Market Presence of Off-Grid Lighting Products

Insights from a Study in Bihar and Odisha

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INDIA

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June, 2014

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Executive Summary

Nearly 400 million people in India do not use grid electricity as their main source of lighting. According to the Census of India, 2011, 43 percent of rural households still use kerosene as a primary source of fuel for lighting. A variety of modern off-grid electric lighting technologies have emerged globally over the last decade. These technologies are popular because they are cost-effective, robust, and use small amounts of energy. The emergence of a large demand for these technologies has led to efforts to develop the market for them.

IFC's Lighting Asia/India program is a market-transforming program aimed at promoting, both in value and presence, modern off-grid lighting among the off-grid population in rural India. Modern off-grid lighting includes solar lighting appliances, home systems, and connections to renewable energy mini-grids. The program is designed with a series of interventions to alter market behavior by removing specific barriers that include market spoilage created by poor products, lack of information on distribution channels, lack of financing for companies and consumers, and lack of awareness that quality solar appliances are affordable, viable solutions.

This study reflects on the current market scenario of off-grid electric lighting products in Bihar and Odisha states of India. It also presents information on the presence of solar-charged off-grid lighting technologies in the conventional retail supply chain. The study covered 120 retailers (60 in each state) at one large central city and a few smaller towns closer to off-grid villages. The objective was to get an idea of the kind of shops that stocked off-grid lighting products, pricing and sales volumes in both cities and towns.

The study "shows" that a large variety of products is available in the off-grid lighting market. These products come in a variety of configurations aimed at different segments of consumers. Around 675 different models of off-grid lighting products were identified in the two states. However, a number of the products were low-cost re-branded products with identical external features; the actual variety (in terms of performance and features) available to consumers is lower than this figure suggests.

A greater number and variety of lighting products are available to customers in the cities, as compared to the smaller towns. Moreover, the prices of approximately 80 percent of the cataloged off-grid lighting products available in Bihar and Odisha are below Indian rupees 400 ($6.40). Though these products use dry cell batteries or grid charging rather than solar charging, it confirms that a good number of electric lighting options are available to consumers at low initial purchase prices.

With a majority of off-grid lighting products using single-use or rechargeable batteries, the actual number of solar-charged off-grid lighting products is low. This study observed that around 30 different solar lighting products are available across the two states. Of these, only three were Lighting Global quality assured off-grid lighting products. The low presence of solar-charged off-grid lighting products suggests that retail store sales are not the dominant sales model for these products. Field observations indicate that direct marketing sales play a larger role in this segment.

These were some additional findings:

- The use of Light-emitting diode (LED) technology was widespread in Bihar and Odisha, where around 90 percent of observed off-grid lighting products were LEDs. Most other products used fluorescent lighting technology.
- Around 90 percent of products surveyed used grid charging and/or dry cell batteries as sources of energy.
- In the regions surveyed, 35 percent of all lighting products were flashlights.
- The average price of solar-charged products was much higher than grid-charged and dry cell battery lighting products.
- Low-cost products tended to use LED technology rather than fluorescent bulbs.
- Considering the form factor,[1] flashlights tended to be the lowest priced.
- Around 50 percent of all reported product failures was related to batteries and another 20 percent was due to LEDs.
- According to retailers, the highest priority for customers was product quality and/or durability. Market sizing analysis showed a thriving local economy for off-grid lighting products.

The report will serve as a useful roadmap for market stakeholders about the presence of off-grid lighting products in retail shops in select states of India. It has relevant information related to product pricing, use of technology, penetration and volumes as well as retail store insights, useful for manufacturers and distributors of solar charged handheld devices.

1. Form factor indicates the type of lighting product and its function. Form factors vary based on type of light beam and use. For example, desk lamps or portable lights with a directional, focused beam are generally used for task lighting and flashlight applications respectively. In contrast, lamps with a wider angle beam, including both fixed and portable designs, are commonly used in ambient room lighting applications

Background

Nearly 400 million people do not use electricity as their primary source of lighting. According to the Census of India, 2011, 43 percent of rural households still use kerosene as a primary source of fuel for lighting. A variety of modern off-grid electric lighting technologies have emerged globally over the last decade. These technologies are popular because they are cost-effective, robust, use small amounts of energy, come in a variety of configurations, and can be used as ambient lights, flashlights, or task lights for both commercial and domestic applications.[2] They use either rechargeable or dry cell batteries to power the lamps. The commercialization of these off-grid portable lighting products has increased access to affordable and clean lighting technologies for low income households.[3]

The objective of this study is to get a deeper understanding of the range of available off-grid lighting products in India, with a focus on Bihar and Odisha. Both states rank very low in terms of access to clean and reliable household energy sources and thus have large potentials for increased use of clean off-grid lighting solutions. Around 86 percent of rural households in Bihar and 63 percent in Odisha still use kerosene as the primary lighting fuel (Census of India, 2011). The large populations that live off-grid in these states, along with their significant differences in geographical and socio-economic conditions, make them an ideal representative cross section of off-grid lighting users.

Data were collected from retailers about the types of off-grid lighting products available for sale.[4] Information was also collected about prices and approximate sales volumes. In addition, the study involved collection of information about shops and shop owners to better understand these stakeholders and their role in the off-grid lighting retail supply chain.

2. Task lamps provide light meant to illuminate a surface where a task is performed (such as reading, studying, selling vegetables, and counting money). Ambient lights provide light to illuminate rooms for socializing or general illumination. Flashlights have highly focused beams of light and are mainly used for outdoor applications
3. Off-grid lighting products referred to in this study can be described as stand-alone dry cell or rechargeable electric lighting appliances or kits that can be installed by a typical user without employing a technician. The basic components in these systems include an energy source (dry cells, rechargeable batteries, or solar panels for solar-charged products), electronics, and a light source
4. Note that the survey only recorded what products were available, but did not collect the entire inventory of products (how many of each product the retailer had in stock)

Fieldwork Methods

The methods used in this study were similar to those used in previous field research conducted under the Lighting Africa program.[5] A questionnaire was administered to retailers and distributers of off-grid lighting products in the selected sites in Bihar and Odisha (image 1). The questionnaire gathered information on the number, variety, retail prices, and sales of the products (see Appendix A: Retail shop information sheet). Information was also gathered about the types of retail stores and profiles of customers active in the off-grid lighting market. This enabled an analysis of the business supply chain and the types and sales volume of off-grid lighting products in the markets covered by the study.

The districts of Patna in Bihar and Kalahandi in Odisha were selected for the field study (image 1). These districts have large off-grid populations and a significant presence of off-grid lighting technologies.[6] Information was collected about locations of the shops that sold off-grid lighting products using a global positioning system recorder. The data was used to create a map of the shops and regions covered in the survey.

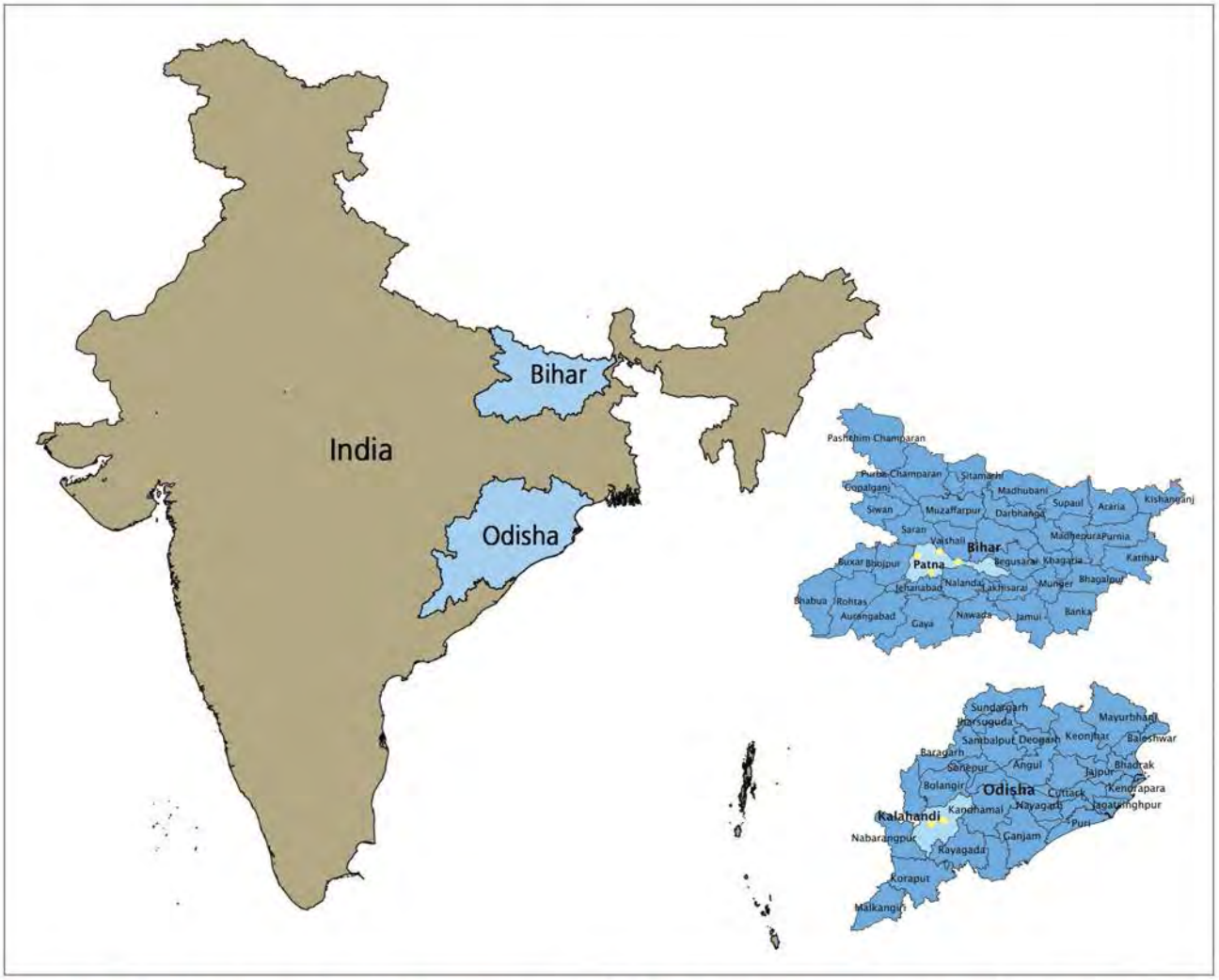

Image 1: The market presence field study was conducted in Bihar and Odisha. The districts of Patna in Bihar and Kalahandi in Odisha were selected for the field work. The yellow dots indicate the actual locations of the retailer surveys.

5. A Growing and Evolving Market for Off-grid Lighting: Market Presence of Off-Grid Lighting Products in the Kenyan Towns of Kericho, Kapkugerwet (Brooke) and Talek, Lighting Africa, a joint IFC and World Bank program (2013) (http://lightingafrica.org/wp-content/uploads/bsk-pdf-manager/44_Off-GridLighting_MarketPresence_Kenya_Mar2013_Final.pdf)
6. Around 66 percent of rural households in Patna and 80 percent in Kalahandi use kerosene as the primary source of fuel for lighting, Census of India, 2011. Available from, www.censusindia.gov.in/2011census/hlo/hlo_highlights.html

Overall, 120 retailers (60 in each state) were reached during the two-state study (image 2). The study was designed such that, in each state, retailers and distributors were surveyed in one large central city and a few smaller towns located closer to off-grid villages. In the city, surveys were conducted in a sampling of shops in selected commercial areas, while the surveys in the smaller towns involved a more exhaustive study of available shops. The objective of the survey in the city was to gain an understanding of types of shops and range of off-grid lighting products available to buyers from rural and peri-urban areas. The goal in small towns was to get a comprehensive profile of market presence, pricing, and sales volume of off-grid lighting products. See Appendix B: Retail shop survey data (for city) and Appendix C: Retail shop survey data (for small town) for information on the survey.

Image 2: Typical town market in Bihar (left) and survey of a retail outlet in Bihar in progress (right)

Bihar: Cities and Towns Surveyed

Patna, the capital of Bihar, has several areas where electronics and electrical shops sell off-grid lighting products. Three such areas, Chandni Chowk, Exhibition Road, and Bakarganj, were selected for the field study (image 3). Each has markets with particular types of off-grid lighting products. Chandni Chowk is known for a large variety of Indian brands, while Bakarganj is known for low-cost Chinese brands. Exhibition Road has a concentration of shops selling solar off-grid lighting products. In all, 20 shops were surveyed in Patna; six of the 34 shops in Chandni Chowk, ten of the 58 shops in Bakarganj and four of the 11 on Exhibition Road.

In addition, three smaller towns were surveyed to get a comprehensive understanding of the number, variety, retail prices, and sales volume of off-grid lighting products available to consumers closer to their communities. The small towns in Bihar targeted for the surveys included Masaurhi, Bihta, and Khusrupur. Surveys were conducted at sixteen of the 22 retail shops in Masaurhi, twelve of the 20 shops in Bihta and twelve of the 15 shops in Khusrupur. See image 4 for a map of the retail shops surveyed.

Image 3: Three electronics and electrical markets were surveyed in Patna. Image on the left shows the overview of the regions surveyed and the three maps on the right show the markets of Bakarganj, Chandni Chowk, and Exhibition Road. The red dots on the image show the shops that were surveyed while the blue dots show shops that were identified but not surveyed. Six retail shops were surveyed in Chandni Chowk (of 34), ten in Bakarganj (of 58), and four in Exhibition Road (of 11).

Image 4: Electronics and electrical markets were surveyed in three Bihar towns. Image at top left shows Khusrupur, top right shows Masaurhi, and bottom shows Bihta. The red dots are shops that were surveyed while blue dots show the un-surveyed shops. 12 shops were surveyed in Khusrupur (of 15), 16 in Masaurhi (of 22), and 12 in Bihta (of 20).[7]

7. Some global positioning system points are missing in Bihta on the map; this map does not reflect the true numbers of shops surveyed

Odisha: Cities and Towns Surveyed

Unlike Bihar, there was little presence of off-grid lighting products in local markets close to off-grid communities in Kalahandi, Odisha. Hence, rather than undertake surveys in small market centers, a comprehensive survey of Bhawanipatna and Junagarh towns in Odisha was conducted. These towns serve a number of off-grid communities in the surrounding areas. Overall, 40 of the 50 retail shops in Bhawanipatna and 20 of 27 shops in Junagarh were surveyed. See image 5, for a map of the shops surveyed.

Image 5: Electronics and electrical markets were surveyed in two Odisha towns. Image on top shows Bhawanipatna and image at bottom shows Junagarh. The red dots on the image show shops surveyed while blue dots show un-surveyed shops. Forty shops were surveyed in Bhawanipatna (of 50) and 20 in Junagarh (of 27).

Results and Discussion

To gain a broad-based insight into the off-grid lighting market, the survey tool was designed to get information about the kinds of shops that sold lighting products as well as the kind of lighting products they sold. Information collected focused on the variety, number and retail prices of products. Additionally, the shops were profiled to gain insight into type and size of business, customer profiles and lines of credit available to the shops. This section discusses the main findings of the survey.

Retail Shop Demographic

Around 85 percent of the 120 retail shops surveyed were electronics and general shops. An additional 8 percent specialized exclusively in the sale of solar products (image 6). The shops that carried off-grid lighting products were generally small retail outlets, with over 90 percent indicating that they had one to two employees. The experience of the shops in selling LED lighting products was diverse, with nearly half of all shops starting sales of the products within the past year, while around 40 percent said they had been selling for three years and more. The shops said that customers for off-grid lighting products did not fit a specific gender and age group profile (table 1).

Image 6: Some of the retail shops surveyed. Top left is an electronics store in Patna, top right is a solar shop in Patna, bottom left is a street vendor at Masaurhi, and bottom right is a general store at Bhawanipatna. All these shops carry off-grid lighting products along with a number of other consumer goods.

Table 1: Location and profiles of retail shops interviewed during the field study. The 120 retailer surveys were distributed among four locations in Bihar and two locations in Odisha.[8]

BIHAR				
Location	PATNA	MASAURHI	BIHTA	KHUSRUPUR
Sample size	20	12	16	12
ODISHA				
Location	BHAWANIPATNA		JUNAGARH	
Sample size	40		20	
ALL DATA				
		Sample size	120	
Interviewee gender (%)				
		Male	98	
		Female	2	
Shop characteristics				
Shop type (%)		Electronics	44	
		General shop	42	
		Hardware	4	
		Market stall	1	
		Solar shop	8	
Sales type (%)		Retail only	86	
		Wholesale only	0	
		Both wholesale and retail	14	
Number of employees (%)		1 - 2	91	
		3 - 5	9	
		6 - 10	1	
Since when did the shop begin to sell LED off-grid lighting products (%)?				
		3 months	20	
		6 months	14	
		1 year	14	
		1.5 years	3	
		2 years	11	
		3 years	10	
		3 - 6 years	18	
		6+ years	9	
Customer demographics				
Gender (%)		Men	38	
		Women	0	
		Both equally	61	
Age (%)		Under 40 years	9	
		Over 40 years	7	
		All ages evenly	84	

8. For a state-wise breakup of retailer demographics, see Appendix D: Retail shop demographic

Credit/Finance

Retail shops were asked about the credit and financing facilities they could access and where applicable, the credit services they extended to their customers. Only 55 percent of respondents said they accessed some kind of financing for their business (figure 1). A large number of those who accessed financing (80 percent) said they got credit from wholesale distributors. Other sources of credit and financing were from product manufacturers and personal loans from banks and friends/family.

The survey indicated that off-grid lighting product consumers had limited access to financing or guarantee on the products they purchased. Around 68 percent of retail shops surveyed in the two states said they did not extend any credit or guarantee on off-grid lighting products sold. However, 15 percent said they offered credit facilities and a further 13 percent said they offered guarantees on some products. A small number (4 percent) of retailers offered both credit and guarantees on at least some lighting products.

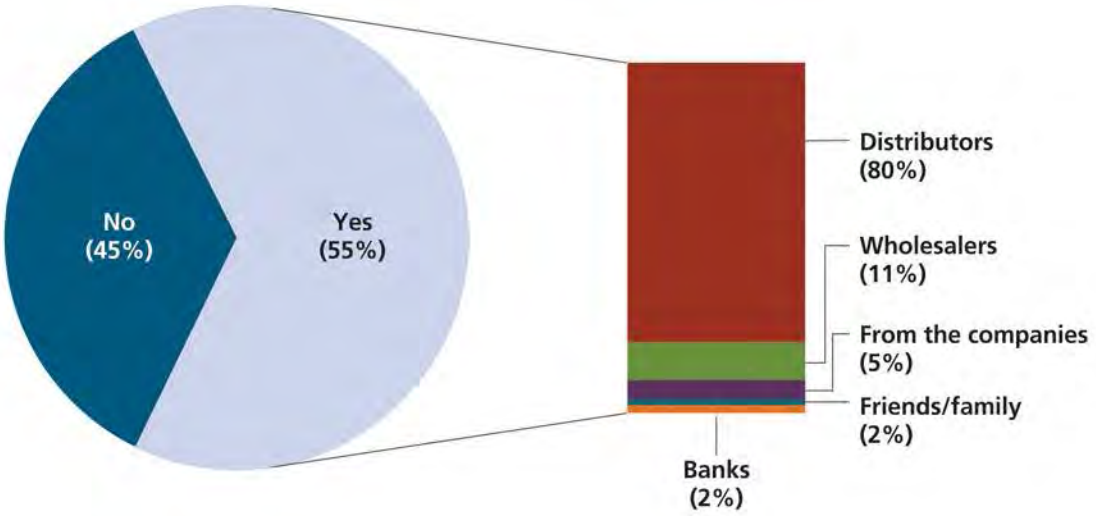

Figure 1: Credit and financing options accessed by retail stores that sell off-grid lighting products. The pie chart on the left shows responses to the question: "Do you access credit or financing facilities for your business?" For those who responded "yes" to the first question, the bar to the right represents answers to the question: "If you do access credit, where does it come from?".

After-sales Service

Questions about types of product failures based on customer feedback revealed that 50 percent of all reported failures were related to the batteries and another 20 percent due to the LED (figure 2). Further, 12 percent of reported failures were related to charging circuits of grid-charged products, which are typically caused by voltage spikes. Switches and connector failures were also reported by some of the retail shops (7 percent) as a cause of concern. Despite failures in the field, very few retail shops (11 percent) offered any complimentary after-sales service. The main reason for not providing this was the high presence of low quality products and absence of any warranty offered by most manufacturers. However, a large number of respondents (76 percent) said they were aware of local technicians who provided repair services for a fee. A few retail shops (11 percent) also said they were aware of authorized service centres for products they sold.

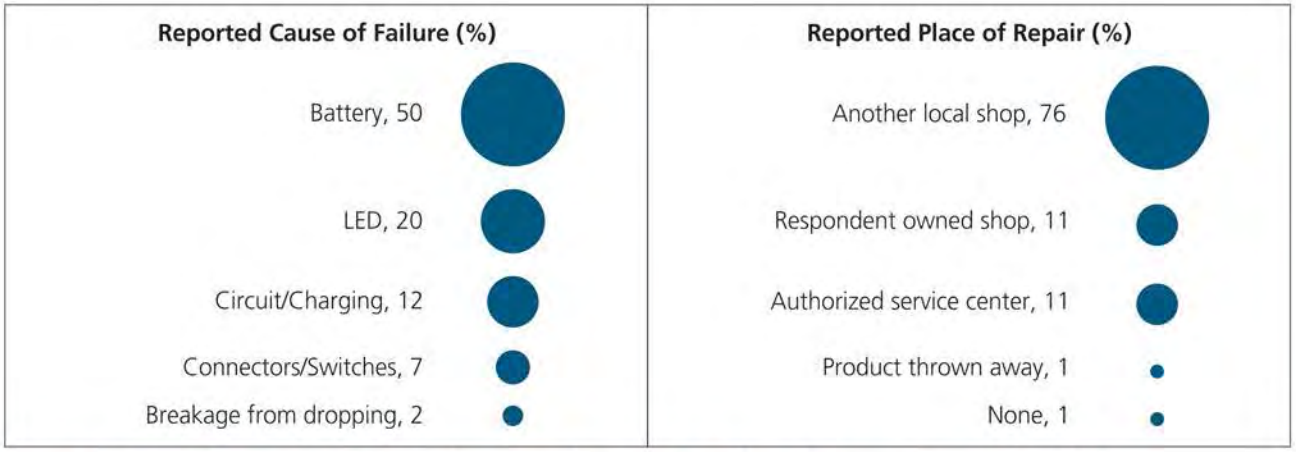

Figure 2: Causes of failures and after-sales service locations for off-grid lighting products (n=120)[9].

Priorities of Customers

Retailers were asked about customer priorities when buying off-grid lighting products (table 2). They said the highest customer priority was quality and/or durability of a product over time. This explains why retailers are very concerned about frequent product failures and that many products do not include manufacturer warranties. The number of hours of operation (or run-time) offered by a particular product and its price (and potential for savings relative to baseline lighting technologies) were the second and third most common customer priorities. These were followed by the brightness of the light, the type of charging mechanism and whether a warranty or guarantee was offered on the products.

Interestingly, a separate, simultaneous consumer-centric field study conducted by IFC showed that off-grid customers were most interested in knowing about brightness of the product, followed by the type of charging mechanism, robustness (or lifetime), and run-time. In addition, information about whether the product could charge mobile phones and warranty terms were jointly the fifth most important features that customers looked for at the time of purchase.[10] These preferences provide programs and off-grid lighting manufacturers and distributors with important information about the needs of both retailers and end consumers.

Table 2: Customer priorities when buying off-grid lighting products, as reported by retailers. The total number of responses was 179.

Customer priorities	(%)
Durability/quality	34
Run-time	20
Price/savings	17
Brightness	8
Type of charging	5
Guarantee	4
Utility/safety	4
Battery	4
Ease of repair	2
Brand reputation	1
Design preference	1

9. Of the retail shops surveyed, 5 percent were relatively new sellers of off-grid lighting products and did not report any failures or complaints from customers
10. Consumer Preference for Off-Grid Lighting Products Insights from a Study in Bihar and Odisha, Lighting Asia/India Program, IFC (2014)

Supply of Products

The survey showed that most retailers procured products from within the state. However, retailers from the larger cities of Patna and Bhawanipatna also sourced products from outside the state. Patna in Bihar and Bhawanipatna and Raipur in Odisha emerged as the preferred places for procurement of lighting products within the two states (image 7).

Though 65 percent of the retailers surveyed in Patna said they sourced products from within the city, some retailers also received products from cities outside the state, such as Delhi, Mumbai, Bangalore and Kolkata. Around 67 percent of retailers in the smaller town of Khusrupur, 88 percent in Bihta and 83 percent in Masaurhi sourced products from Patna, with the rest sourcing from within their towns.

In Odisha, around 40 percent retailers from Bhawanipatna said they procured products from within the city. Another 40 percent said they procured from Raipur, with a small number also procuring from Cuttack. In Junagarh, 50 percent said they purchased products from within the city and another 30 percent said they sourced from Raipur.

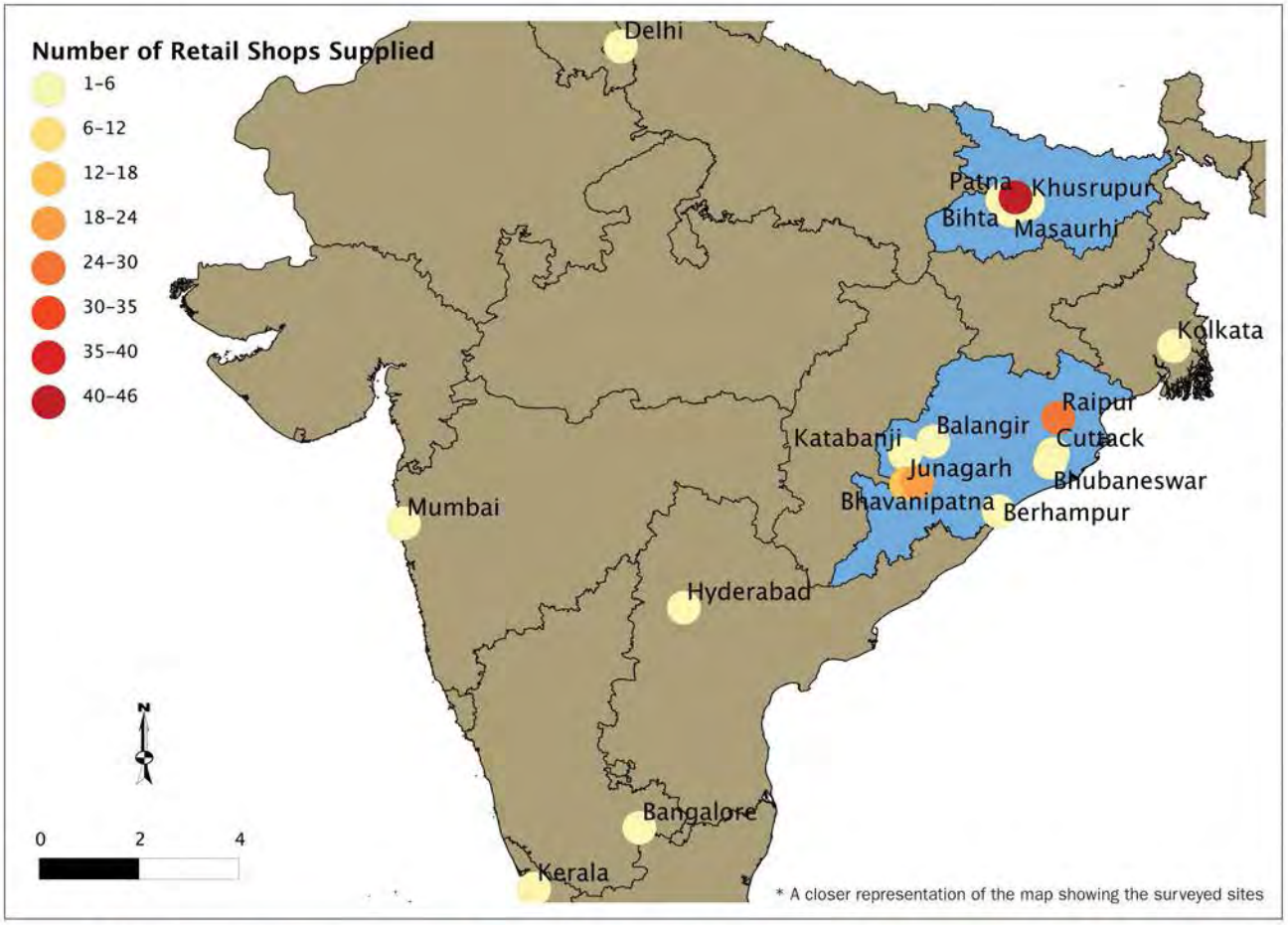

Image 7: Map showing primary sources of off-grid lighting products for surveyed retail shops in Bihar and Odisha. The dots on the map indicate the regions from where the retailers get products. The color of the dots represents the number of retailers that sourced products from that particular region (see key at top left).

Retailers from larger city centers generally received products through deliveries to their shops, while retailers located in smaller towns typically had to travel to the larger cities to procure products (figure 3). In Patna, 90 percent of retailers got products delivered to their shops. This was in contrast to smaller towns of Khusrupur, Bihta and Masaurhi where 60 to 90 percent of retailers picked up products themselves from wholesalers or manufacturers. In Odisha, around 25 to 30 percent of retailers indicated they had to arrange to pick up products.

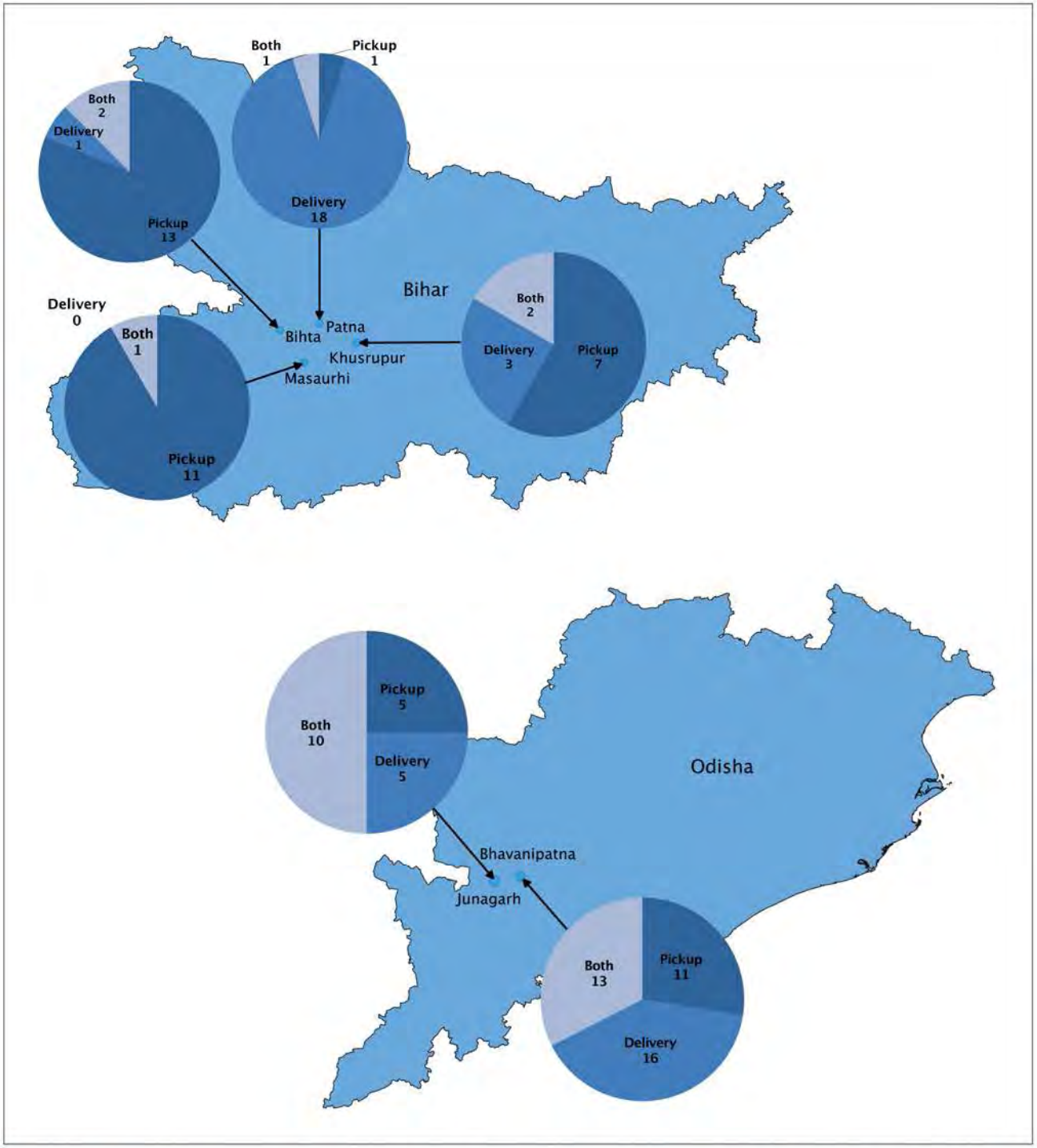

Figure 3: Product procurement and delivery options for retail shops in Bihar and Odisha. Generally, in larger cities such as Patna and Bhawanipatna, retailers get products delivered to their shops. In small towns retailers typically travel to larger city centers to procure lighting products.

Range of Off-Grid Lighting Products

Besides brand name and model number, the survey collected information about form factor, light source, and energy source for products sold. The results confirmed there was a wide range of lighting products available in the off-grid market. These products came in a variety of configurations and offered solutions to different consumer segments. The study identified 675 different models in the two states. However, a number of them were low-cost re-branded products with identical external features, indicating that actual variety available (in terms of performance and features) is lower than this value suggests. The larger city centers had a greater number and variety of lighting products compared to the range available in smaller towns.

The study showed that the use of LED technology was widespread in Bihar and Odisha; around 90 percent of products cataloged used LEDs. Most others used fluorescent lighting technology.

The form factors varied greatly among products, with a wide range of flashlights, ambient lights, and task lights available (image 8). Flashlights accounted for 35 percent of all lighting products, while ambient lights and multiple function lights (which offered both task and ambient light) accounted for 21 and 25 percent respectively.

Grid charging and dry cells were the most prevalent sources of energy. However, there was a small presence of solar-charged products in the shops. Patna had 21 solar-charged products (15 percent of all products) and Bhawanipatna had seven (5 percent). The smaller towns of Masaurhi and Junagarh had three and one solar products respectively.

In all, 30 different solar lighting products were available in the two states. Of these, around 95 percent were ambient lights; some also had task lighting and flashlight applications. Solar lighting products mostly used LED lighting technology (70 percent) while the rest used fluorescent technology. Along with solar charging, 22 percent of products provided grid charging as an additional feature. Only three Lighting Global quality assured off-grid lighting products were cataloged in the study. The low presence of solar charged off-grid lighting products suggested that retail store sales were not the dominant sales channel for these products. Field observations by the Lighting Asia team indicated that direct marketing played a larger role than retail shop sales for this segment.

For detailed information on solar-charged off-grid products, see Appendix E: Solar charged off-grid lighting product details.

Image 8: Off-grid lighting products in retail shops in Bihar and Odisha. Images on top show typically available task lights, ambient lights, and lights with multiple form factors available in the region. Images at bottom show dry cell and rechargeable flashlights.

Range of Off-Grid Lighting Products in Bihar

A large number and variety of off-grid lighting products were observed in each of the regions surveyed in Bihar (figure 4). A total of 153 different products were observed in Patna, 141 in Bihta, 104 in Masaurhi, and 56 in Khusrupur. A large number of these were LED-based. In Bihta and Masaurhi, 99 percent were LED-based as compared to 94 percent in Khusrupur and 77 percent in Patna. In Patna, fluorescent technology accounted for 20 percent of products.

Form factor varied greatly between the four towns surveyed in Bihar. In Patna, ambient lights accounted for 73 percent, while task lights and flashlights accounted for 10 percent and 12 percent respectively. The trend was slightly different in smaller towns, where multi-purpose lights were more prevalent. In smaller towns, multi-purpose products that function as task as well as ambient lights accounted for 20 to 50 percent. Additionally, flashlights accounted for significant numbers in the smaller towns: 45 percent in Bihta, 34 percent in Masaurhi, and 38 percent in Khusrupur. This reflects the typical needs of rural households who need portable lighting products for outdoor farm use.

The energy systems for off-grid lighting products observed in Bihar were largely electric grid and dry cell-based. The proportion of grid-charged products surveyed in the four regions varied from 50 to 70 percent. Dry cell-based charging systems were more prevalent in the smaller towns (24 to 35 percent) when compared to Patna (11 percent).

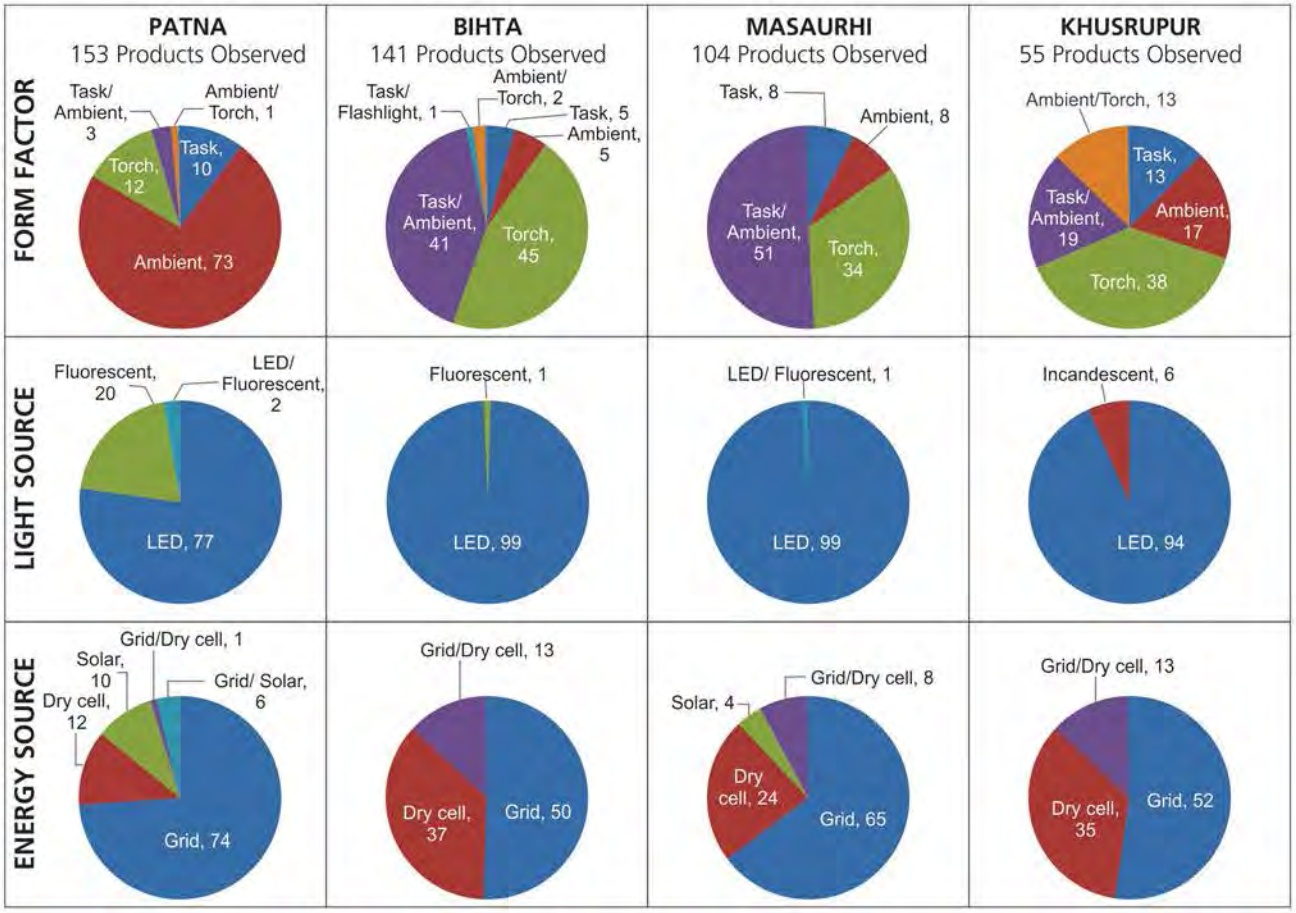

Figure 4: Form factor, light source and energy source trends (percentages) for off-grid lighting products in retail shops in Bihar. The four regions surveyed in Bihar are Patna, Bihta, Masaurhi, and Khusrupur. Refer to the column to find a particular region and then to a row to see the breakdown of products by category.

Range of Off-Grid Lighting Products in Odisha

As in Bihar, Odisha too had a large number and variety of off-grid lighting products (figure 5). Bhawanipatna had 148 different lighting products while Junagarh had 74. Most products were LED lighting: 85 percent in Bhawanipatna and 93 percent in Junagarh. The rest used fluorescent technology.

Lighting products in Odisha had a large variety of form factors. As in the smaller towns of Bihar, lights with multiple form factors were more prevalent than single use lights. In Bhawanipatna, 38 percent of lights had a combination form factor of task lighting, ambient lighting and flashlight. A further 11 percent had both task and ambient capabilities. This trend was reversed for Junagarh, with only 12 percent having a combination form factor of task lighting, ambient lighting, and flashlight, while 40 percent had task and ambient lighting. In addition to multiple form factors, flashlights had a large market presence; 45 percent in Bhawanipatna and 43 percent in Junagarh were flashlights.

The energy systems in Odisha were largely electric grid and dry cell-based technologies. The proportion of grid-charged products was 65 percent in Bhawanipatna and 60 percent in Junagarh. The presence of dry cell-based charging systems was also high: 24 percent in Bhawanipatna and 38 percent in Junagarh. Solar-based technologies in retail shops were limited in the region, with only 5 percent of products in Bhawanipatna and 1 percent in Junagarh using solar photovoltaic panels as an energy source.

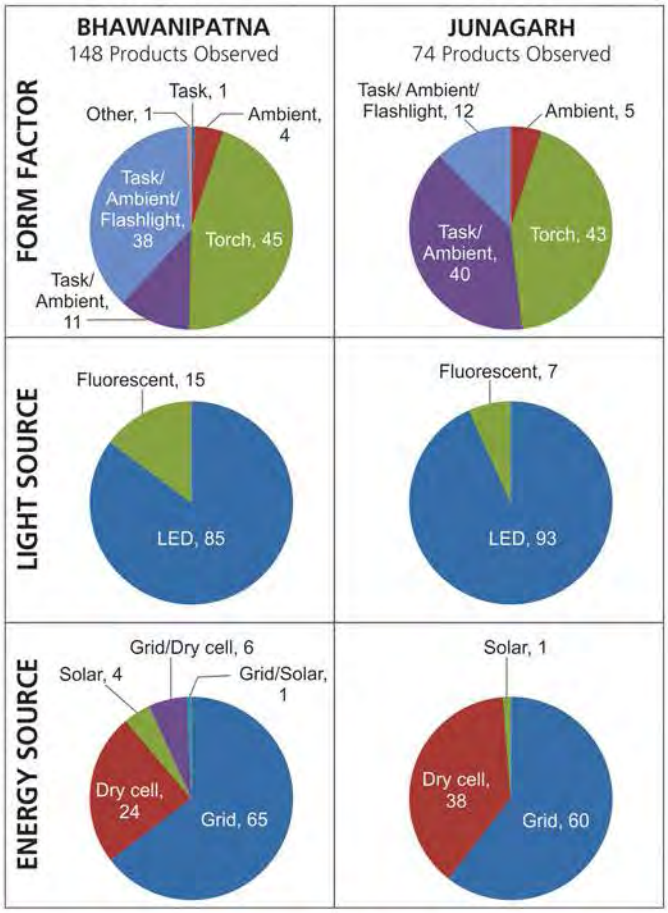

Figure 5: Form factor, light source, and energy source trends (%) for off-grid lighting products in retail shops in the two regions of Odisha. The two regions surveyed in Odisha are Bhawanipatna and Junagarh. Refer to the column to find a particular region and then to a row to see the breakdown of products within a category.

Off-Grid Lighting Product Price Analysis

The prices of approximately 80 percent of off-grid lighting products available in Bihar and Odisha were below Indian rupees 400 ($6.41).[11] This indicates that a large number of low-cost options are available to consumers (figure 6).The prices of solar-charged products were much higher than grid-charged and dry cell lighting products. Solar charged products had an average price of Indian rupees 1,320 ($21.14), ranging from Indian rupees 800 to 1,800 ($12.81to $28.83). In comparison, grid-charged products had an average price of Indian rupees 360 ($5.77) and dry cell products of Indian rupees 170 ($2.72); both categories had a relatively narrow range of prices.

Price comparisons between LED and fluorescent lighting products showed that LED lighting was cheaper than fluorescent with an average price of Indian rupees 277($4.44) compared to Indian rupees 941($15.07) for fluorescent lighting. Cheaper LED lighting products may be one reason for the widespread use of LED products in both states compared to fluorescent-based lighting. According to form factor, flashlights tended to be the lowest priced products. Flashlights had an average price of Indian rupees 120 ($1.92) followed by task lighting with Indian rupees 230 ($3.68), followed by multiple function lighting that ranged from Indian rupees 200 to 400 ($3.20 to $6.41). Ambient lights were the most expensive form factor and ranged in price from Indian rupees 550 to 700 ($8.81 to $11.21).

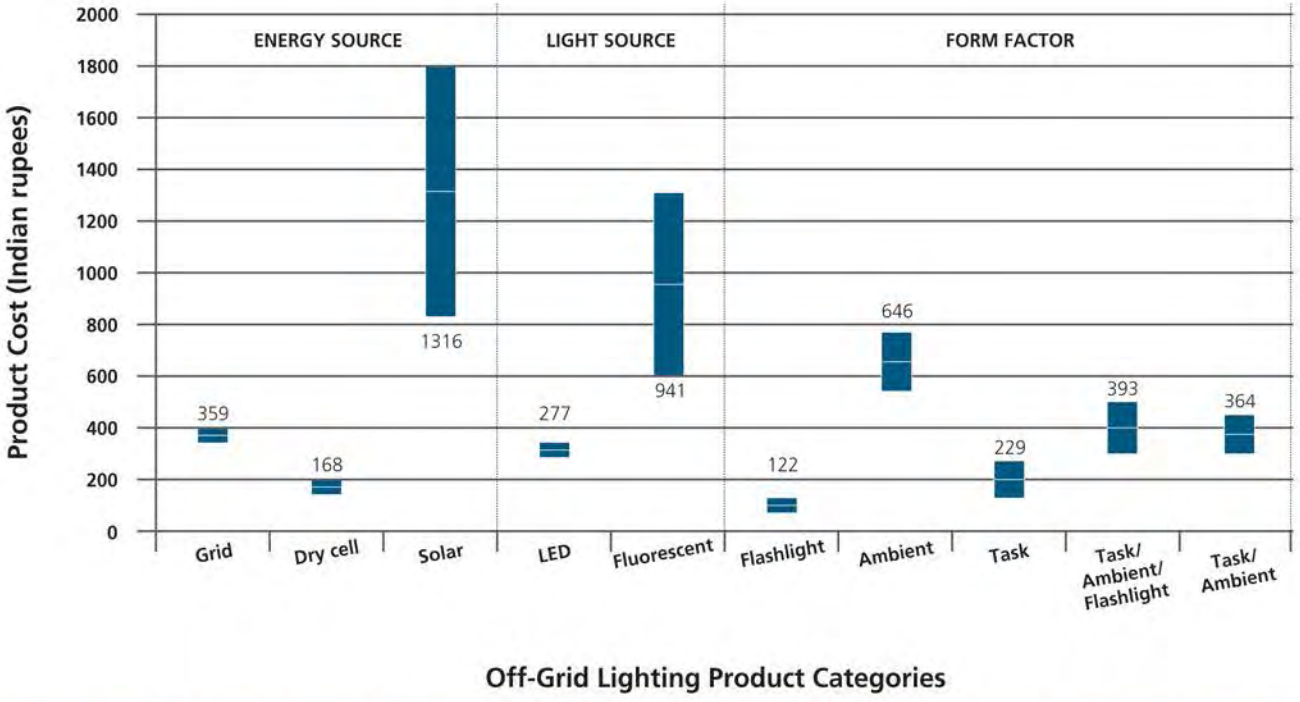

Figure 6: Breakdown of off-grid lighting product retail prices by energy source, light source and form factor. The center horizontal line and value of the box plot indicates the average retail price with the extremes defined with a 99 percent confidence interval (alpha=0.01).

11. Exchange rate of $1= Indian rupees 62.43 (as on February 12, 2014; Reserve Bank of India)

Bihar Price Analysis

Shops surveyed in Patna city had a wider range of products than shops in the small towns (figure 7). Lighting product prices in Patna ranged from as low as Indian rupees 50 to 2,000 ($0.80 to $32.04). Around 50 percent of products cataloged in Patna were priced below Indian rupees 400 ($6.41). However, there were also a number of products available in the higher price brackets. Overall, 20 percent of products were priced between Indian rupees 401 and 800 ($6.42 to $12.81). Products in the smaller towns of Bihta, Masaurhi, and Khusrupur were generally lower-cost units, with 95 percent priced lower than Indian rupees 400 ($6.41).

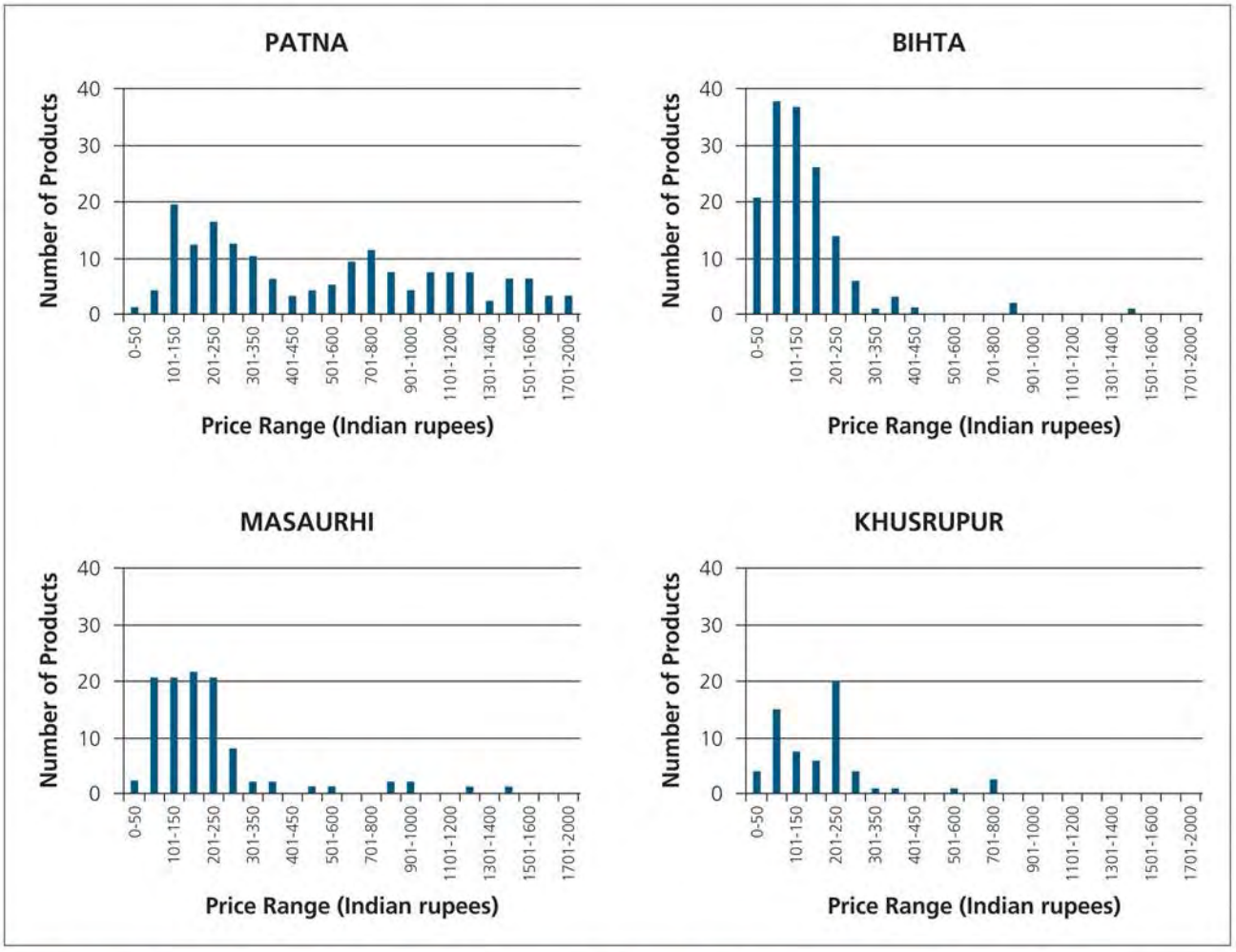

Figure 7: Price breakdown of off-grid lighting products in Patna, Bihta, Masaurhi, and Khusrupur in Bihar.

Odisha Price Analysis

As in Bihar, the bigger city center of Bhawanipatna, Odisha had a wider range of product types than the smaller town of Junagarh (figure 8). In Bhawanipatna, 80 percent of lighting products were priced below Indian rupees 400 ($6.41). A further 12 percent was in the range of Indian rupees 401 to 800 ($6.42 to $12.81), with a few products available at higher prices, even as high as Indian rupees 6,000 ($96.11). In Junagarh, options were comparatively limited, with around 95 percent of products priced below Indian rupees 400 ($6.41).

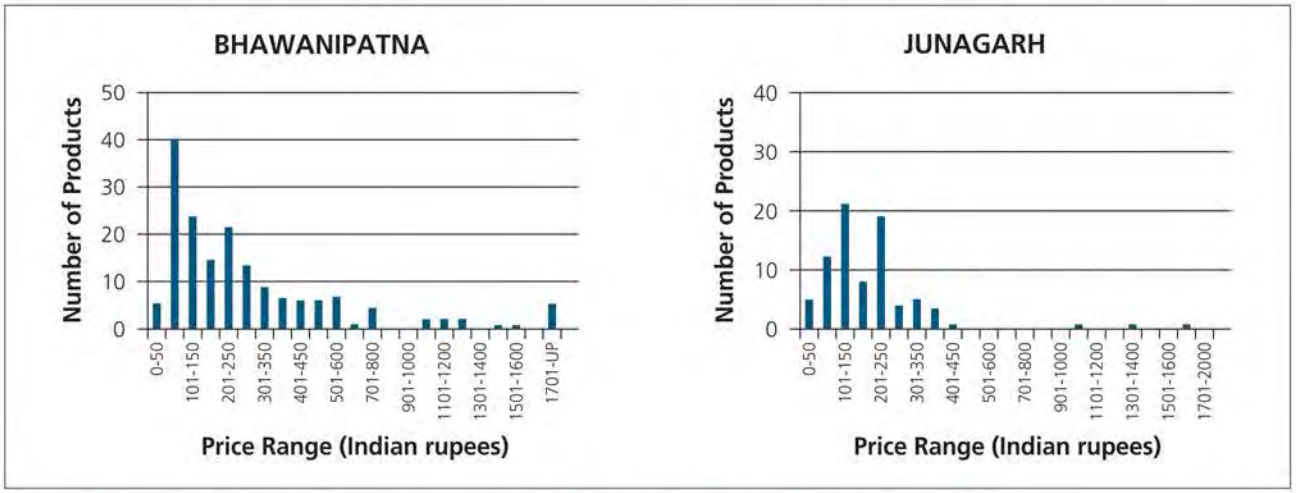

Figure 8: Price breakdown of products surveyed in Bhawanipatna and Junagarh in Odisha.

Off-Grid Lighting Market Size

Information on sales of off-grid lighting products was collected from shops in small towns in Bihar and Odisha. Retailers were asked to share sales and prices of particular products in the seven days prior to the survey. These weekly sales data were then used to estimate monthly sales volumes by unit and revenue for each of the respective regions (table 3).[12] These sales numbers should be taken as indicators rather than accurate values, given uncertainties associated with assumptions used in the estimates. Note that the numbers do not include direct marketing sales of solar off-grid lighting products.[13]

Results from the analysis show a thriving local economy for off-grid lighting products. Around 990 off-grid lighting products were sold in the three towns of Junagarh, Masaurhi, and Khusrupur every month. Assuming that the low-cost products lasted for around three months on an average and monthly sales were sustained at this rate, the quantity sold would mean that roughly 20 percent of households in these towns used these products. This estimate suggested a relatively high penetration of off-grid lighting products, given that the technologies were quite new. However, while the sales numbers were reasonably high, the revenue associated with these sales, about Indian rupees 150,000 ($2402.7) per month, was low due to the low average price of the products. Further, given the high failure rates of the products, they could be considered consumable items that are replaced often, rather than durable goods. Anecdotal evidence from retailers showed that the increased availability of warranties would increase customer faith in the products. This, in turn, could lead to increased sales volumes.

12. Retailers were asked to indicate sales volumes of each of their lighting products using a scale that involved discreet ranges. That is, for each product they were asked to report if they had sold 1-5 units, 6-10 units, or 11-20 units, etc. over the past week. The lower value in each of these discreet ranges was then used to estimate weekly and then monthly (four weeks) sales numbers for each product. The reported prices of each of these products were then used to estimate total sales revenues

13. Field observations by the Lighting Asia team indicate that direct marketing sales are more common than retail shop sales for sales of quality assured solar lighting products. Given the focus on retail shops, this study did not capture information about direct marketing sales

As indicated in table 3, the town of Junagarh in Odisha had a thriving local economy for off-grid lighting options with around 560 lighting products sold per month for a total of around Indian rupees 82,000 ($1,314). Although the town has a small population of 16,000, the markets serve a number of local off-grid lighting communities which results in a high volume of sales. The town of Khusrupur in Bihar also has a strong off-grid lighting market with an estimated 300 products sold in a population of around 12,200. The estimated sales revenue in this town amounts to Indian rupees 33,600 ($538) per month. Khusrupur has a relatively smaller off-grid lighting market, with sales volumes of around 130 products per month. This amounts to a revenue of Indian rupees 30,700 ($492) in a month.

Table 3: Estimated monthly sales volumes and revenues for off-grid lighting products by region.

State	Town	Approximate number of households (2001 Census Data)[14]	Estimated monthly sales revenue (Indian rupees)	Estimated number of products sold per month
Odisha	Junagarh	3,200	82,000	560
Bihar[15]	Khusrupur	2,450	33,600	300
	Masaurhi	9,400	30,700	130
Total		**15050**	**146,300**	**990**

14. Information on population at the village/town level is not available from the Census of India, 2011 at this time. As a result, data from the earlier 2001 census were used. An assumption of five persons per household was made to estimate number of households in each of the three towns. Available from, http://www.censusindia.gov.in/towns/town.aspx

15. Information around sales volumes for retailers surveyed in Bihta (Bihar) was collected but not included in this section since the region where information was collected is part of a large satellite city, Bihta with a population of over 2,10,000 people

Key Findings

The study showed that a large variety of products were available in the off-grid lighting market. These products came in a variety of configurations and offered solutions to different customer segments. In all, 675 different models of off-grid lighting products were identified in the two states. However, a number of the products identified were low cost re-branded products with identical external features, indicating that the actual variety (in terms of performance and features) was some what lower than this value suggested.

A greater number and variety of lighting products was available to customers in the cities, when compared to the smaller towns. Moreover, the prices of approximately 80 percent of the cataloged off-grid lighting products available in Bihar and Odisha were below Indian rupees 400 ($6.40). Though these products used dry cell batteries or grid charging rather than solar charging, it confirmed that a good number of electric lighting options were available to consumers at low initial purchase prices.

The study indicated that the majority of off-grid lighting products available in retail shops either used dry cell batteries or rechargeable batteries that charged using AC power. The presence of solar charged off-grid lighting products was low in the shops surveyed. Thirty different solar lighting products were observed in the two states. Only three Lighting Global quality assured off-grid lighting products were cataloged in the study. The low presence of solar charged off-grid lighting products suggested that retail sales were not the dominant sales channel for these products. Field observations by the Lighting Asia team indicated that direct marketing sales currently play a larger role than retail shop sales for this segment.

Some of the key field research findings are highlighted below.

- **The use of light-emitting diode (LED) technology was widespread in Bihar and Odisha, where around 90 percent of the observed off-grid lighting products were LEDs.** Most of the remaining products used fluorescent lighting technology.

- **Around 90 percent of products surveyed used grid charging and/or dry cell batteries as sources of energy,** though, as noted above, there was a small presence of solar-charged products in the larger cities of Patna and Bhawanipatna and in two of the smaller towns.

- **In the regions surveyed, 35 percent of all lighting products were flashlights.** Ambient lights and multiple function lights (which offered both task and ambient light) were also widely available, representing 21 percent and 25 percent of the surveyed products respectively.

- **The average price of solar-charged products was much higher than grid-charged and dry cell battery lighting products.** Solar-charged products ranged in price from approximately Indian rupees 800 ($12.81) to 1,800 ($28.83). In comparison, grid-charged products were priced at around Indian rupees 360 ($5.77) and dry cell products at around Indian rupees 170 ($2.72); both having a relatively narrow range of prices.

- **Low-cost products tended to use LED technology rather than fluorescent bulbs.** LED lighting products had an average price of Indian rupees 277 ($4.44) compared to an average price of Indian rupees 941 ($15.07) for fluorescent lighting systems. LEDs are smaller, can operate at higher efficiency and, therefore, lower power. They require simpler circuitry than fluorescent bulbs, and therefore cost less. This cost difference accounted for the greater availability of LED products in both states, as compared to fluorescent lighting technologies.

- **Considering the form factor, flashlights tended to be the lowest priced.** Flashlights had an average price of Indian rupees 122 ($1.95) followed by task lighting with an average price of Indian rupees 229 ($3.67). These lighting options were followed by multiple function lighting systems that ranged from Indian rupees 200 ($3.20) to 400 ($6.41). Ambient lights were the most expensive in terms of form factor and ranged in price from Indian rupees 550 ($8.81) to 700 ($11.21).

- **Around 50 percent of all reported product failures was related to batteries and another 20 percent was due to LEDs.** Further, 12 percent of reported failures was related to charging circuits of grid-charged products and another 7 percent was due to switch and connector failures. Despite reported failures in the field, few retail shops (11 percent) offered any complimentary after-sales service. The main reasons cited for lack of service were the high presence of low-quality products and absence of warranties from most manufacturers. However, a large number of retail shops (76 percent) indicated they were aware of local technicians who offered repair services for a fee.

- **According to retailers, the highest priority for customers was product quality and/or durability.** The number of hours a light can be used each day and the retail price (and corresponding potential savings over existing lighting methods such as kerosene lamps) were the second and third highest priority customer concerns. These were followed by brightness of the light, type of charging mechanism, and warranties.

- **Market sizing analysis showed a thriving local economy for off-grid lighting products.** Around 990 off-grid lighting products were sold in the three towns of Junagarh, Masaurhi, and Khusrupur every month. Assuming that the low-cost products lasted for around three months on an average and monthly sales were sustained at this rate, the quantity sold would mean that roughly 20 percent of households in these towns used these products. This estimate suggested a relatively high penetration of off-grid lighting products, given that the technologies were quite new. However, while the sales numbers were reasonably high, the revenue associated with these sales, about Indian rupees 150,000 ($2403) per month, was low due to the low average price of the products. Further, given the high failure rates of the products, they could be considered consumable items that are replaced often, rather than durable goods. Anecdotal evidence from retailers showed that the increased availability of warranties would increase customer faith in the products.

Conclusion

This study will provide information to market stakeholders about the market presence of off-grid lighting products in retail shops in select states of India. The report gives a snapshot of the current market scenario with respect to technology, product pricing, product penetration, sales volumes, and retail store characteristics. Information on the presence of solar charged off-grid lighting technologies in the conventional retail supply chain is also presented here. This study will be especially useful to manufacturers and distributers of solar charged light technologies interested in understanding the options currently available to end-consumers in the selected states.

Appendix A. Retail shop information sheet

This section gives additional information on the methods used during the fieldwork in Bihar as well as some of the results from the analysis.

Retailer Information Sheet

The survey tools used in this study was adapted from a previous market presence field study in Kenya under the Lighting Africa Program.

Off-grid lighting research in rural India, retailer information sheet.

Surveyor Names_____

Date		**Town**	
Shop Name			
Location			
GPS Point #		**Box #**	
Phone #			
Shop Type	**Electrical/ [1] Gen Shop [2] Supermarket [3] Hardware [4] Solar [5] Electronics**		
	Kiosk [6] Market Stall [7] Table [8] Hawker [9] OTHER [10]		
# Employees	**1-2 [1] 3-5 [2] 6-10 [3] 11+ [4]**		

Interviewee

Name	
Gen	**M** [1] **F** [2]
Position	**Owner** [1] **Worker** [2] **Other** [3]

Notes _____

_____

_____

_____

1.1 When did the shop **first** start selling LED off-grid lighting products?

☐ 3 months ago [1] ☐ 6 months ago [2] ☐ 1 year ago [3]

☐ 1.5 years ago [4] ☐ 2 years ago [5] ☐ 3 years ago [6]

☐ 3- 6 years ago [7] ☐ 6+ years ago[8] ☐ Do not sell yet [9]

1.2 Is this a normal week for sales?

☐ Low [1] ☐ Normal [2] ☐ High [3]

1.3 **Why** do you think people buy some products over others? What are their priorities?

1.4 What are the **main problems** that you or your customers have experienced with the lighting products that you sell? (Mark all that apply)

☐ LEDs fail ☐ Battery failure ☐ Breakage from dropping

Other Problems experienced:_____

1.5 Where do customers go for repairs of the products they purchase from your shops?

1.6 Do you mainly sell products on a **retail** basis or a **wholesale** basis?

☐ Retail [1] ☐ Wholesale [2] ☐ Both [3]

1.7 Who are the **customers** that buy the off-grid lighting products?

a) ☐ Mostly Men [1] ☐ Mostly Women [2] ☐ Both Equally [3]

b) ☐ Under 40 years [1] ☐ Over 40 years [2] ☐ All ages evenly [3]

1.8 Where is the main source of **your products?** _____

1.8.1 **How** do you get them?

☐ Go to buy [1] ☐ Products are delivered [2] ☐ Both [3]

1.9 Does your shop offer any **credit** to customers or **guarantees** on products?

☐ Credit Offered [1] ☐ Guarantee Offered [2]

☐ Both Offered [3] ☐ None Offered [4]

1.10 Do you access **credit** to run your business: ☐ Yes [1] ☐ No [0]

1.10.1 **If so, where** does it come from? (Mark all that apply) ☐ NA

☐ Bank ☐ Distributor ☐ Friend/Family

☐ _____ ☐ Other_____

Appendix B. Retail shop survey data (for city)

Off-Grid Lighting Research in Rural India, Product information sheet.

Shop Name _____ Surveyor Initials _____

If being sold, check for BIS, indicate price or make an X for unknown price.

Fill each line completely.

	Is product cost subsidized?	Form Factor				Source			Energy				BIS	Price	Remarks
Code for data entry ➡															
Product Brand/ Model (and features)		Task	Ambient	Flashlight	Other	LED	Incan	Fluor	Grid	Dry cell	Solar	Dynamo	BIS?	**Price (Indian rupees)**	

Appendix C. Retail shop survey data (for small town)

Off-grid lighting research in rural India, Product information sheet.

Shop Name _____ Surveyor Initials _____

If being sold, check for BIS, indicate price or make an X for unknown price. Record how many sold in past 7 days.

Fill each line completely.

	Is product cost subsidized?	Form Factor				Source			Energy				BIS	Price	About how many did you sell in the past 7 days?						
Code for data entry ➡															[1]	[2]	[3]	[4]	[5]	[6]	[7]
Product Brand/ Model (and features)		Task	Ambient	Flashlight	Other	LED	Incan	Fluor	Grid	Dry cell	Solar	Dynamo	BIS?	**Price (Indian rupees)**	**0**	**1-5**	**6-10**	**11-20**	**21-30**	**31-40**	**40+**
Keychain LED																					

Appendix D. Retail shop demographic

Table 4: Location and profile of the retail shops interviewed during the field study in Bihar

BIHAR					
Location		Patna	Masaurhi	Bihta	Khusrupur
Sample size		20	12	16	12
Interviewee gender					
Male (%)		90	100	100	100
Female (%)		10	0	0	0
Business characteristics					
Shop type (%)	Electronics	50	42	44	33
	General shop	0	42	56	58
	Hardware	20	0	0	0
	Market stall	0	0	0	0
	Solar	30	17	0	0
Sales type (%)	Retail	40	100	100	100
	Wholesale	0	0	0	0
	Both	60	0	0	0
Number of employees (%)	1 - 2	75	83	100	100
	3 - 5	25	17	0	0
	6 - 10	0	0	0	0
How long ago did the shop begin selling LED off-grid lighting products (%)?					
3 months		10	50	19	17
6 months		5	17	31	17
1 year		10	0	25	25
1.5 years		0	0	0	8
2 years		20	17	6	0
3 years		20	0	13	17
3 - 6 years		35	8	6	8
6+ years		0	8	0	8
Do not sell yet		0	0	0	0
Customer demographics					
Gender (%)	Mostly men	65	17	25	42
	Mostly women	0	0	0	0
	Both equally	35	83	75	50
Age (%)	Under 40 years	25	8	13	8
	Over 40 years	10	0	13	17
	All ages evenly	65	92	75	75

Table 5: Location and profile of the retail shops interviewed during the field study in Odisha

ODISHA			
	Location	**Bhawanipatna**	**Junagarh**
	Sample size	40	20
Interviewee gender			
	Male (%)	97.5	100
	Female (%)	2.5	0
Business characteristics			
Shop type (%)	Electronics	47.5	50
	General shop	50	45
	Hardware	2.5	0
	Market stall	0	5
	Solar	0	0
Sales type (%)	Retail	90	85
	Wholesale	0	0
	Both	10	15
Number of employees (%)	1 – 2	95	90
	3 – 5	5	5
	6 – 10	0	5
How long ago did the shop begin selling LED off-grid lighting products (%)?			
	3 months	15	10
	6 months	10	5
	1 year	12.5	10
	1.5 years	5	5
	2 years	5	20
	3 years	5	5
	3 - 6 years	20	30
	6+ years	25	15
	Do not sell yet	2.5	0
Customer demographics			
Gender (%)	Mostly men	50	30
	Mostly women	0	0
	Both equally	50	70
Age (%)	Under 40 years	0	0
	Over 40 years	0	0
	All ages evenly	100	100

Appendix E. Solar charged off-grid lighting product details

This section details the different types of solar charged products carried by retailers in the two states along with their retail prices.

Table 6: Location, brand name, type and cost of solar off-grid lighting products cataloged in the field study (Exchange rate of $1= Indian rupees 62.43)

Brand/model number	LED light	Fluorescent light	Grid charge	Retail price (Indian rupees)
Bhawanipatna (Odisha)				
ANDAS LIGHT-SHL-1		Yes		6000
D-LIGHT S-20	Yes			600
PS-8170 LX - SOLAR		Yes	Yes	600
SOLAR VAN-05XX2A		Yes		4500
SOLAR-PETRO MAX 12 VOL		Yes		4500
SUN KING PRO	Yes			1600
SUN KING ECO	Yes			550
Junagarh (Odisha)				
SUNKING PRO	Yes			1400
Masaurhi (Bihar)				
GEE LITE	Yes			1000
MITVA (NIPPO) MS-16	Yes			500
SUN KING SOLO	Yes			850
Patna (Bihar)				
AVNI	Yes			1600
BPL S.LITE SL1300	Yes		Yes	1300
BPL S.LITE L605		Yes	Yes	1649
BPL S.LITE LANTERN SL650		Yes	Yes	1529
ELECTRO POWER SOLAR LANTERN		Yes		1200
EURO DIYA	Yes			1850
EXIDE SOLALITE	Yes			1500
KETAN KEL-12T		Yes	Yes	1390
METRON		Yes		1300
METRON MMISO/AR LANTERN	Yes			680
MITVA (NIPPO) MS-16	Yes			550
MITVA (NIPPO) MS-322	Yes			1600
NO BRAND NAME	Yes			280
NO BRAND NAME	Yes			1050
SOLAR LED LANTERN (3NT)	Yes			1100
SUNMAC	Yes		Yes	1200
SURYA SHAKTI	Yes			1600
TAIBA TB 2020L5	Yes			400
TAIBA TB 3517	Yes			600
WONDER LAMP	Yes			450

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About Lighting Asia/India

Lighting Asia/India is a market-transforming program with the objective of promoting the value and presence of modern off-grid lighting among two million people in rural India. Modern off-grid lighting includes solar lighting appliances, home systems, and connections to renewable energy mini-grids. The program is designed as a series of interventions to alter market behavior, reach two million people, and displace at least 64,000 tons of CO_2 by the end of 2015.

For more information, visit www.lightingasia.org

In partnership with

About Lighting Africa

Lighting Africa, a joint initiative of IFC and the World Bank, accelerates the development of markets for clean off-grid lighting products in sub-Saharan Africa. The program mobilizes the private sector to build sustainable markets that will provide millions of people in Africa not connected to grid electricity with clean, affordable, quality lighting products, most of which are solar powered.

For more information, visit www.lightingafrica.org

About Lighting Global

Lighting Global is a joint IFC/World Bank program which manages the quality assurance framework and testing for the regional Lighting Asia and Lighting Africa programs. Lighting Global maintains a set of Minimum Quality Standards which off-grid lighting products must meet to access program services.

For more information, visit www.lightingglobal.org

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