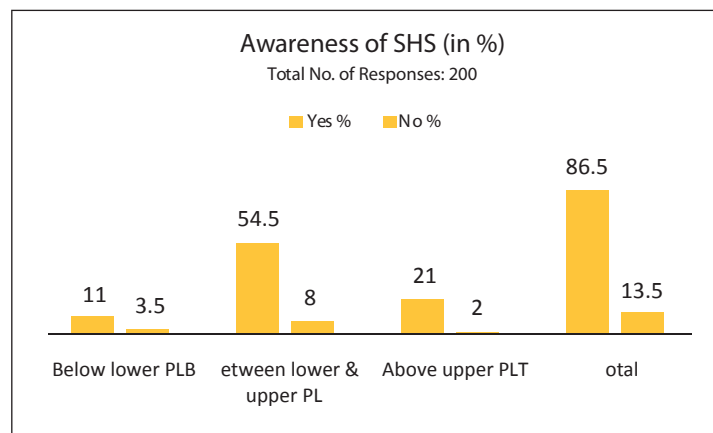
Among the surveyed households, only 4.5 percent used radio. As expected, the increase in mobile phones with integrated radios has decreased the number of radio users. The average price of radio was BDT 534. The highest price of radios was BDT 1,000 and the lowest price found was BDT 280. The Survey has found that all the radio using households paid in cash for the purchase of the radio.

### 5.5 Awareness and Willingness to Pay

#### Awareness of Solar Home Systems (SHS)

As shown in the chart 5.5.1 below, 86.5 percent of the households were aware of solar home systems. This indicates that people are aware of the concept of solar energy usage and the benefits of solar power.

Chart 5.5.1: Awareness of SHS



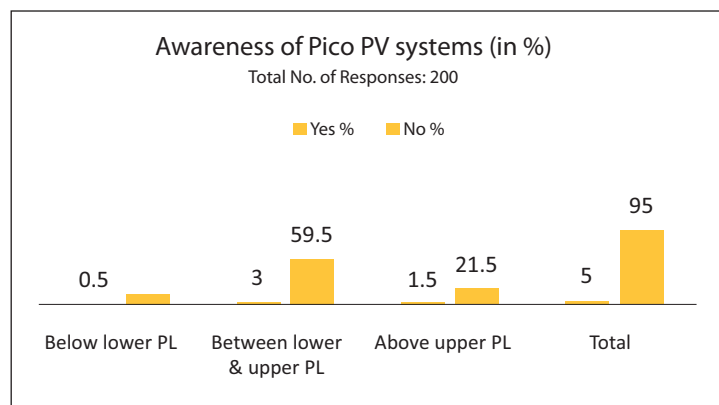
## Table 5.5.1 Buying Decision

Reason for not buying	Below lower PL		Between lower & upper PL		Above upper PL		Total	
	Count	%	Count	%	Count	%	Count	%
Expensive	18	9.5	71	37.4	22	11.6	111	58.4
Need smaller system	1	0.5	9	4.7	4	2.1	14	7.4
Will buy in future	4	2.1	42	22.1	19	10.0	65	34.2
Total responses							190	100

### Awareness of Pico PV systems

Only 5 percent of the households surveyed had heard about Pico PV systems whereas 95 percent had not, as shown in chart 5.5.2 below. This indicates that prior to initiating any Pico PV system deployment project, awareness campaigns must be undertaken.

### Chart 5.2.2 Awareness of Pico PV Systems



### Willingness to Buy Pico PV systems

94 percent of the respondents were willing to buy Pico PV systems for home use. Willingness to buy Pico PV systems was more or less same for all three income groups. This is shown in the table. The remaining 6 percent were unwilling to buy Pico PV systems because of high expenses, lower durability and absence of suppliers and technicians.

Willingness to buy Pico PV system		Below lower PL	Between lower & upper PL	Above upper PL	Total
Yes	Count	28	116	44	188
	%	14.0	58.0	22.0	94.0
No	Count	1	9	2	12
	%	0.5	4.5	1.0	5.0
Total responses	Count	200			
	%	100			

### Amount Willing to Pay for Pico PV systems

A majority of respondents, about 41 percent, preferred the price of Pico PV systems to be between BDT 500 to BDT 1,000. Another 30 percent were willing to pay more than BDT 1,500 for the Pico PV systems.

Amount	Below lower PL		Bet. lower & upper PL		Above upper PL		Total	
	Count	%	Count	%	Count	%	Count	%
<=BDT 500	11	5.5	12	6.0	4	2.0	27	13.5
BDT 500-1000	11	5.5	53	26.5	18	9.0	82	41.0
BDT 1001-1500	1	0.5	21	10.5	9	4.5	31	15.5
>BDT 1500	6	3.0	39	19.5	15	7.5	60	30.0
Total responses							200	100.0

### Potential Benefits of Pico PV systems

The survey found that 43 percent households thought Pico PV systems would be beneficial for studying. 32 percent households thought Pico PV systems would benefit them for mobile charging and 29.5 percent of the household thought that Pico PV systems would be beneficial for performing household chores. The benefits are shown in details in the following table. In addition, 99.5 percent believed that the lighting condition of the households would improve through the use of Pico PV systems.

Potential benefits of Pico PV system	Total	
	Count	%
Better lighting condition	54	27
Less fuel expense	8	4
Beneficial for business	1	0.5
Increase in income	39	20
Less black fume	27	14
Mobile charging	64	32
Studying	86	43
Household chores	59	30
Less expensive than SHS	2	1
Increased security	16	8
Total responses	200	

### Model Preference for Pico PV system

During the survey, the households were shown different models of Pico PV systems. The Pico PV systems were categorized into three groups according to their prices and functions: budget lanterns (low price range with single adjustable light), medium lanterns (medium price range with single adjustable light and mobile charger) and premium lanterns (high price range with multiple adjustable lights and mobile charger). The respondents were given the opportunity to choose more than one lantern group and thus 200 respondents made 241 choices about their preferred Pico PV

system models. About 64 percent of the respondents went for the Premium lanterns. The following table shows that despite the high price range, respondents preferred Pico PV systems with multiple lights and mobile charging option. On the other hand, 22.8 percent of the responses went for budget lanterns and it is clearly visible in the table that the preference for Budget lanterns is high among households in below lower poverty line and between lower and upper poverty line.

Model preference	Below lower PL		Between lower & upper PL		Above upper PL		Total	
	Count	%	Count	%	Count	%	Count	%
Budget	8	3.3	28	11.6	19	7.9	55	22.8
Medium	4	1.7	21	8.7	8	3.3	33	13.7
Premium	18	7.5	101	41.9	34	14.1	153	63.5
Total responses							241	100

While the majority of the households prefer the premium category lanterns, as shown in the table below (following next point), only 5.2 percent households were willing to pay the market price for these lanterns. The overwhelming majority of the respondents were willing to pay price of BDT 5,000 or less, i.e. price of budget or medium category lanterns.

### Expected Price for Pico PV systems

Table 5.5.1: Expected prices for Pico PV systems

Expected price (BDT)	Budget		Medium		Premium	
	Count	%	Count	%	Count	%
=<500	31	56.4	7	21.2	10	6.5
501-1,000	11	20.0	14	42.4	47	30.7
1,001-1,500	5	9.1	8	24.2	13	8.5
1,501-2,000	4	7.3	3	9.1	15	9.8
2,001-2,500	1	1.8	0	0.0	12	7.8
2,501-3,000	2	3.6	1	3.0	12	7.8
3,001-3,500	1	1.8	0	0.0	2	1.3
3,501-4,000	0	0.0	0	0.0	11	7.2
4,001-4,500	0	0.0	0	0.0	2	1.3
4,501-5,000	0	0.0	0	0.0	21	13.7
> 5,000	0	0.0	0	0.0	8	5.2
Total	55	100.0	33	100.0	153	100.0



Table 5.5.1 shows that 30.7 percent respondents, who preferred Premium lanterns, expected the price to be between BDT 501 to BDT 1,000. About 43 percent of the respondents, who preferred Medium lanterns, expected the price of the lanterns to be between BDT 501 to 1,000 and most of the respondents (56.4 percent), who preferred Budget lanterns, expected the price of the lanterns to be BDT 500 or less.

#### *Preferred Payment Method*

The survey found that 54.1 percent respondents preferred combinations of down payment and monthly installments to pay for Pico PV systems whereas 26.5 percent preferred installments only. For most (65.1 percent), the affordable amount of down payment was BDT 500 or less across all three income group and 22.2 percent thought the affordable amount of down payment is between BDT 500 to BDT 1,000. 49 percent of households preferred to pay between BDT 100 to BDT 200

for the installments of Pico PV system while 30 percent of households preferred to pay less than BDT 100 for the installments of Pico PV system. The average amount of affordable down payment was BDT 696 within the survey group while the affordable amount of monthly installment was BDT 155 on average.

#### *Period and Type of Warranty*

34 percent of the respondents preferred two to five years of warranty, while 31 percent preferred more than ten years of warranty. As the systems were pretty expensive for all three income group, people asked for longer warranty periods. On average, the surveyed households wanted a warranty period of eight years. More than half of the households (57 percent) wanted replacement warranties while 23.1 percent wanted lifetime guarantees and 19.5 percent wanted period checking within the life of the warranty.





## Overall Findings from the Survey of Potential Pico PV System Users

The Conclusions that can be drawn from analyzing the data from the survey can be summarized as follows:

- The survey shows that, on average 3.19 liters of kerosene were being consumed every month in each household for lighting purposes and 5.32 liters of kerosene were being used per month for cooking purposes.
- At the existing kerosene price (during the survey), 70 BDT per liter, each household would spend an average of 236 BDT on kerosene for lighting purposes and 375 BDT on kerosene for cooking.
- 86.5 percent of the households were aware of the SHSs, while only 5 percent were aware of Pico PV systems.
- After receiving information on solar lanterns, 94 percent expressed interest in buying a Pico PV system.
- 99.5 percent of respondents agreed that solar lanterns would improve the lighting conditions in their households.
- 41.0 percent of the respondents were willing to pay between BDT 500-1,000 and 30.0 percent of the respondents were willing to pay more than BDT 1,500.
- 54 percent of the respondents who would like to buy solar lanterns preferred to buy it through both down payments and installments.
- 92 percent of the respondents who preferred down payment and installment arrangements for solar lanterns would like to pay their installments monthly and the average amount of down payment for the respondents was BDT 1,071.
- 34 percent of the respondents preferred a 2 to 5 years warranty period for the solar lanterns while 31 percent of the respondents wanted more than 10 years of warranty period.
- 57 percent of the respondents preferred a replacement arrangement for the given period of warranty for the products.

## 6. Conclusion

Bangladesh presents a significant potential for the Pico PV solar lighting appliance market and the estimated five million households market is a conservative count. If the companies are successful in penetrating the market by forging good partnerships with the last mile channel partners and if a snow-balling effect takes place once the consumers start accepting the products, the coverage area could be expected to grow significantly.

The survey of the existing Pico PV users suggested that 51 percent of the surveyed respondents learned about Pico PV systems from NGOs or from PBSs while about 30 percent heard about the systems from neighbors or relatives with another 19 percent from local shopkeepers or businessmen. Approximately 70 percent of the households had Pico PV systems that allowed mobile charging. 68 percent of the respondents had purchased a Pico PV system within the price range of BDT 2,000 and BDT 5,000; most of the respondents, about 81 percent, paid for their system in cash. Most of the respondents typically used their systems for three to four hours daily; about 72 percent said their system provided sufficient light. Materially, about 92 percent of respondents were found to be satisfied with their system and said they would recommend their respective Pico PV systems to others.

Based on the survey of potential customers, 94 percent expressed positive interest in purchasing a Pico PV solar lighting appliance after receiving information about these systems. 41 percent of potential customers were willing to pay between BDT 500-1,000 for a Pico PV system and 30 percent of the respondents were willing to pay more than BDT 1,500 for one.

The overall population density in Bangladesh, including in the rural areas, is likely to help companies in terms of target marketing, logistics, planning and sales growth. A widespread network of MFIs and NGOs throughout Bangladesh could prove to be a big resource for these companies to strike a partnership. Although the target customers are aware of the solar concept as a result of the IDCOL solar home systems

program (86.5 percent aware of SHSs), they remain unfamiliar with Pico PV systems (5 percent awareness). It is likely that these smaller appliances are likely to remain more of a “push” rather than a “pull” product. This is why the proposed Lighting Bangladesh consumer awareness campaign is designed to inform and educate potential customers to engender the beginning of a market “pull”. Although some lower quality Pico PV system products can be found in circulation, they have failed to gain consumer confidence and are contaminating the market. The quality testing framework underpinning Lighting Bangladesh will help safeguard the market from the proliferation of inferior products. Subsidies are not per se a requirement for the Pico PV products market and although the existing popular SHS program was initially subsidy driven, the product costs were higher and the subsidy portion is now gradually being scaled back. It is clear from the surveys that existing and potential consumers will consider cash up front payment or payment in installments for Pico PV systems and that the price points of the Pico PV systems is more likely to be aligned with their affordability and expectation than the comparatively expensive SHSs. The market driven approach, led by the manufacturers and distributors of the Pico PV systems may therefore lead to more sustainable practices that will help demand grow over time. Lighting Bangladesh primarily targets segments of the population for whom the larger SHS’s are not affordable, but who are likely to be able to afford the basic and medium category Pico PV systems in either cash or through installment payments. As the survey results suggest, of the total existing users, about 68% purchased systems priced between BDT 2,000-5,000 and about 81% purchased these in cash. For the premium or larger products, some rationalized subsidy in terms of buy-down grants or channel financing schemes could be employed.

This snapshot assessment highlights that Pico PV systems have a role to play in this undersupplied and substantial market in Bangladesh and the survey demonstrates that potential customers have initial awareness of solar lighting solutions through the SHSs and are both willing and able to pay cash for smaller products.

LIGHTING ASIA BANGLADESH

IFC, United House, 10 Gulshan Avenue

Dhaka 1212, Bangladesh

Tel: 88-02-883-3752-66

Fax: 88-0-883-3495, 989-4744

**[www.lightingglobal.org](http://www.lightingglobal.org)**

