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A Study on Demand of Energy-Efficient Illuminating Devices in Smart City Guwahati and Its Implications for North Eastern India

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Abstract

Energy-efficient illuminating devices are very much in vogue primarily due to two reasons one to curtail non-renewable energy consumption and other is the increased price efficiency of these devices due to lowering prices over a period of time. The purpose of the current study is to understand the demand for LED as a product i.e. LED bulbs and LED batten in district Guwahati of the northeast region of India and to find the variation in demand in lighting segment in core and non-core areas of Guwahati in North-Eastern region of India. Energy-efficient illuminating devices like LED lighting has vast potential in India especially in the North-Eastern region which is facing immense power shortages and high electricity costs. The objective of the study finds if an identified top 20 smart city like Guwahati has moved in the direction to adapt the energy-efficient illuminating devices like LED or not. Further, the study intends to unearth the demand implications of adoption or non-adoption of LED devices in Guwahati city for the northeastern region in India. An important argument that appears on the horizon is that energy-efficient lighting at affordable cost is no doubt a must but an equilibrium is sought in the divergent interests of stakeholders involved i.e. consumers, government, manufacturers and sellers whether state-owned or private distributors and retailers.

Keywords: LED, Energy-efficient Illuminating Devices, Lighting Devices, North-East India

Introduction

Energy-efficient illuminating devices are very much in vogue primarily due to two reasons one to curtail non-renewable energy consumption and other is the increased price efficiency of these devices due to lowering prices over a period of time. As per the 2018 market research report on LED lighting market size, share and trends analysis by product, by design, by application and by segment these devices are much more cost-effective than incandescent lights. They have the capability to illuminate for 50,000 hours with a nominal amount of energy consumption. They are ten times better than traditional lighting solutions by way of having low cost and efficient functioning with respect to weight, temperature and response time.

The Asia Pacific region is the largest manufacturer as well as the consumer of these devices due to public policy interventions. Due to various government initiatives and municipality support mechanism, the demand for these devices is pushed further. This has also lead to an increase in a number of market players which produce these devices.

In the Indian context due to rapid urbanization demand for electricity has gone up in the last decade however supply has not been that adequate which has led to problems like frequent load shedding. The Indian energy sector has shown its commitment to this issue by way of policy and

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regulatory interventions in the better interest of various stakeholders and market players. Apart from the focus on conventional energy sources, there is equal thrust on renewable energy with respect to energy consumption as well as sensitization towards energy saving. One such way out is thrust on the use of energy-saving devices.

The purpose of the current study is to understand the demand for LED as a product i.e. LED bulbs and LED batten in smart city Guwahati of northeast region of India and to find the variation in demand in lighting segment in core and non-core areas of Guwahati in North-Eastern region of India. The variation in demand for LED bulbs and battens in core and non-core areas of Guwahati can be used as an indicator of acceptance of these devices either in relatively developed areas or it may also be an indicator of uniform adoption of LEDs by households. It is further to be seen that if the demand for these cost and energy-efficient devices has cut across to the masses in suburban to semi-rural areas in the not so developed region like North East India. If LEDs are demanded all over in Guwahati irrespective of core or non-core areas than such an assumption can be made for rest of the region as well.

The Government of India intends to transform 100 Indian cities into 'Smart Cities' out of which Guwahati happens to be one of the twenty cities to be selected in the first round of smart cities challenge. To become a smart city the basic infrastructure like transportation, water supply, housing, electricity supply needs to be upgraded. The Government of India with a loan from Asian Development Bank has been upgrading Assam's power sector gradually since the last decade in the interest of economic growth, human development aspects such as poverty reduction, employment generation through secure energy supply etc., (adb.org, 2016.) Energy-efficient illuminating devices like LED lighting has vast potential in India especially in the North-Eastern region which is facing immense power shortages and high electricity costs. India as a whole and states like Assam and the other six sister states struggle to meet the increasing electricity demand which is leading our country to build more power plants for sustaining the higher electricity demand of this region. However, there is an alternative which can make an incremental difference to the situation. By virtue of changing light bulbs to the new LED technology which is one of the best energy-efficient illuminating devices, one can surprisingly reduce the country's electricity demand by as much as 40 percent. As compared to CFLs, LEDs are 50 per cent more energy efficient. LEDs don't contain any toxic mercury as is the case with CFL. Also, the life of an LED lamp is four to five times more than that of a CFL, and, therefore, it is a cheaper option on life cycle cost basis. Though it has been observed that there is a rising trend to switch from incandescent light bulbs and CFLs to more cost-effective and energy-efficient illuminating devices like LEDs however, this trend needs to be observed statistically also. The Government of India & state governments of the seven sisters in north-east India has been instrumental in pushing the use of LEDs with huge subsidies. Therefore, the study seeks to map the electrical outlets of Guwahati city to collect demand data from sellers of lighting devices over a period of two months of May and June 2018. In order to argue a shift or increase in the demand for energy-efficient illuminating devices in North Eastern region of India the data from sellers of Guwahati has been collected because it is an identified selected smart city in the making. The results of the study may be considered as a representative for the possible demand for more such energy-saving devices in the North Eastern Region of India in the times to come.

Literature Review

Singh and Michaelowa, 2004 found in their paper that in the interest of clean development mechanism (CDM) of the Kyoto protocol there should be the focus on appliance disseminations. Here, the use of energy-efficient devices is going to play a very important role. In terms of energy demand, India ranks sixth in the world therefore it is all the more important for the government to take steps in the direction of efficient and optimized energy utilization. Though the demand for energy depends a lot on region and climate however buildings which can be a household or a commercial space commonly use energy for both lighting as well as for cooling & heating. The urban households meet their 87% of energy demand through clean energies like electricity and LPG but on the other hand, only 43.5% rural households have electricity connections and 85% of them use it for lighting purpose only. Hence energy-efficient lighting solutions have a huge scope for energy savings irrespective of a household being urban, semi-urban, or rural. The compact Fluorescent lights and LEDs are energy-efficient and can greatly help in reducing energy demand.

Fouquet and Pearson, 2006, have argued that the next revolution in lighting technologies would be brought through LEDs, organic LEDs and other developments leading to a dramatic decline in the price of these lighting solutions. Energy use, in the long run, would depend a lot on energy improvements related to energy use.

Khan and Abas, 2010, did a comparison of florescent lamps, LEDs with incandescent bulbs and found them to be equally good for light emissions and further found LEDs to be on the lower side of operational costs. A normal bulb consumes the power of 100 watts to give lumens of 1700 while a LED bulb consumes only 15watts for the same lumens of light. Hence there is huge energy-saving and cost-saving potential attached with the use of LED bulbs. However they deduced that it is very important to increase the awareness about LED amongst the business community by way of media campaigns, cost reduction of bulbs, technical know-how sharing and international policy push in order to push the demand for LED lights in Pakistan.

Fouquet and Pearson, 2012, have argued a shift in the demand towards efficient lighting solutions due to their relative complex implications for energy consumption. Incandescent light bulbs are banned since 2012 in Europe and were phased out by 2014 in the USA. Such improvements in energy-efficient lighting solutions are pertinent not just for Europe and USA but for the whole world.

Mills and Schleich, 2013, studied the adoption of energy-efficient lighting technologies by households in Germany. They examined the factors associated with the transition of households from incandescent lighting (IL) to CFL and LED lighting. They highlighted that the European Union ban on IL and state preference for environment-friendly lighting solutions fostered the transition to energy-efficient lighting. Cuba was the first country followed by Australia and New Zealand to ban ILs. Canada, China and US also followed the IL ban.

Ganandran et. al, 2014, studied the payback of lighting retrofits which is around four years in Malaysia. Lighting retrofit is a process of replacing inefficient light systems with more efficient light systems. The modern light sources can produce a similar light in comparison to traditional sources at half the cost. Lighting, on one hand, consumes 20-30% electricity of the world while on the other hand, the major consumption of electric lighting happens in commercial and residential sectors. A much research effort went into to improve the LED bulbs. The brighter models available today have improved light quality at low prices.

As per the Ministry of Power, Government of India, 2019, there is special emphasis on rural electrification under the various schemes like "Deendayal Upadhyaya Gram Jyoti Yojana" of the current government. A good many Below the Poverty Line (BPL) households have also been provided free connections and lakhs of villages have been brought under electrification with a special category status being given to all states of North East including Sikkim, J&K, Himachal Pradesh and Uttarakhand. Under the Energy Conservation Act, 2001, The Ministry of Power through Bureau of Energy Efficiency (BEE) launched Standards & Labeling (S&L) scheme for equipment and appliances so that consumers can make an informed choice about the energy and cost-saving potential of a device. Such a labelling encompasses 21 appliances including the lighting devices.

The Ministry of Urban Development (MoUD) Government of India under its smart city mission identified Guwahati the state capital of Assam to be a part of the top 20 cities in India for inclusive and sustainable development. One of the core infrastructure elements of a smart city is assured electricity supply. The smart solutions with respect to the energy that can be adopted in smart cities are energy management, smart metering, and renewable sources of energy, energy-efficient and green buildings and street lighting (The Assam Tribune, 2019.) The LED street lighting can really make a difference to reduction in energy consumption (India Smart City Mission, MoUD, GOI, 2015) Post the launch of Smart City Mission (SCM) in India in 2015 smart lighting systems gathered momentum cities like Guwahati have already issued tenders for street lighting and city lighting systems. Light management by way of light on demand, plug and play and use of LED lighting had the potential to save a lot of energy (India Infrastructure.com, 2018).

Objective

The objective of the study finds if an identified top 20 smart city like Guwahati has moved in the direction to adapt the energy-efficient illuminating devices like LED

or not. Further, the study intends to unearth the demand implications of adoption or non-adoption of LED devices in Guwahati city for the northeastern region in India.

Research Methodology

The adoption of LED which is an energy-efficient device can be gauged either by approaching the end consumer of these products i.e. households and commercial buildings in the Guwahati city or alternatively adoption can also be argued with the help of sales data collected from the sellers of LEDs. Since randomly approaching a desirable number of households and commercial establishments in the fieldwork of only 2 months was a challenging task therefore it was decided to approach the sellers of these products. Philips Lighting India was approached and was requested to share an indicative list of sellers of LED devices like bulbs and battens in Guwahati. The company which has in its product portfolio the LED-based lighting solutions both for domestic and commercial purposes specifically identifies LEDs based products as smart city solutions. Philips provided a wide range of led based luminaries be it lamps or tubes such as LED spots, LED tubes, LED capsules and specials etc. (http://www.lighting.philips.co.in) For the purpose the current study two generic LED-based lighting devices i.e. a bulb and a tube-light are identified for the purpose of this study. The nomenclature used for a bulb is LED bulb and for LED-based tube-light is 'LED batten.'

In order to map an existing electrical outlet/seller in Guwahati city and to find its business potential to sell energy-efficient illuminating devices, it was important to visit each of these in order to collect the respective demand data. The current demand and potential demand for these products means current sales data and potential sales/demand data based of existing sales and as quoted by these electrical outlets which sell Philips lighting products as well as products of its competitors who have a presence in Guwahati like Havells, Osram, Eveready, Wipro, Oreva, Bajaj. Syska, Charlton, Moserbear, Surya, Crompton, NTL Lemnis.

Data Collection

In order to find out the actual demand and the potential demand of various lighting products including the energy-efficient illuminating devices and simultaneously map the electrical outlets in and around Guwahati city, the city was divided into 30 beat areas to easily identify these outlets and visit them. Actual data from electrical outlets found in the respective beat area was collected and was compiled in an excel sheet with respect to the name of the outlet, name of the town, contact person and contact details, under Philips Lighting Product stockist coverage or not. Further data specific to lighting products such as GSL, Tubelight, LED Bulbs, Sumo Choke, LED Batten etc. with respect to their actual and potential demand and light values were collected. In all 219 outlets were covered to collect the demand for Philips lighting products and their demand potential by way of demand data collection for its competitors. The combined demand of all market players was attributed as the potential monthly demand in units for Guwahati.

Based on the actual and potential sales data collected from 219 shops in various beats of Guwahati city, GLS incandescent bulbs ruled the market, but due to growing awareness in the people, about its high energy consumption, its demand showed a declining trend across outlets.

The GLS Bulb's total potential sales in units was 50836 out of which 39,639 units per month was of the competing brands of Philips Lighting such as Osram, Havells, Ever ready, Crompton Greaves, Syska whereas GLS bulb of Philips sells just 11,197 units per month as of now. The light value is the number of units sold multiplied by its price and potential light value is the number of units demanded multiplied by its price. The monthly light value data for potential and actual demand in units can be found in Fig. 1 below:

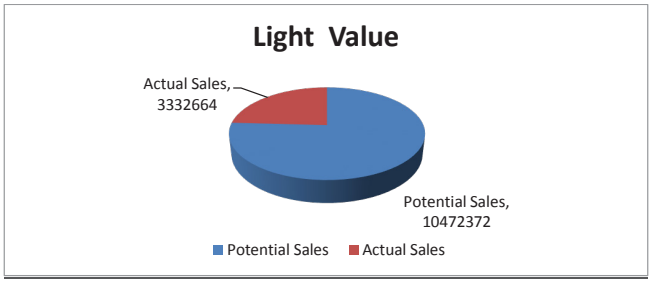

Fig. 1: Monthly Light Value Data

The demand for normal tube lights also cooled down with the advent of LED tubes which has much less energy consumption. For normal tube light combined competitors' potential sale was 14,320 units, whereas Philips tube lights sold around 5,836 units per month.

LEDs being in focus were in huge demand in the market. The combined competitors' potential sale was 56,725 units per month. Philips LED bulbs per month sold around 12,268 units. This could be due to its high price compared to its competitor's products.

The demand for Chokes also came down due to various reasons which also include the popularity of LEDs and electronic ballasts. Choke's combined competitors' potential sale per month was around 7,378 units, whereas Philips sumo extreme choke sold around 2,905 units per month. The better results achieved by the competitors could be due to less price tag of their products in comparison to that of Philips. It may also be mentioned here that customers of North Eastern States are quite priced sensitive like customers elsewhere in India.

LED Batten is a new segment in this lighting category which has also caught up in this LED trend due to its energy efficiency however the price is still an issue for the customers. LED Batten's combined competitors' potential sale was around 8,181 units per month whereas Philips LED Batten sold around 3,833 units per month.

Based on the initial findings from the collected demand data it is pretty evident that demand for LED devices has started moving in an upward direction however it is equally important at this juncture to find if this movement or variation in the direction of efficient illuminating devices is statistically significant or not. Its statistical significance only can help the study to argue the adoption of LED devices by households and commercial establishments in smart city Guwahati.

Sample Selection, Hypothesis and Statistical Tool

In order to find the adoption of LED-based energy-efficient illuminating devices, it is important to test the hypothesis. For testing the hypotheses related to uniform adoption of LED bulbs and battens/tube-lights, the smart city Guwahati was divided into two parts based on the Guwahati urban morphology map. As per the map the city is divided into two parts as core Guwahati and non-core Guwahati based on the level of development, density of population, availability of infrastructure like railway station, post office, important administrative and commercial establishments like the courts, educational institutions and important offices of banks and companies. Also last but not the least the posh residential area constituting a number of households. The non-core Guwahati is composed of suburban residential area with low density of population, lower level of development and low connectivity however there are commercial establishments like retailers and whole-sellers, office buildings, schools and colleges. The objective of dividing the data into two parts as core and non core is to check if LED-based lighting devices are demanded irrespective of the area being core or non core or the demand is relatively more on posh areas because of other factors than the smart city policy initiatives. If the demand is uniformly there irrespective of core or non-core areas of Guwahati then it can be argued to an extent that the city had adopted the energy-efficient illuminating devices. However, if the demand varies in the two groups the increase in demand can be said based on the demand data but the adoption of energy-efficient devices would be far cry.

According to Land-use Zonning Plan – 2025 of Comprehensive Master Plan for Guwahati Metropolitan Area which has mapped all the retail locations of Guwahati City and has identified 75 localities within the city helped a lot in assigning code to the outlets as core or non-core additionally with the help of postal pin codes. The outlets falling in the core Guwahati were given code 1 and outlets falling in the non-core Guwahati were given code 2. This led to formation of two groups of data. However, on the days of field visit, certain outlets were found be closed and no information on demand could be collected. Such outlets were removed before analysis of data. Also, a few outlets visited were whole-sellers and not retailers therefore in order to avoid outliers those outlets were also removed.

The data was intended to be collected from 219 shops across 75 localities of Guwahati City. Having been divided into 2 sub-groups of core city location and non-core city location as per Government of Assam's Guwahati Urban Morphology map, postal pin-codes have additionally

been used as an identifier for identifying the core of the city and non-core locations.

However, the final sample after removing outliers consisted of 133 outlets only. Group 1 which represents core Guwahati has 67 outlets and Group 2 which represents non-core Guwahati has 66 outlets mapped into it. This division and the sample size is good enough to perform a t-test in SPSS.

Following hypotheses are arrived at for conducting the t-test:

H_0: There is significant difference in the means of demand for LED bulbs in Groups 1 & 2.

H_1: There is no significant difference in the means of demand for LED bulbs in Groups 1 & 2.

H_0: There is significant difference in the means of demand for LED battens in Groups 1 & 2.

H_2: There is no significant difference in the means of demand for LED battens in Groups 1 & 2.

H_0: There is significant difference in the means of Potential Light Value in Groups 1 & 2.

H_3: There is no significant difference in the means of Potential Light Value in Groups 1 & 2.

Discussion Based on Data Analysis

The data in the two groups of electrical outlets in core and non-core Guwahati for LED bulbs, LED battens and potential Light value was analyzed to find significant differences in the means of two groups. For each of the three distributions normality was assumed based on sample size. In order to analyze the data for no significant difference in the demand for energy-efficient illuminating devices in core and non-core smart city Guwahati, demand pertaining to LED Bulbs, LED battens and Potential Light Value was divided into groups 1 & 2. The Group 1 represented demand in core Guwahati and the Group 2 represented demand in non-core Guwahati across the three distributions. The group statistics and Levene's test of equality of variances for the three distributions of demand for LED bulbs, demand for LED Battens and Potential light value can be found. Independent Samples test has been applied to test the respective hypotheses.

Analysis of Demand for LED Bulbs

The demand for LED bulbs in the two groups' core and non-core Guwahati has mean value of 168.73 units in group 1 as and Group 2 had mean value of 223.03 units with Standard deviation of 138.453 and 177.627 [see table 1(A)].

Table 1: Group Statistics

		GROUP-1(Core) GROUP- 2 (Non-core Guwahati)	*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*
A.	LED Bulb Demand	1	67	168.73	138.453	16.915
		2	66	223.03	177.625	21.864
B.	LED Batten Demand	1	67	43.67	52.606	6.427
		2	66	79.62	163.103	20.077
C.	Potential Light Value	1	67	-8.36271895522388E3	1.930175960932791E4	2.358085246570565E3
		2	66	7.25793030303027E2	6.163121329500542E4	7.586277935347490E3

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Analysis of Demand for LED Battens

The demand of LED batten in the two groups' core and non-core Guwahati the mean value of group 1 is 43.67 units and Group 2 has mean value of 79.62 units with Standard deviation of 52.606 and 163.103 respectively. [see table 1(B)].

Potential Light Value of LED Devices

The total potential light value of an outlet is calculated by adding the potential light value of LED bulbs and LED battens. The potential light value of LED bulbs is calculated by multiplying the number of units demanded with price per unit. Similarly, the potential light value of LED battens is calculated by multiplying the number of units demanded with price per unit. The total potential Light value distribution was arrived at by adding the potential light value of LED bulbs and LED battens demanded at an outlet. The distribution was once again divided into the two groups of Core and non-core Guwahati. The objective of testing the statistical significance of total light value was to see if there is an impact of price of LED bulbs and LED battens on their demand in the two groups [see table 1(C)].

Table 2: Independent Samples Test

			Levene's Test for Equality of Variances		*t-test for Equality of Means*						
			F	*Sig.*	*t*	*df*	*Sig. (2-tailed)*	*Mean Difference*	*Std. Error Difference*	*95% Confidence Interval of the Difference*	
										Lower	*Upper*
A.	LED Bulb Demand	Equal variances assumed	3.181	.077	-1.968	131	.051	-54.299	27.592	-108.883	.285
		Equal variances not assumed			-1.964	122.776	.052	-54.299	27.643	-109.018	.420
B.	LED Batten Demand	Equal variances assumed	7.341	.008	-1.716	131	.089	-35.950	20.951	-77.395	5.496
		Equal variances not assumed			-1.705	78.195	.092	-35.950	21.080	-77.915	6.016
C.	Potential Light Value	Equal variances assumed	4.129	.044	-1.151	131	.252	-9.088511985526911E3	7.895032405837680E3	-2.470676935922420E4	6.529745388170377E3
		Equal variances not assumed			-1.144	77.455	.256	-9.088511985526911E3	7.944317399401533E3	-2.490618565325023E4	6.729161682196411E3

The F statistic of the distribution is not significant with p value 0.007 therefore equality of variances is assumed under Levene's test of equality of variances. Assuming equality of variances the t statistic is not significant with p value < .05 for demand for LED Bulbs in Core and non-core Guwahati [see table 2(A)], this leads to the rejection of null hypothesis and acceptance of alternate hypothesis H_1. Hence, the difference in the mean values of demand of LED bulbs in groups 1 and 2 doesn't vary with statistical significance. This explicitly implies the uniform adoption/ demand of energy efficient Lighting device like LED Bulb in smart city Guwahati and has further implications for its adoption/demand in north eastern region in India.

The F statistic of the distribution is not significant with p value 0.008 therefore equality of variances is assumed under Levene's test of equality of variances. Assuming equality of variances the t statistic is not significant with p value < .05 for demand for LED Battens in Core and non-core Guwahati. [see table 2(B)], this leads to the rejection of null hypothesis and acceptance of alternate hypothesis H_2. Hence, the difference in the mean values

of demand of LED bulbs in groups 1 and 2 doesn't vary with statistical significance. This explicitly implies the uniform adoption/demand of energy efficient Lighting device like LED Batten in smart city Guwahati and has further implications for its adoption/demand in north eastern region in India.

The F statistic of the distribution is significant with p value 0.044 therefore equality of variances cannot be assumed under Levene's test of equality of variances. Assuming unequal in variances the two groups the t statistic is not significant with p value > .05 for Potential Light Value in Core and non-core Guwahati [see table 2(C)], this leads to the acceptance of null hypothesis and rejection of alternate hypothesis H_3. Hence, the difference in the mean values of total potential light value of bulbs and battens in groups 1 and 2 does varies with statistical significance. This explicitly implies that price continues to be the important factor in leading the demand for energy efficient Lighting device like LED bulbs and batten in smart city Guwahati and has further implications for its adoption/demand in north eastern region in India. Moreover by screening the adoption pattern for LEDs by countries like China and Japan Government of India launched "Domestic Efficient Lighting Programme" on 1 May 2015. The idea behind this programme was make LED lighting affordable to not just urban but also the rural Indian population. On hindsight this was also done to boost up Make in India Initiative to encourage manufacturers to produce LEDs at affordable cost considering the higher levels of demand for the product. However, the big picture remains to be the concurrent vision of current Prime Minister Narendra Modi, i.e., "it is economical to conserve power than to produce power." The scheme focused on all towns with a population above one lakh and procured and distributed LEDs at 250 to 300 times lowered prices (Mohan, 2017).

Interestingly a contrary view appeared in the beginning of 2019 that the Government's participation in bulb distribution has distorted the price of the product which is making it tough for the retailers to sell them. However, the state-run nodal agency 'Energy Efficient Service Ltd (EESL), out rightly, rejected the view and contemplated that the scheme is rather helping the industry to grow. The vice chairman of Philips Lighting India endorsed the nodal government agency by affirming that the scheme has rather been successful in assuring the critical mass required to initiate local production at lower cost and building the demand for the LED lamps. The' UJALA' scheme itself has boosted 400% growth in the LED sales. Havells President Sunil Sikka has vouched the 'UJALA' scheme to help the industry reach a new height. Nevertheless considering the market dynamics the possibility of a potential disadvantage to retailers and distributors cannot be ruled out which call for complete or partial withdrawal of scheme in the interest of retailers and distributors in the years to come.

An important argument that appears on the horizon is that energy efficient lighting at affordable cost is no doubt a must but equilibrium is sought in the divergent interests of stakeholders involved i.e. consumers, government, manufacturers and sellers whether state owned or private distributors and retailers.

Conclusion

The study observed and found that energy efficient illuminating devices such as LED bulbs and battens are uniformly demanded in Guwahati irrespective of level of development in core town area or suburbs. However this demand is majorly influenced by price of the product wherein the role of the government of India and its policies with respect to electricity generation, distribution and consumption largely has made manufacturing, procurement and distribution of devices at low cost very much possible. Based on the data collected from various outlets in Guwahati the retailers shared very encouraging demand statistics for LED bulbs and battens that is more or less an indicator of success of government initiatives to boost the demand for these products than to cause the market distortions leading to any disadvantage to private distributors and retailers. Guwahati being a participant of Smart City initiative has lot of implications for adaptability of these devices in rest of the North east region because the policy ambit identifies a town for UJALA scheme on the basis of population and not on the basis of region. Therefore if Energy efficient lighting is uniformly accepted in Guwahati, then there are high chances of households in north east adapting to LED given the lower price and efficiency of the product.

Originality/Contribution/Implications

The study has huge implications for the market players both buyers and sellers. For buyers there is a need to have energy efficient illuminating devices which lead to cost savings due to energy efficiency. For sellers the increasing demand for such devices adds to their business potentials. For policy makers and firms operating in energy efficient illuminating devices industry, this study may help in adding a perspective to the demand assessment for the complete North Eastern Region and accordingly policies for the region can be advocated with respect to production, marketing and subsidies on such products in this region.

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