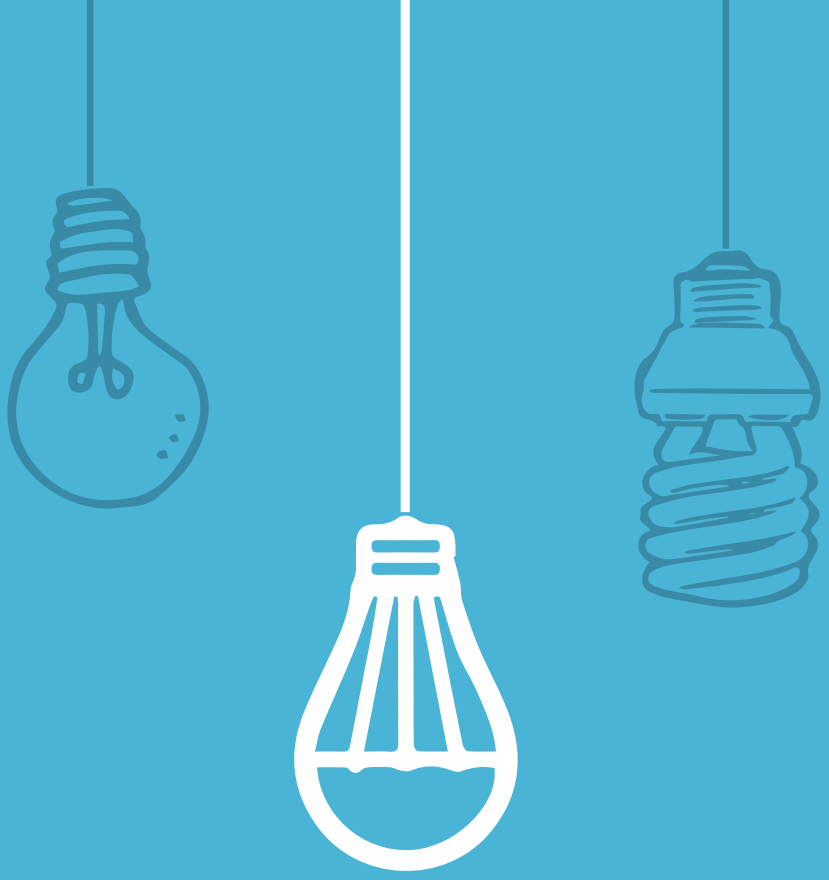

Understanding the impacts of India's LED bulb programme, "UJALA"

Executive Summary

Prayas (Energy Group)

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The entire report is available at http://www.prayaspune.org/peg/publications/item/354

Aditya Chunekar | Sanjana Mulay | Mrudula Kelkar

August 2017

Prayas (Energy Group)

About Prayas

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non Governmental, non-profit organization based in Pune, India. Members of Prayas are professionals working to protect and promote the public interest in general, and interests of the disadvantaged sections of the society, in particular. Prayas (Energy Group) works on theoretical, conceptual regulatory and policy issues in the energy and electricity sectors. Our activities cover research and intervention in policy and regulatory areas, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed in the energy sector policy development as part of several official committees constituted by Ministries and Planning Commission. Prayas is registered as SIRO (Scientific and Industrial Research Organization) with Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

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Executive Summary

Unnat Jyoti by Affordable LEDs for All (UJALA) is arguably the world's largest zero-subsidy LED bulb programme for households. The UJALA programme has sold more than 230 million LED bulbs (and counting) to Indian households in just the three years since its launch in 2014. These bulbs are claimed to be saving more than 30 billion units (kWh) of electricity annually, which is about 13% of the residential electricity consumption in India in 2016. The avoided peak demand is claimed to be about 6000 MW, which is about the amount of solar capacity added in India in 2016. UJALA's popularity has spurred Energy Efficiency Services Ltd. (EESL), its implementing agency, to use the programme model to sell energy efficient ceiling fans and air-conditioners. EESL also plans to implement the UJALA model in other countries like the United Kingdom, Canada, Nepal, and Bangladesh.

In this report, we systematically studied the varied impacts of the UJALA programme and effectiveness of the processes employed. The primary objective is to draw lessons to increase effectiveness of the existing UJALA programme, and to aid the design of similar future programmes in India and abroad. A secondary objective of this study is to highlight the importance of the comprehensive evaluation of energy efficiency policies and programmes. Such evaluations can increase their credibility and their effectiveness in achieving savings. We hope that this study will make a strong case to evaluate other energy efficiency programmes in India as well.

Three key questions are considered to understand the impacts of the UJALA programme:

i. How has India's lighting market changed?

ii. How have consumers responded?

iii. How effective are the various processes of the programme?

A methodology combining desk and field research was adopted. The field research included:

- Surveys of 1029 households who bought LED bulbs under the programme in the cities of Pune, Lucknow, and Puducherry
- Surveys of 150 retailers selling LED bulbs in the above cities
- Survey of 7 distribution kiosks in Pune currently selling LED bulbs under the programme
- Interviews with manufacturers, representatives from ELCOMA (Electric Lamp and Component Manufacturers' Association of India) and with independent market and technical consultants from the lighting industry
- Interviews with representatives from EESL and the Bureau of Energy Efficiency, the statutory nodal agency responsible for energy efficiency programmes in India

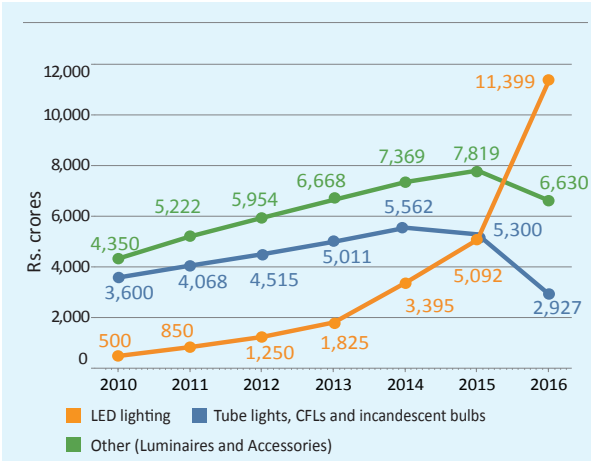
- Interviews with representatives from 9 electricity distribution companies (DISCOMs)

The study is not intended to be a comprehensive evaluation of the UJALA programme. Our household surveys include only three cities and hence do not statistically represent the entire country. Our assessment is based on limited public data and interactions with selected stakeholders. Our intention is to provide an indicative assessment of the UJALA programme.

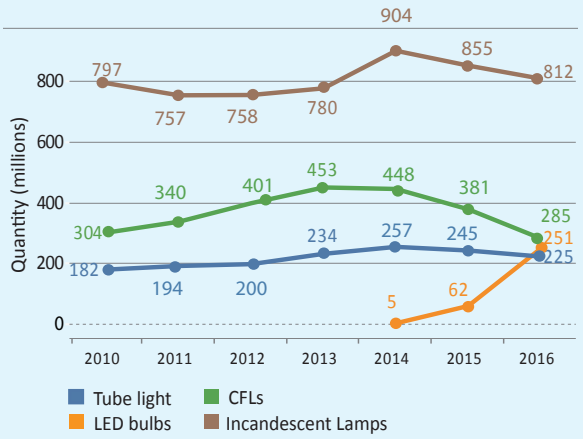
Key impacts, causes, and sustainability

- The UJALA programme has transformed the LED lighting industry in India. Its share by value in the total lighting industry grew from 6% in 2010 to 54% in 2016. Demand for LED bulbs has gone up 50 times in the three years since 2014, while the retail market price (for bulbs sold beyond UJALA) has dropped to a third of its value. India now has about 176 local manufacturing units and 300 registered companies selling LED bulbs. The number of accredited testing laboratories for LED bulbs in the country has increased from three to fifteen in the last three years. A thriving small-scale industry for LED lighting has emerged, albeit amidst concerns about the quality of its products.

Indian lighting industry trends by value



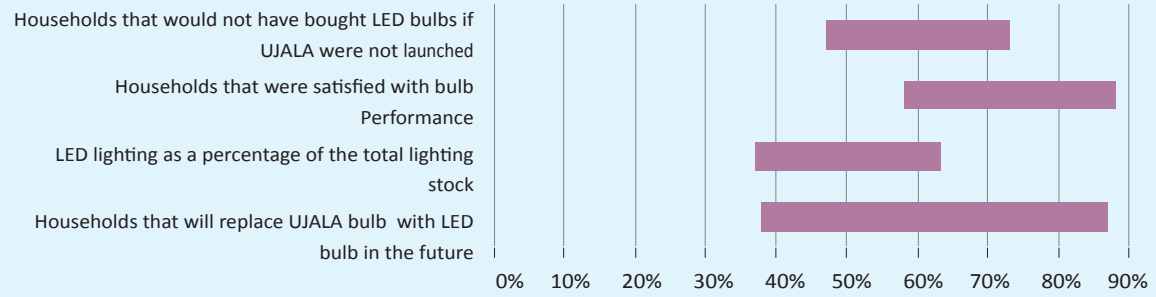
Sales trends of lighting devices in India



Source: ELCOMA

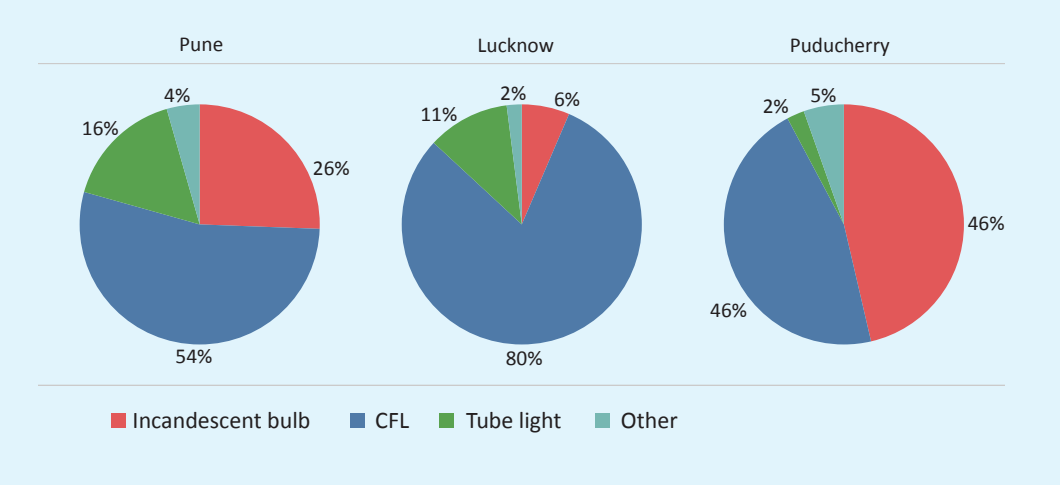
- Two factors contributed to the dramatic price drop of LED bulbs in India:
  - LED chip prices have fallen by a factor of 10 every decade since the 1960s, as observed by Haitz's Law contributing to the reduction in the price of LED bulbs globally.
  - LED bulbs, being a recent application of LEDs, presented a significant potential for reduction in the manufacturing cost, achieved through economies of scale. In India, UJALA driven demand provided the economies of scale that enabled manufacturers to bring down their prices.
- The demand for LED bulbs has replaced the demand for CFLs rather than incandescent bulbs. Sales of CFLs have fallen by a third since their peak in 2013, boosted by the Bachat Lamp Yojana (BLY) programme. The sales for incandescent bulbs have also dropped but at a lesser annual rate of about 5% from their peak in 2014.

- The increased demand for LED bulbs, increased manufacturing capacity, development of efficiency standards, and the growth in the number of testing laboratories are expected to sustain over time. The shift from CFLs to LEDs is also likely to be permanent, as LED bulbs provide better light, consume less electricity, and can be disposed of safely, while costing the same as CFLs.
- The price of LED bulbs sold under the UJALA programme is almost half of the price of LED bulbs sold in retail outlets in India. This price difference is due to aggressive bidding by manufacturers and the exclusion of regular dealers and retailers from the programme. However, both are not sustainable in the long term. Interviews with industry stakeholders reveal that the retail market prices, after falling to a third of its value in 2014, have stabilised and may not go down further.
- The UJALA programme has notably increased consumer awareness about LED bulbs. Among the surveyed households in three cities, 47% to 73% reported that they would not have bought LED bulbs if it were not for the programme. The majority of surveyed households were satisfied with the performance and quality of the LED bulbs. Following a similar trend, most households in Pune and Lucknow said that their next purchase would be an LED bulb. Post the UJALA programme, LED lighting made up 37% to 63% of the total lighting points in the surveyed households. The chart below displays the range of responses to selected questions from the surveyed households in the different cities.



- Data on replacements and usage of LED bulbs gathered from household surveys indicates annual electricity savings of 31 to 47 units (kWh) per LED bulb, and a peak reduction of 16W to 29W. Households were using most of the bulbs (70% to 81%) bought through UJALA, with the average daily usage hours ranging from four to six hours in different cities. A considerably large proportion of the UJALA LED bulbs were used to replace CFLs, followed by incandescent bulbs and tube lights. Although these observations are limited to the cities we surveyed, they differ substantially from the assumptions used by EESL to estimate the savings from the UJALA programme at the national level. EESL assumes that households are using all the LED bulbs bought through UJALA, that all of these bulbs were used to replace incandescent bulbs, and that all the bulbs are being used for about eight hours daily. A wider survey across different states can result in better assumptions and consequently a realistic estimation of actual savings realised.

Lighting option replaced by UJALA bulb



Source: Consumer survey

Key processes

- **Designing the programme:** EESL designed the UJALA programme based on the lessons learned from the Bachat Lamp Yojana (BLY) for CFLs and its own pilot programme for LED bulbs in Puducherry. UJALA was significantly different from the pilot and did not involve any subsidies or exchange of old bulbs. Each household was allowed to buy ten LED bulbs if paying upfront and four if paying through monthly instalments. These limits were the same across different states and not necessarily based on local load research studies. Technical specifications of the procured LED bulbs were adopted from the prevalent standards by the Bureau of Indian Standards (BIS).
- **Getting DISCOMs on board:** The role of DISCOMs in UJALA was limited; this resulted in their quick participation. EESL's uniform national level model for the programme resulted in quick approvals from the state regulatory commissions. A strong political ownership of the programme provided the final push for DISCOMs, most of which are susceptible to political influence, to participate in the programme.
- **Bulk procurement:** All the participating manufacturers commended EESL's efficient and transparent e-bidding process for procurement of LED bulbs. Successive bids saw significant price reductions as EESL's quantum of orders increased with more DISCOMs participating in the programme. However, manufacturers feel that the latest bids are too aggressive to be sustainable. EESL's initial strategy preferred domestic manufacturing but did not mandate it, as its core objective was market transformation. Subsequently, the manufacturers were required to assemble the LED bulbs in India.
- **Marketing:** EESL adopted innovative marketing initiatives. The #iledtheway campaign saw more than 75 million citizens committing to buy LED bulbs. The UJALA dashboard with its real time updating of the number of LED bulbs sold in India was periodically reported by media and politicians. EESL also conducted numerous local level campaigns like TV ads, newspaper ads, mobile advertising vans, and others.

- **Distribution:** EESL hired vendors in each state to distribute the LED bulbs, record consumer data, collect defective bulbs for warranty, and advertise locally. EESL's small team effectively coordinated the supply chain with the vendors across the country, which at the peak of the programme sold six lakh LED bulbs per day. However, our surveys show that the processes on the consumer end lacked compliance. Consumer data was not entirely recorded, the limit of ten LED bulbs per household was not strictly followed, and defective bulbs were not collected at all the centres, to be replaced under warranty.
- **Monitoring and evaluation:** EESL has a three-tier approach to ensure that procured LED bulbs comply with the BIS standards for safety and performance. This approach includes compliance reports from certified laboratories submitted by manufacturers, testing of a random sample by EESL, and a call centre to receive complaints from consumers. Our surveys found that about 2%, 6% and 14% of the total bulbs bought failed in Pune, Lucknow, and Puducherry respectively. Most of the households preferred not to replace these bulbs under warranty due to procedural and perceptual reasons. A comprehensive evaluation to assess the national and local level impacts of UJALA has not been conducted. EESL's estimation of savings realised from UJALA needs to be justified by wider surveys collecting data on the actual use of LED Bulbs.

Key lessons and recommendations

Following are two sets of lessons and recommendations: one for the UJALA programme and the other for future programmes to be designed based on UJALA.

UJALA programme

- **Focus on incandescent bulbs:** Industry data and consumer surveys indicate that LED bulbs are mainly replacing CFLs. Going ahead, the programme needs to focus on lower income households and small commercial establishments who buy incandescent bulbs to phase out their use. One way to do this is to reemphasise the on-bill financing mechanism.
- **Plan for systematic withdrawal:** EESL cannot expect to continue selling LED bulbs perpetually and replace the vast network of dealers and retailers across India. Half of the demand for LED bulbs in India is still generated through the UJALA programme. A sudden withdrawal may result in a sharp drop in demand with a possible rise in price. A gradual withdrawal combined with shifted focus to low income households can be a good exit strategy.
- **Ensure a smooth process for warranty settlement:** Household surveys reveal that buyers are not keen on exchanging the faulty LED bulbs under warranty because they are either unaware of the option or have difficulty with the exchange process. EESL can make it convenient for consumers to return the faulty bulbs by conducting periodic collection drives or collaborating with local retail shops.
- **Conduct awareness campaigns on the latest prices:** UJALA prices for LED bulbs are half of the market price. Our kiosk surveys in Pune have revealed that distribution vendors can take advantage of this by charging a premium, while still keeping the final price below the market price. Consumers unaware of the latest prices still buy them and vendors pocket the premium. EESL and the local DISCOM can conduct awareness campaigns to avoid this.

- **Monitoring and evaluation:** A stricter monitoring of the distribution of UJALA bulbs is required to ensure that they do not end up in retail shops. Also, data should be collected on participating households to facilitate systematic evaluation of the actual savings realised either through bill analysis or randomised consumer surveys. Periodic evaluation of the savings and processes should be conducted to increase their effectiveness.
- **Disposal of CFLs**: People are mostly replacing CFLs with LEDs under the UJALA programme. CFLs, with their mercury content, pose serious problems if they are discarded without care. EESL can collaborate with an e-waste company to set up collection kiosks for old CFLs along with the LED kiosks. Buyers should not be mandated to submit CFLs but could use the facility if they want to discard their used CFLs. This can ensure their proper disposal.

Future programmes

- **The case of LED bulbs was an exception:** The dramatic price drop in LED bulbs was a result of a global price reduction and the significant potential of economies of scale. The large scale uptake was also possible as LED bulbs are relatively cheaper than other appliances, as well as easy to buy and store. Although the bulk procurement model has the potential of transforming the market, programmes for other appliances should not be burdened with expectations of a speed and scale similar to that of the UJALA programme.
- **Market transformation may be better if gradual and predictable:** A gradual and predictable increase in demand for energy efficient technology is better for the creation of a market and its supporting eco-system such as testing laboratories and standards. A gradual transformation also prevents a mass lock-in to a particular technology given the rapid pace of technology change. Also, a proper withdrawal plan must be in place so that the market is not disturbed when the programme is withdrawn.
- **Limited role of DISCOMs may work but not recommended for the long term:** The EESL limited the role of DISCOMs in the programme to ensure faster and higher levels of participation. However, DISCOMs should not completely withdraw from the Demand Side Management (DSM) programmes. Effective DSM programmes can significantly impact the demand and load profiles which in turn can impact planning for the purchase of power by DISCOMs. They should actively engage with EESL to design specific programmes according to their needs. EESL and BEE should continue their efforts to build the capacity of DISCOMs with regard to DSM programmes.
- **Comprehensive and periodic evaluation is necessary:** A comprehensive evaluation of the varied impacts of the programme and the effectiveness of the processes is crucial. The BEE can commission these studies at the national level while regulatory commissions or DISCOMs can commission evaluation studies at the local level. A realistic estimate of achieved savings can reliably inform the planning process and also increase the credibility of the programmes.
- **Transparency and accountability is important:** A programme design document delineating all the features and processes along with their rationale can be useful as a reference for all the stakeholders, a guide for future programmes, and a tool to hold all the actors accountable. Similarly, during the course of the programme, reports on testing, evaluation, and warranty claims should be made public on a regular basis. This will help identify any major issues during the implementation and also increase the public credibility of the programme.

To conclude, UJALA has succeeded in creating a large and sustainable market for LED bulbs in India using the no-subsidy, bulk procurement model. Demand for LED bulbs has increased manifold and the retail market price (for the LED bulbs sold beyond UJALA) has dropped by a third. Domestic manufacture of LED bulbs has increased, efficiency standards are being implemented, and the number of accredited testing laboratories has grown, all pointing to sustainability of the LED lighting market. It has also created a significant awareness about LED bulbs in India, further contributing to their increasing demand. Going ahead, EESL should target low income households and small commercial establishments who are still buying incandescent bulbs. It can conduct special campaigns and also focus more on the on-bill financing mechanism that reduces the upfront cost of the LED bulbs. The streamlined procurement processes and innovative marketing campaigns from the UJALA model can be used for other appliances as well. However, stricter monitoring and evaluation should be incorporated in the programme design to ensure the quality of the appliances, compliance of various processes, proper disposal of old appliances, and realistic calculation of achieved savings. Although the bulk procurement model does not involve subsidy, it is important to quantify the savings realistically to factor them into planning optimised capacity addition and adequate climate change mitigation actions.

The entire report is available at
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Our analysis shows that UJALA has succeeded in creating a large and sustainable market for LED bulbs in India. Demand for LED bulbs has increased manifold and the retail market price (for the LED bulbs sold beyond UJALA) has dropped by a third. A number of other indicators point to the sustainability of the LED bulbs market. The demand for LED bulbs has replaced the demand for CFLs rather than incandescent bulbs. Going ahead, EESL should target low income households and small commercial establishments who are still buying incandescent bulbs. The streamlined procurement processes and innovative marketing campaigns from the UJALA model can be used for other appliances as well. Stricter monitoring and evaluation mechanisms should be incorporated in the programme design to ensure the quality of the appliances, compliance of various processes, proper disposal of old appliances, and realistic calculation of achieved savings.

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