

Prakash Path (Way of light)

The LED revolution is underway

INDIA | CAPITAL GOODS AND ENGINEERING

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The Honorable Prime Minister Mr. Narendra Modi has recently launched the “**National Programme for LED based Home and Street lighting**” with the aim to replace incandescent bulbs (ICLs) with LED lights for residential and street lighting. *The aim is to install LED lamps for household and street lighting in 100 cities by March, 2016.* The LED market which stood at Rs19bn in CY13 is expected to jump 3x to Rs 60bn by CY17e driven by the government’s initiatives and will form 29% of the overall lighting market vs. 14% in CY13. During the same period we estimate the overall lighting market to grow to Rs210bn in CY17e (11% CAGR). We note key beneficiaries in our coverage universe are **Crompton Greaves and Havells**.

Strong economic case in favor of use of LED’s vis. a vis. Incandescent bulbs and CFL’s. Replacement of Incandescent lamps(ICLs) and CFL’s by LED’s makes economic sense as these have a much longer life (*50,000hrs vs. 10,000hrs for CFL and 1,500hrs for ICL*), energy efficient (*80-100 lumen/watt vs. 50 lumens for CFL and 13-15 lumens for ICL*), and a payback period of 2-2.5 years vs. CFL’s.

Market size for LED’s set to jump 3x over CY13-CY17e driven by government push. The key driver of the increased usage of LED’s over the next few years will be the government’s push to replace street lighting (*via municipalities*) and residential lighting (*via state discoms*) to achieve energy efficiency and savings. There are ~ 27mn street lights in India of which we estimate 5.5mn lie in the top 100 cities while the retrofit of incandescent lamps over the next 3 years could amount to ~490mn units. The government intends to ban the sale of 100W, 60W and 40W ICL’s by CY17e and this along with a further fall in prices of LEDs (*already down to Rs350-400 from Rs1,000-1,200 earlier*) would fuel a large scale switchover to LEDs. We also expect commercial establishments (*retail outlets/offices/shops*) to increasingly opt for LED down lights to replace less efficient FTL’s and CFL’s; the price gap of LED’s vs. CFL’s down lights has narrowed significantly which provides a good incentive to switch to LED lights. The LED market (in value) which stood at Rs19bn in CY13 is expected to grow 3x to Rs60bn as per our estimate by FY17e.

Competitive intensity to be high initially but market will consolidate. We are already witnessing new players enter the market (*Eveready, Syska LED, Oreva*) sensing the large opportunity which is set to open up over the next few years. After the initial euphoria, we expect the industry to consolidate on lines similar to what was seen in the CFL segment. To put it in perspective, there are currently 60 manufacturers of CFL’s in India with a capacity of 1bn units; this number stood at 30 in 2009 and doubled post the government’s push towards replacing ICL’s with CFLs. However, do note that currently the top 9 companies’ control 75% of the overall market. Indian companies also have to compete against cheap imports from China.

Key beneficiaries in our coverage universe are Crompton Greaves and Havells; other listed plays are Bajaj Electric, Surya Roshni and Eveready Industries. We expect both Crompton and Havells to be key beneficiaries of the increase in spending on LED lighting. For Crompton, lighting is ~Rs10bn of sales in FY15 (*~7-8% of sales*) primarily on CFL and luminaire; assuming it is able to maintain its share at ~7-8%, we see its lighting revenues rise to Rs16bn by FY18e which implies a 17% CAGR in growth. In a bull case scenario, if we assume its market share rises to 10%, revenues from lighting could even touch Rs21bn (26% CAGR). Havells had a 6% share (*~Rs8bn*) in the overall lighting market in FY15 and its sales could grow to Rs12-13bn by FY18 assuming a constant market share. Note that both Havells and Crompton are increasingly diversifying their product portfolios to LEDs as they gear up to gain share in this market.

Companies

Crompton Greaves		
Reco		BUY
CMP, Rs		165
Target Price, Rs		230
Havells		
Reco		Neutral
CMP, Rs		245
Target Price, Rs		246
Bajaj Eletricals		
Reco		NA
CMP, Rs		241
Target Price, Rs		NA
Surya Roshni		
Reco		NA
CMP, Rs		106
Target Price, Rs		NA

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Why do LED's make economic sense over CFLs/ICLs?

An LED has multiple benefits over a traditional compact fluorescent or incandescent lamp – these relate to parameters such as life of the bulb, electricity consumption, color rendition, toxic material usage (*in the case of CFL*) and start up time (*see table below for more details*).

Comparison of an LED bulb with a CFL and an Incandescent bulb

Description	LED	CFL	Incandescent Bulbs
Life expectancy (hrs)	50,000	10,000	1,500
Watt	10	13-15	60
Kwh of electricity used in 50,000 hrs	263	700	3,000
Hazardous material used	None	5 mg Mercury/bulb	none
Color rendition	Wide range	Restricted colors	Restricted colors
Dimmability	Yes	Restricted possibility	Yes
Robustness	Breakable	Sensitive	Sensitive
Start up time	Instant	Delayed	Instant
Disposal	Landfill	As per guidelines	Landfill
Light efficiency	80-100 lum per watt	53 lum per watt	13 lum per watt

Source: EESL, A lumen is a measurement of the time rate of flow of light

Light output by bulb type (LED's have 80-100 lumen/watt)

Lumens	LED(Watt)	Incandescent Bulbs(Watt)	Compact Fluorescents Lamps(Watt)
450	4-5	40	10-12
800	6-8	60	13-15
1,100	9-13	75	18-25
1,600	16-20	100	23-30
2,600	25-28	150	30-55

Source: EESL, A lumen is a measurement of the time rate of flow of light

Cost comparison between using an LED, CFL and an Incandescent bulb

Parameter	Units	Light Type		
		Incandescent	CFL	LED
Life Span	Hours	1,500	10,000	50,000
Wattage	Watts	60	14	6
Power consumed per hour	Kilowatt-hour (kWh)	0.06	0.014	0.006
Cost of usage for one hour @Rs 6 per kWh	Rupees	0.36	0.084	0.036
Cost of usage for 50,000 hours(A)	Rupees	18,000	4,200	1,800
Bulbs needed for 50,000 hours of running	no of bulbs	33	5	1
Bulb Cost	Rupees	10	120	400
Cost of replacement(B)	Rupees	330	600	400
Total 50,000hrs lighting cost (A+B)	Rupees	18,330	4,800	2,200

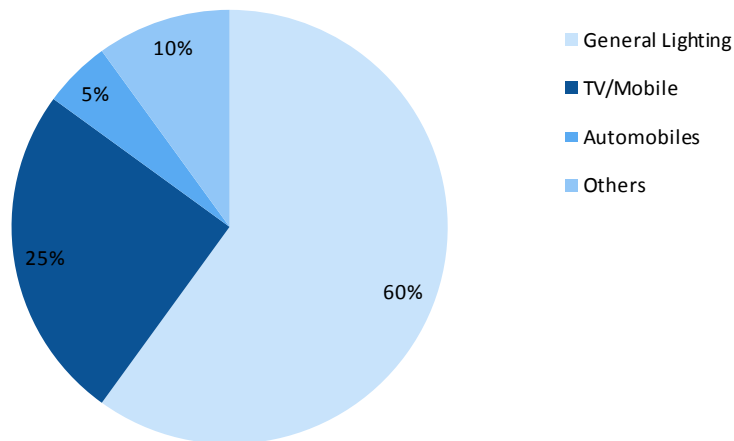
Source: PhillipCapital Research, Industry

Price comparison for a LED, CFL and Incandescent bulb for similar lumen of output

LED	Price (Rs)	Lumens Output
45W	1,400	2,900
10W	750	800
7W	600	500
5W	500	350
3W	400	240
0.5W	80	40
CFL		
40W	145	2900
10W	105	600
7W	75	400
5W	70	250
Incandescent Bulb		
40W	20	410
25W	15	230
15W	10	120

Source: PhillipCapital, Industry

LED market by end use (% of total)



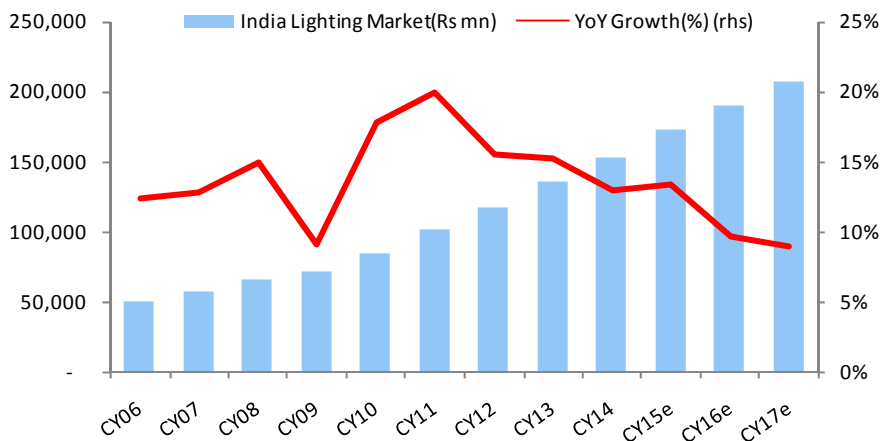
Source: ELCOMA

LED market could grow 3x over CY13-17e

To incentivise the use of efficient lighting in households, the Bureau of Energy Efficiency had implemented the Bharat Lamp Yojna(2009-2012) under which CFLs were provided as a replacement to ICLs at a cost of Rs 15 each.

This price was similar to the price being paid for ICL’s with the balance cost being recovered by the Clean Development Mechanism (CDM) of the Kyoto Protocol. The programme, having its commercial viability tied solely to CDM revenues, came to an abrupt halt when the carbon market crashed. Only about 30mn ICLs could be replaced under this programme.

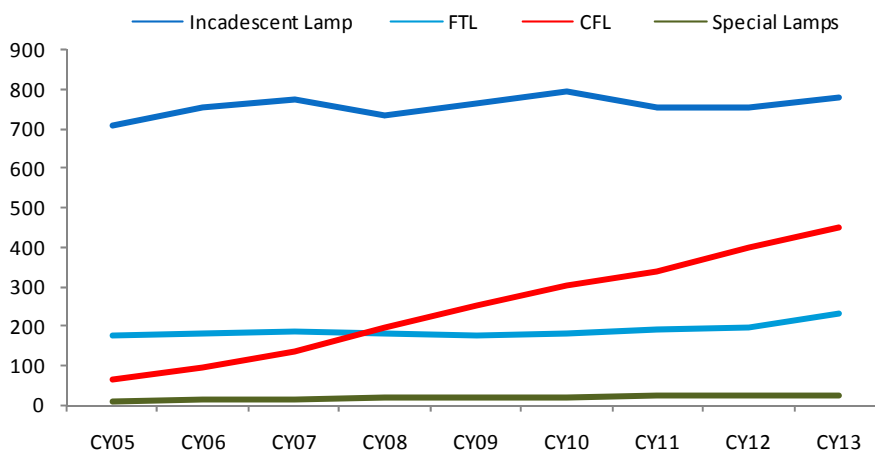
India Lighting market (Rs mn) and YoY Growth (%)



Source: ELCOMA, PhillipCapital India Research estimates

However, this programme triggered a massive growth in the CFL market which saw its annual sales rise from 200mn pieces in CY08 to 453mn pieces in CY13, a growth of more than 2x in 4 years. Currently, the Indian lighting market is currently dominated by CFL’s (in value).

India Lighting Market (units mn) – sharp growth in CFL’s



Source: ELCOMA, PhillipCapital India Reserach


The government’s recent initiative to kickstart the replacement of inefficient ICLs with LEDs could in our estimate, result the in the LED market growing 3x to Rs60bn from the Rs19bn in CY13. There are 4 key areas which would lead to the growth in LED demand namely, **Steet lighting, Retrofit Lamps in household lighting, Downlights for use in office and shops and luminaires** (See table below).

Total market for LED's (Rs mn)

Year	Streetlights	Downlights	Retrofit Lamps	Luminaire	Total
CY13	9,200	3,800	1,750	4,500	19,250
CY14e	9,500	4,200	9,620	4,730	27,620
CY15e	10,542	8,000	20,280	4,967	43,788
CY16e	11,596	14,000	22,308	5,215	53,119
CY17e	13,000	16,000	25,350	5,476	59,827


Source: PhillipCapital India Research, ELCOMA

LED focus area



Self Ballasted LED Lamp

- Domestic
- DSM Schemes
- CDM Schemes



Down Lighters for show rooms & Show windows

- Show Rooms
- Show Windows
- Office General areas



Road Street Lights

- Highways
- Medium Roads
- Smaller Roads
- By lanes
- Parks
- Service Roads

Source: EESL. PhillipCapital India Research

Use of LED's to be driven by replacement of street lights, down lights and retrofit of LED lamps

Under the government's recent initiative called the "National Programme for LED based home and street lighting", launched by the Honourable Prime Minister Mr Modi, LED bulbs shall be used to replace existing ICLs in domestic households in a period of 1 year starting from Mar,'15. Similarly, existing street lights are proposed to be replaced with cost effective LEDs.

Retrofit of LED lamps for household lighting

Incandescent Lamps are primarily used for domestic household lighting. Under the government's initiative, it is expected that ICL's in India top 100 cities would be replaced by LED's to encourage energy efficiency and cost savings. As a step towards phasing out of ICL's and increasing the usage of LED's, 100W ICL's have been banned for sale and this will be followed by 60W ICLs in CY16 and 40W in CY17.

A total of **780mn ICL's** were sold in CY13 (758mn in CY12) as per ELCOMA. Replacement of these ICL's by LED's which use 85% less energy would help save a total of 50bn units and a cost savings of Rs25bn (See table below).

Statewise sale of Incandescent Lamps in CY12

State	ICL Sale (2012 Rs mn)	Savings Potential (mn kwh)	Savings (Rs mn) @Rs5/kwh
AP	68	4,531	2,265
Assam	9	571	286
Bihar	62	4,119	2,059
Chattisgarh	18	1,196	598
Delhi	51	3,388	1,694
Gujarat	42	2,797	1,398
Haryana	19	1,269	634
HP	4	266	133
J & K	6	412	206
Jharkhand	16	1,036	518
Karnataka	43	2,823	1,412
Kerala	21	1,395	698
Maharashtra	93	6,158	3,079
Manipur	1	86	43
Meghalaya	1	80	40
MP	36	2,391	1,196
Nagaland	1	80	40
Odisha	12	810	405
Punjab	18	1,202	601
Rajasthan	26	1,727	864
TN	51	3,388	1,694
Tripura	2	133	66
UP	82	5,447	2,724
Uttarakhand	7	465	233
WB	62	4,190	2,095
Other states	7	465	233
Total	758	50,366	25,213

Source: EESL

As part of this programme in Delhi, 10mn energy efficient LED bulbs shall be distributed to consumers (*with a seven year warranty*) which shall lead to an annual saving of 250mn units annually.

Note similar schemes have already been or are under implementation in various states across the country including **Puducherry, Karnataka, West Bengal, Goa, Jharkhand, Andhra Pradesh and Rajasthan**. Note that the *Energy Efficiency Services*

Limtied(EESL) is a government promoted agency which has tied up with distribution companies in these states for distribution of LED lamps to consumer in exchange of working ICLs.

Under these schemes, 2 LED lamps are given to the consumer which shall be used to replaced the existng working ICLs at a price of Rs10 and then the balance Rs120 is deducted from the consumer over the following 12 months; this implies that the total cost to the consumer comes to Rs130 for each LED lamps vs. the market price of Rs350-400/lamps for the same LED lamp. A warranty of 5-6 years is provided to the customer. Alterntatively, EESL is paid based on the deemed energy savings for the discom while the consumer is given the bulb for Rs10.

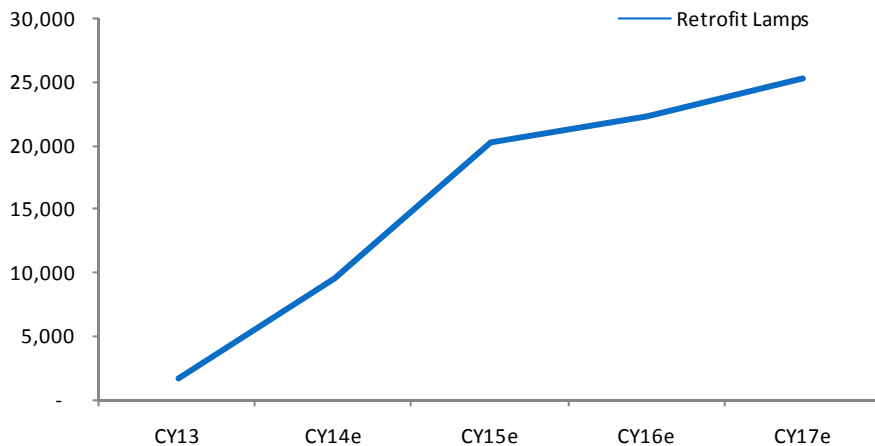
Upcoming and commissioned Domestic Efficient Lighting Projects (DELP) by EESL

Name of state	No. of ICLs(mn)
Karnataka	43
West Bengal	62
Goa, A&N and Lakshadweep	10
Jharkhand	16
Rajasthan	26
Puducherry Electricity Department	0.7
Total	157

Source: EESL

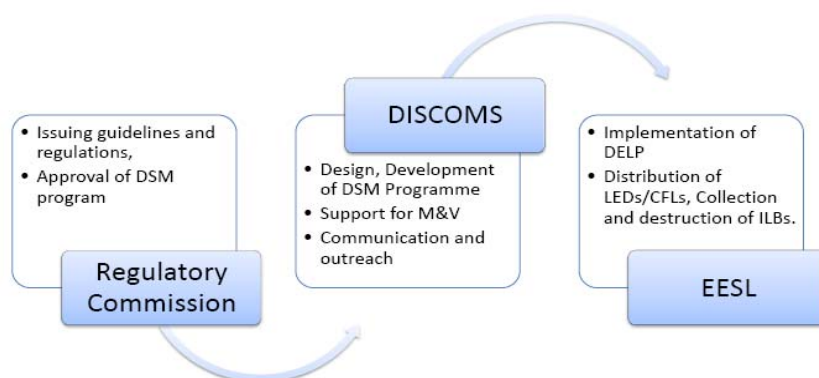
We estimate that the market for retrofit lamps would grow to Rs25bn by CY17e from Rs1.8bn driven primarily by the government’s push to replace existing ICL’s with LEDs. Note that such LED’s are procured under bulk procurement with the lowest bidder getting to supply the lamps to EESL/Discom.

Market size for retrofit LED lamps (Rs mn)



Source: PhillipCapital, Elcoma

DSM based domestic Efficient Lighting Proposal model (DELDP)



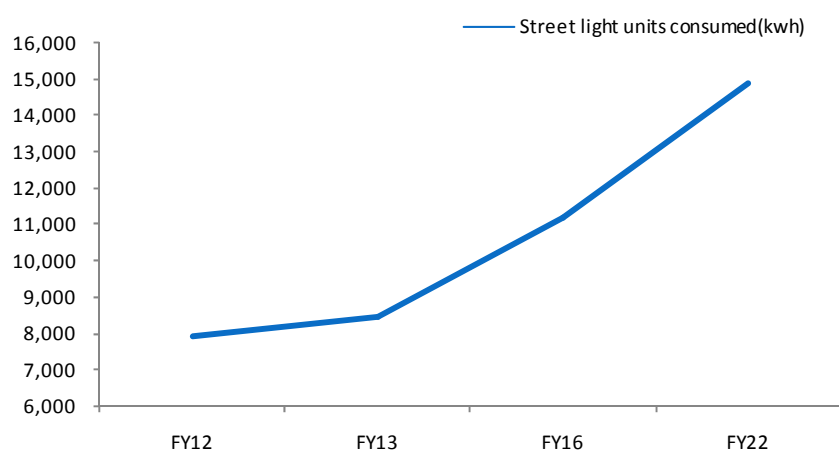
Source: EESL

Replacement of street lights with LEDs

Energy Efficiency Services Limited (EESL) has also initiated the street light LED replacement programme in various municipal corporations across the country – these include municipalities at Nasik, West Bengal, Punjab, Andhra Pradesh, Delhi and Pondicherry amongst others.

Note that EESL has recently signed an MOU with the South Delhi Municipal Corporation for replacing 0.2mn street lights with LED lights at zero upfront costs to the municipality. This would be completed over the next 1 year while a nationwide rollout is expected to be completed over the next 3 years.

Electricity consumed by street lights (mn kwh)



Source: EESL, 18th Electric Power Survey

India currently has 27.5mn streetlights installed across the country which could potentially be replaced with energy efficient LED lamps at a total cost of Rs177bn. We estimate each fixture to cost Rs6500 vs. the current Rs8000 on bulk procurement by EESL.

Streetlight replacement market size in India (Rs mn)

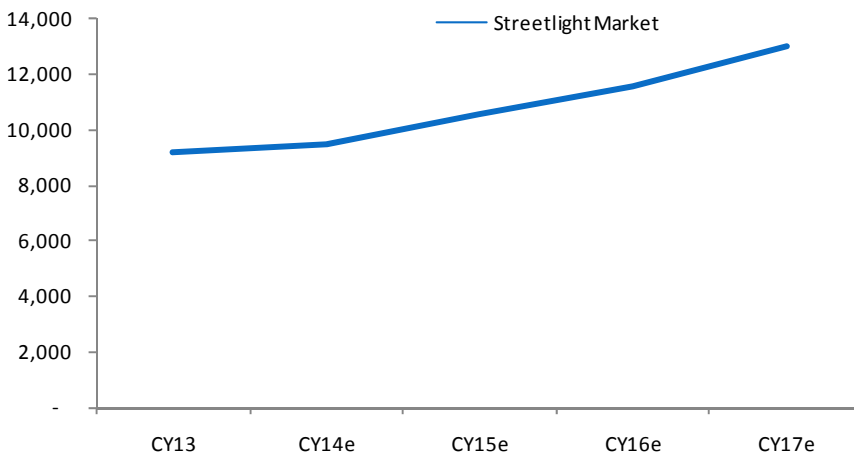
Description	In mn
Street lights with Fluorescent Lamps	25
Street lights with HID, Gas discharge	2
Total street lights in India	27
Price per unit(Rs)	6,500
Total market size for replacing all street lights in India	177,125

Source: EESL

Mr Modi targets to replace the existing streetlights in the top 100 cities by March, 2016 – we estimate this opportunity could be worth Rs35bn based on 20% of the total streetlights being installed in the top 100 cities. ~15-16% of the country’s total population resides in the top 100 cities – we assume that 20% of the streetlights in the country are installed here as the density of streetlights would be much higher in bigger cities than otherwise.

We estimate that this Rs35bn opportunity would pan out over the next 3 years versus the government’s more aggressive estimate of one year. The chart below shows how this opportunity would play out over the next few years.

Market opportunity for streetlight replacement in top 100 cities in India (Rs mn)



Source: EESL

Competition could be intense as seen in the case of CFL's; will consolidate over time

As stated earlier, CFLs had seen an explosive growth during the period CY09-13e driven by the government's thrust to replace ICL's with CFL's. This in turn has led to the entry of a large no. of players into the market. As per ELCOMA, there are 60 players with a domestic manufacturing capacity of ~1bn pieces per annum supplying to the Indian market. Note the sharp increase in the manufacturing capacity post the Bharat Lamp Yojna which was started from 2009 onwards by the government of India.

We expect that the CFL market would continue to grow at 5-6% over the next few years – the current high price of LED's (Rs350-400/ lamp vs. Rs100-150 for a CFL) will act as a deterrent for a complete switchover. We however do expect that LED prices will continue to trend down and higher consumer awareness would lead to higher replacement of CFL's with LEDs.

Our feedback from talking to distributors and various channel partners is that a number of Chinese LED bulbs are also available in the market which is considerably cheaper than the branded ones being offered. However, given the lower warranty and better consumer awareness, customers are more likely to choose a branded Indian brand over a Chinese made lamp.

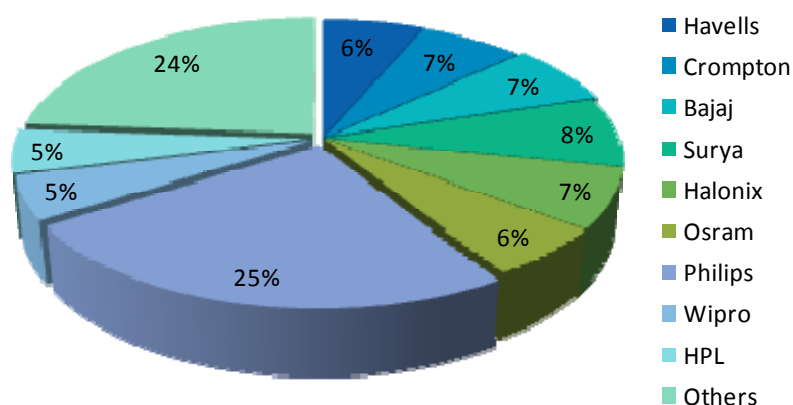
CFL manufacturers and current capacity (Mn units)

Year	Number of players	Capacity
2002	5	19
2003	7	22
2004	10	29
2005	12	50
2006	13	80
2007	16	130
2008	20	200
2009	32	350
2010	45	500
2011	52	730
2013	60	1,000

Source: Elcoma, PhillipCapital India Research

We note that despite the presence of such a large number of players, the top 9 control ~75% of the market between themselves. This indicates that the industry has consolidated post the entry of a large no. of players.

Share in the lighting market – FY14

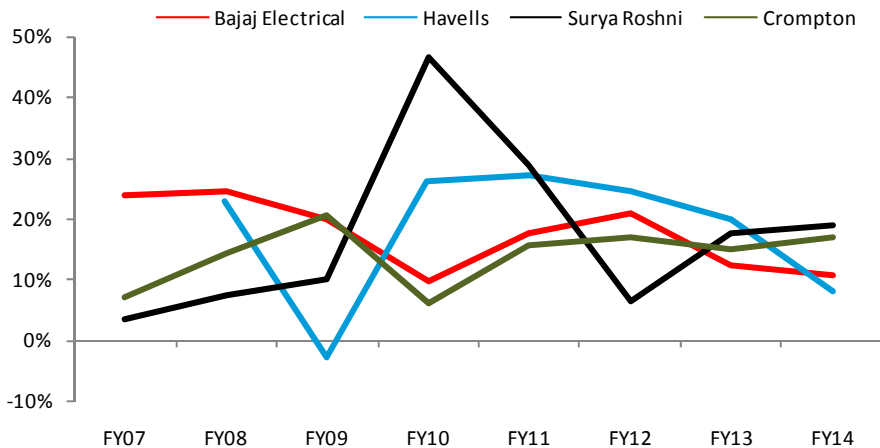


Source: PhillipCapital India Research, Industry

Lighting business growth of key listed players witnesses strong growth in CFL from FY08-FY14

As seen in the chart below, we note the strong growth in the lighting businesses across players with the average growth across companies at 15% CAGR over FY08-14. A large part of this growth would have been driven by CFL's and fixtures (*luminaire*). In turn driven by the government's initiative to replace the old ICLs and heightened consumer awareness about the energy saving properties of CFLs.

Lighting revenue growth of listed players (FY07-14)



Source: Company, PhillipCapital

As mentioned earlier, we do expect the LED market to grow 3x over CY13-CY17e but this would be accompanied by a marked increase in competitive intensity – both from existing and new players.

We are also seeing new players targeting the LED market such as SYSKA LED, Eveready who have recently been very aggressive in their marketing strategies to penetrate the LED market in India.

Comparing Eveready LED's versus competition

LED Bulb 7W	lm/Watt	Lumens*	MRP per pc. (U)**
Eveready	100	700	449
Philips	86	600	599
Syska	93	650	599
Bajaj	86	600	485
Halonix	86	600	550
Surya	80	560	500
Havells	71	500	600

*As per details available on specific brand packaging. **MRP (incl. of all taxes).

Source: Eveready, PhillipCapital Research

Advertisement for an Eveready LED lamp



Source: Eveready, PhillipCapital Research

Snippets from Crompton Greaves Annual Report on LED market presence

- a. Crompton Greaves growth in the LED market is four times that of the market. Launching a large range of LED products (lighting and luminaire) across all key market segments has played a role in being able to introduce **180 SKU's** in the market in 2014.
- b. CG was the first to launch an LED flat panel luminaire and gained a 25% share in the first quarter of launch
- c. New products accounted for 17% of total lighting sale and 24% of luminaire
- d. CG installed a smart street lighting automation project for PGCIL in Pondicherry which has allowed the municipality to save energy up to 40%.
- e. CG is the first players to launch high power chip on board street lights and bay lights based on tie up with **Bridgelux for LED chips and lights.**

Case Study – Bachat Lamp Yojna(BLY) drove the growth of CFL’s during the CY09-2012

The “**Bachat Lamp Yojna**” scheme aimed at large scale replacement of incandescent bulbs in households by CFLs. It was aimed to provide CFLs to households at the price similar to that of incandescent bulbs and plans to utilize the Clean Development Mechanism (CDM) of the Kyoto Protocol to recover the cost differential between the market price of the CFLs and the price at which they are sold to households.

The scheme addressed the first high cost barrier by providing CFLs as replacement to ICLs at a cost of Rs. 15 each. BLY also provided information and awareness about the benefits of using CFLs as against ICLs to overcome the information asymmetry.

BLY was a public-private partnership between the Government of India, private sector CFL suppliers and State level Electricity Distribution Companies (DISCOMs). The CFL suppliers provided high quality CFLs to households at a price of **Rs. 15 per CFL.**

BEE developed a Programme of Activities (PoA) to serve as an umbrella CDM project and got it registered with the CDM Executive Board. The individual projects designed to be in conformance with the umbrella project, were added to the PoA and standard templates were prepared by BEE. A tripartite agreement (TPA) between BEE, DISCOMs and the CFL suppliers was signed that laid out the roles and responsibilities of the three stakeholders. The programme which had its commercial viability tied to the viability solely to CDM revenues came to a halt with the crash in the carbon credit market. However, the programme triggered the growth in CFL market which saw volumes grow from less than 20mn pieces in FY08 to almost 40mn pieces in CY12.

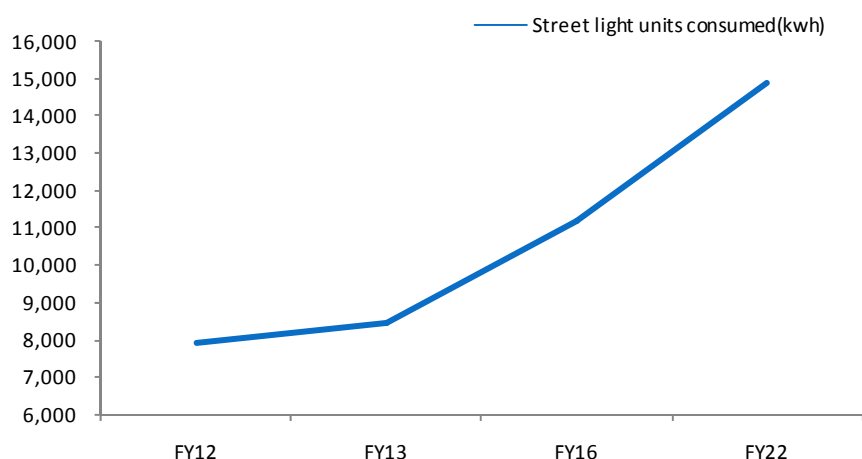
So how will such an ambitious project be implemented?

Energy Efficiency Services Limited (a company promoted by the Ministry of Power as a JV of PFC, REC, NTPC and PGCIL) has been instrumental in implementing the usage of LED lamps for street lights and replacement of domestic Incandescent lamps with LED's. Based on its past experience in similar projects, it has developed *detailed model documents* for implementation of the municipal streetlight and residential projects which can be used by discoms and municipalities.

Municipal Streetlight retrofit model

The annual consumption by streetlights in India stood at 8.5bn (FY13) and is seen growing at a CAGR of 7% annually. Savings in electricity consumption could imply significant cost savings for municipalities and as per EESL, replacement of the entire conventional streetlights with LED's could result in annual savings of 4.3bn units (~45-55% savings) which is ~50% of energy consumed annually and Rs.25bn (at Rs5/unit)

Electricity consumed by street lights annually in India (Mn units)



Source: 18th Electric Power Survey

EESL's methodology for replacing existing street lighting with LED's

EESL has already initiated the street lighting programme in various municipal corporations across the country – these include municipalities at Nashik, West Bengal, Punjab, Andhra Pradesh, Delhi and Pondicherry amongst others. Note that EESL has recently signed an MOU with the South Delhi Municipal Corporation for replacing 0.2mn street lights with LED lights at zero upfront costs to the municipality. This would be completed over the next 1 year while a nationwide rollout is expected to be completed over the next 3 years.

EESL has evolved an annuity based model that ensures retrofitting with an overall cost saving to the municipality. **The cost saving is recovered from the combined expenditure of MC/ ULB on electricity bill and O&M charges.**

EESL Projects under implementation

Name of Municipality	Units	Rs mn	Cost per unit
Kolkata Municipal Corporation	281,000	2,950	10,498
Kerala ULB	520,000	3,900	7,500
Andhra Pradesh ULB	340,000	2,550	7,500
Ranchi Municipal Corporation	20,000	300	15,000
Puducherry UT	41,100	240	5,839
Ludhiana Municipal Corporation	90,000	540	6,000
Mohali Municipal Corporation	20,000	120	6,000
Total	1,312,100	10,600	8,334

Source: PhillipCapital Research

Steps involved in the street light replacement programme

MoU	MoU to be signed between Municipalities & EESL
DPR/Rd Validation of DPR	Detailed walk through energy audit for data validation of existing DPR and Joint Verification
Technology Demonstration	Assess actual energy savings, determine annuity payments and finalize technical specifications
Agreement	Agreement to be signed between Municipalities & EESL for implementation.
Payment Mechanism	The payment security mechanism to be finalized
Implementation	EESL will implement the project based on own resources
M & V	Deemed saving approach used

Source: EESL

- MOU signed between the municipality and EESL.** EESL enters into an MOU with the municipality(MC) to provide a framework for implementation of efficiency measures in street lighting in the MC. The implementation will be undertaken by EESL by investing the entire upfront capital cost of energy efficiency interventions, including preparation of Detailed Project Report
- Preparation and validation of the draft project report.** DPR's are prepared and existing DPR's need to be validated with a joint team of EESL and MC to verify the no. of street lights and rated wattage.
- Technology demonstration.** Based on a designated area, EESL will retrofit street lights with LED light and the actual consumption data be collected and analyzed with the baseline. The difference will be the savings. The annual service charge will be based on demonstrated savings, capital cost incurred by EESL, O&M cost and a reasonable return on investment.
- Implementation Agreement.** After the demonstration of technology and determination of energy savings and annuity payouts, EESL will enter into an implementation agreement.
- Payment security mechanism.** In orders to ensure robust payment mechanism, there could be either a bank gurantee from the MC or a state government gurantee.

Domestic energy efficient lighting programme (DELP)

Domestic consumers account for 24% of the total electricity consumed in the country and the primary source of household lighting continues to be incandescent bulbs, where only 10% of the electricity is converted into light. Promotion of LED bulbs can save ~50bn units every year and also reduce electricity related costs for consumers.

State wise sale of Incandescent Lamps (2012)

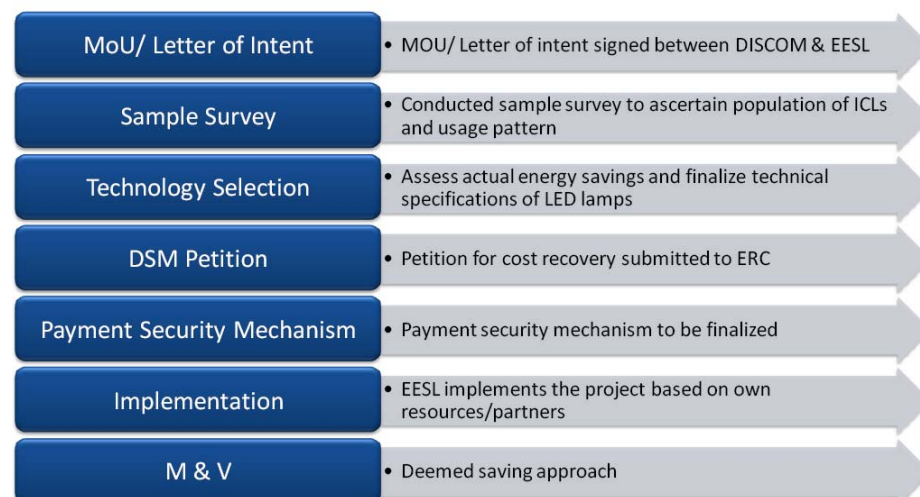
State	ICL Sale (2012 Rs mn)	Savings Potential(kwh)	Savings (Rs mn)
AP	68	4,531	2,265
Assam	9	571	286
Bihar	62	4,119	2,059
Chhattisgarh	18	1,196	598
Delhi	51	3,388	1,694
Gujarat	42	2,797	1,398
Haryana	19	1,269	634
HP	4	266	133
J & K	6	412	206
Jharkhand	16	1,036	518
Karnataka	43	2,823	1,412
Kerala	21	1,395	698
Maharashtra	93	6,158	3,079
Manipur	1	86	43
Meghalaya	1	80	40
MP	36	2,391	1,196
Nagaland	1	80	40
Odisha	12	810	405
Punjab	18	1,202	601
Rajasthan	26	1,727	864
TN	51	3,388	1,694
Tripura	2	133	66
UP	82	5,447	2,724
Uttrakhand	7	465	233
WB	62	4,190	2,095
Other states	7	465	233
Total	758	50,366	25,213

Source: ELCOMA

The key barrier to use of efficient lighting in the household sector is the high cost of efficient LED's (CFL's at Rs100 vs. LED's at Rs350-400 and ICL's at Rs10).

DELP Business Model

Energy Efficiency Services Limited (EESL) has developed the DELP business model for replacement of ICLs in residential housing with LEDs. The methodology is explained below:



Source: EESL, PhillipCapital India

- **MOU/Letter of Intent signed with discom** - EESL will, in consultation with DISCOM, select an area for implementation of the scheme.
- **Technology selection:** EESL has evolved robust technical specifications for indoor LED lighting and will use that as benchmark to select bidders.
- **Develop methodology:** EESL, DISCOM and SERC will agree on necessary DSM regulations that will inter-alia include a mechanism for monitoring and verification, Logistic arrangements for distribution of LEDs
- **Asses savings:** Assess energy savings and initiate tender for procurement of LED lamps. LED will be procured by EESL through competitive bidding.
- **Distribution of LED:** EESL shall distribute LED's to grid connected household through discoms at discounted rate Further discoms will also file petition with ERC for recovery of cost of procurement.
- **Payment mechanism:** DISCOM will provide EESL payment on a periodic basis based on the methodology agreed. Deemed saving approach would be adopted to make payments to EESL. ESCROW/payment security mechanism to be in-built to reduce the revenue risk to EESL

Standards on LED lighting – Bureau of Indian Standards and ELCOMA

To ensure standardization of LED lamps as also to have minimum safety requirement both BIS and ELCOMA have come out with LED specifications and standards. This would ensure that the quality of the LED's being sold in India meet the requisite standards for consumers.

The Bureau of Energy Efficiency will **also start a standard labeling programme** to grade the LED lamps which are currently being sold in the country. This would help the end consumer make a more informed decision on the LED bulb being purchased and also curtail decision making purely on the basis of the price.

ELCOMA specified standard for LED lamps

Sr.NO	Test Parameters	Requirements	Referred Standard IS/IEC
1	Rated Wattage	Upto and including 60 W	IS 16102 (Part 2)
2	Rated Voltage	Upto and including 250 V, ac]do]
3	CCT	2700K (2723 } 82); 3000K (2940 } 98); 3500K (3397 } 125); 4000K (4036 } 154); 5000K (4991 } 220); 5700K (5665 } 270); 6500K (6432 } 340)]do]
4	Cap Type	B22/E27	IS 16102 (Part 1)
5	Power factor	5W . no requirement > 5W]0.85 minimum	IS 16102 (Part 2)
6	Efficacy (lm/w)	Up to 5W]>55 lumen/watt >5 W]>60 lumen/watt	IS 16102 (Part 2)
7	CRI	>80%	IS 16102 (Part 2)
8	Lumen Maintenance	70% at 15000 hrs.	IS 16102 (Part 2)
9	Life	25,000 hrs	IS 16102 (Part 2)
10	Temperature Cycling test and supply voltage switching test	Product must survive one cycle for every hour of rated	IS 16102 (Part 2)
11	Harmonics	Shall comply with Table 5A and 5B	IS 16102 (Part 2) and 14700 (Part3/sec.2)

Source: ELCOMA

ELCOMA prescribed standards for luminaries

Sr. No.	Tests Parameters	Requirements	Referred standard IS/IEC
1	Lumen per Watt	Low Output (<9000 lm) 65 lm/W; Mid Output (9000 to <23000 lm) 80 lm/W; High Output (\geq 23000 lm) 100 lm/W	16103 (Part 2)
2	CRI	\geq 60	16103 (Part 2)
3	Minimum rated life (L70 /B50)	50,000 h	16103 (Part 2)
4	Rated voltage	Upto and including 250 V, Operating range 140V to 270V AC, 50 Hz	IS 16103 (Part 2)
5	Power Factor	> 0.9	IS 16103 (Part 2)
6	THD	Not more than 20%	14700 (Part 3/Sec 2)
7	Driver	Accessible for easy replacement.	-
8	CCT	3000K (3045 \pm 175) 3500K (3465 \pm 245) 4000K (3985 \pm 275) 5000K (5028 \pm 283) 5700K (5665 \pm 355) 6500K (6530 \pm 510)	IS 16103 (Part 2), IS 16105 and IS 16106
9	Junction Temperature	Less than 90° C @ ambient 25 degrees C. To be calculated by measuring at solder point and adding thermal resistance.	-
10	Capacity to withstand surges	Upto 4 KV	IEC 61000-4-5
11	Warrantee	2 years	-

Source: ELCOMA

Bureau of Indian Standards standards on LED lamps sold in India

SI No	IS No	Title
1	16101 : 2012	General Lighting -LEDs and LED modules – Terms and Definitions
2	16102(Part 1) : 2012	Self-Ballasted LED Lamps for General Lighting Services Part 1 Safety Requirements
3	16102(Part 2) : 2012	Self-Ballasted LED Lamps for General Lighting Services Part 2 Performance Requirements
4	16103(Part 1) : 2012	Led Modules for General Lighting Part 1 Safety Requirements
5	16103(Part 2) : 2012	Led Modules for General Lighting Part 2 Performance Requirements
6	15885(Part2/Sec13):	2012 Safety of Lamp Control Gear Part 2 Particular Requirements Section 13 d.c. or a.c. Supplied Electronic Controlgear for Led Modules
7	16104 : 2012	d.c. or a.c. Supplied Electronic Control Gear for LED Modules -Performance Requirements
8	16105 : 2012	Method of Measurement of Lumen Maintenance of Solid State Light (LED) Sources
9	16106 : 2012	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products
10	16107Part 1):2012	Luminaires Performance Part 1 General Requirements
11	16107-1:2012	Luminaires Performance Part 2 Particular Requirements Section 1 LED Luminaire
12	16108 : 2012	Photobiological Safety of Lamps and Lamp Systems

Source: BIS

Annexure 1. Different types of lamps

So how does an LED really work?

LED's are a sort of semi-conductor. The movement of free electrons across a diode releases energy in the form of a photon (basic unit of light). LEDs are heat sensitive, so to ensure that heat moves away and doesn't damage the semiconductors, heat sink plate made of aluminum are used to move heat away from the light-emitting diodes. Generally the heat sink plate becomes part of the design of the bulb and from the heat sink plate, the heat moves into the air surrounding the bulb.

Light Emitting Diode bulb

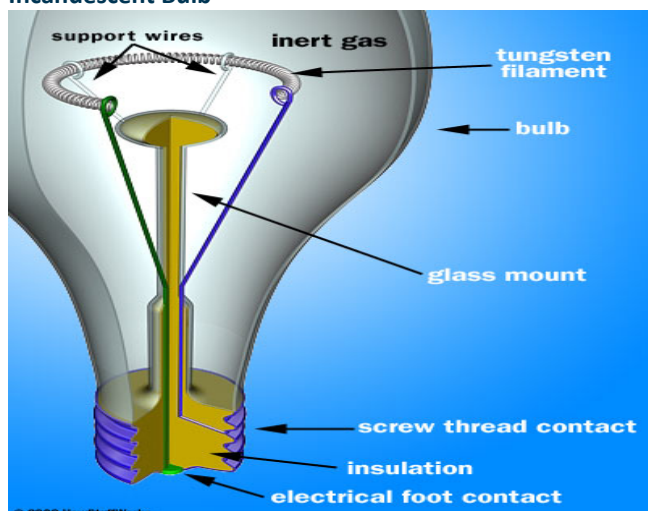


Source: Industry, PhillipCapital Research

Working of an Incandescent Light

The light bulbs have two metal contacts, which connect to the ends of an electrical circuit. The metal contacts are attached to two stiff wires, which are attached to a thin metal **filament**. As **electric current** flows from one contact to the other, through the wires and the filament is heated. The movement of electrons releases photon and when heated to around 4,000 degrees Fahrenheit (2,200 degrees C) in the case of a light bulb -- they emit a good deal of light. However, do note that only 10% of the energy in an ICL is converted into light – the remaining goes into heat generation.

Incandescent Bulb



Source: Industry, PhillipCapital Research

Working of Compact Fluorescent Lamp

A compact fluorescent lamp is designed to replace an incandescent lamp with some types fitting into light fixtures formerly used for incandescent lamps. The lamps use a tube which is curved or folded to fit into the space of an incandescent bulb with a compact electronic ballast in the base of the lamp.

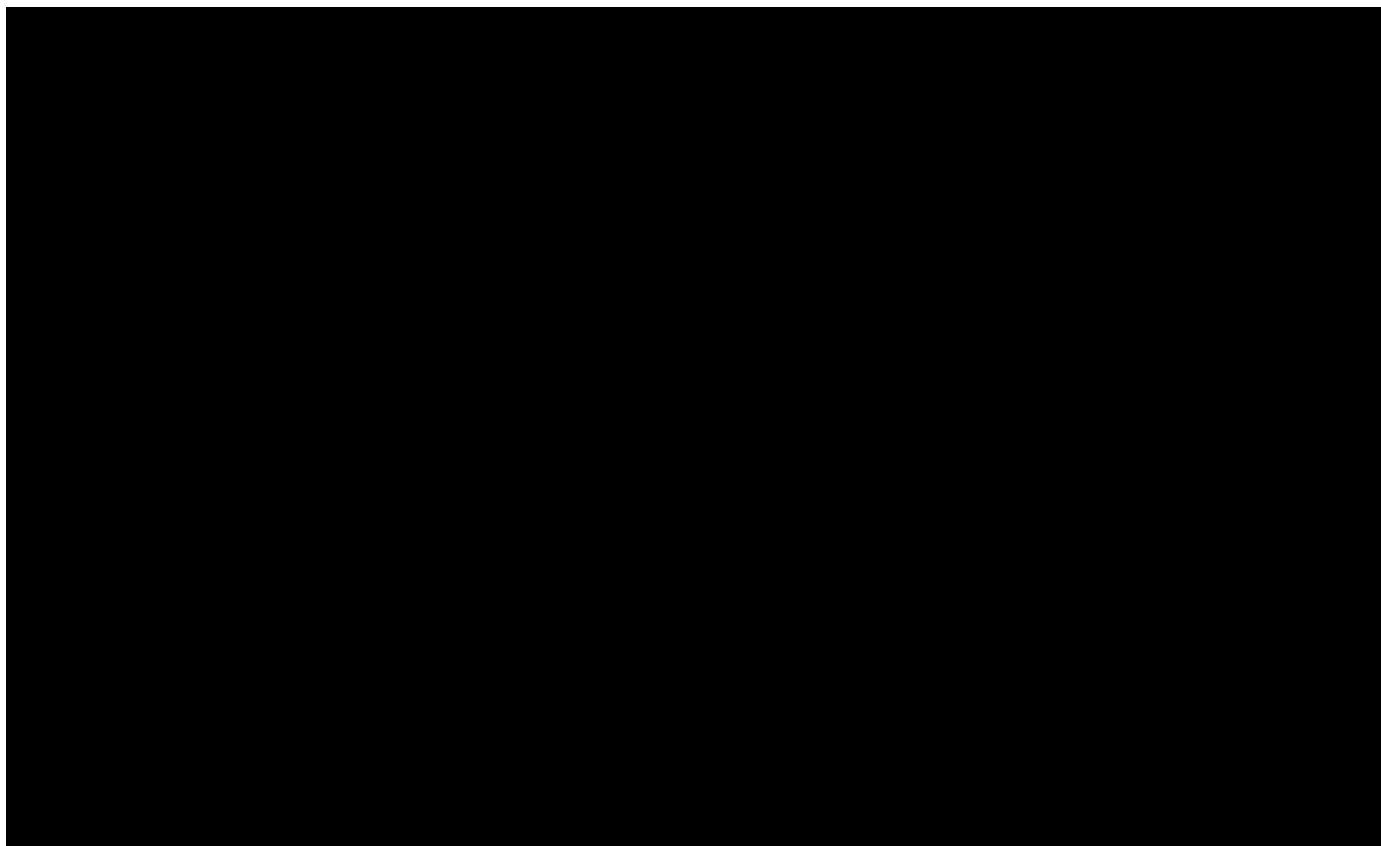
The mechanism in case of CFL is slightly different relative to traditional incandescent light. CFLs contain argon and mercury vapor housed within a spiral-shaped tube. When electric current to pass through the vaporous mixture it excites the gas molecules and produces ultraviolet light. The ultraviolet light, in turn, stimulates a fluorescent coating painted on the inside of the tube. As this coating absorbs energy, it emits visible light. As compared to traditional incandescent bulbs, CFL's require lesser heat to illuminate light and hence are environment friendly.

Compact Fluorescent Lamps



Source: Industry, PhillipCapital Research

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