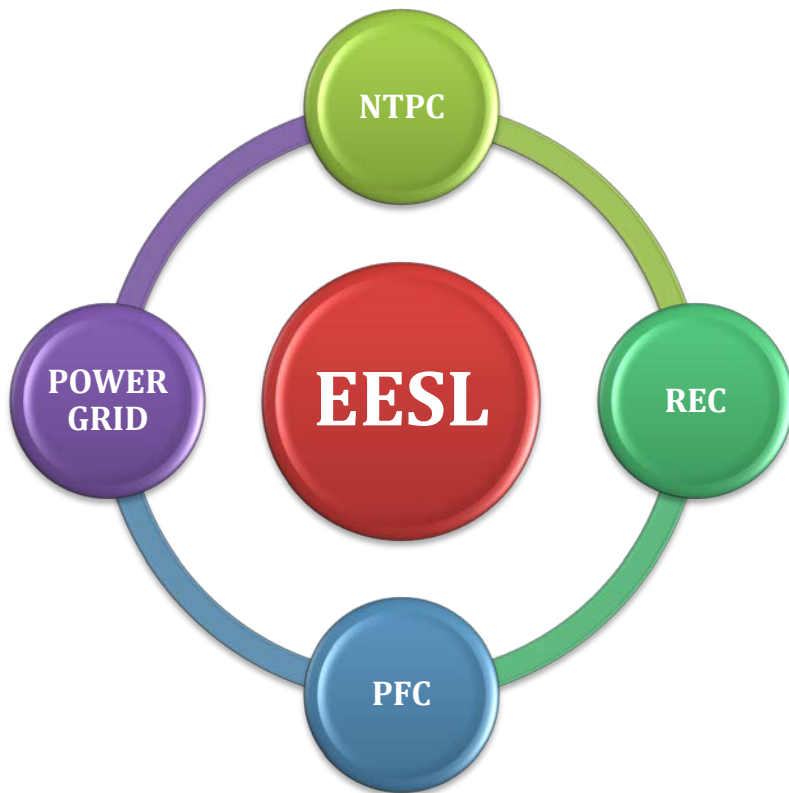




## **Developing A Market For Energy Efficiency In India**

**N. Mohan, Manager - Technical**  
**Energy Efficiency Services Limited**  
(A JV of PSUs of Ministry of Power, Government of India)

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## Energy Efficiency Projects For Demand Side Measures

- Agriculture
- Municipalities
- Buildings
- Distribution Efficiency
- DSM Efficient Lighting Programme (DELP)
- Cogeneration & Tri-generation Projects

## Implementation Of Central & State Government Policies

- S & L Programs
- SDA Capacity Buildings
- Perform Achieve & Trade Scheme For Industries

## Consultancy Services

- Technical Advisory Services
- Policy Advice To The Government
- CSR & Sustainable Development Programme

## Development Of Private ESCOs.

# ENERGY EFFICIENCY POTENTIAL

## Energy Scenario:

India's present electricity generation is 978 billion kWh and expected electricity demand is about 3400 billion kWh by 2030-31

(As per the 18th Electric Power Surveys (EPS) conducted by Central Electricity Authority (CEA)).

## Energy Savings Potential:

<b>Consumer category</b>	<b>Electricity saving potential (%) (As per BEE, NPC study 2009 and EESL Study )</b>
Domestic Urban	15-20%
Domestic Rural	40-50%
Commercial buildings (> 500kW connected load)	20%
Public lightings	50%
Public Water Works	20-25%
Industry (including SMEs)	7-10%
Agriculture pumping	30%

# DSM - STRATEGIES

**“Demand side management (DSM) means actions of a utility, beyond the customer's meter, to alter the end-use of electricity, whether it be to increase demand, decrease it, shift it between high and low peak periods, or manage it when there are intermittent load demands, in the overall interests of reducing utility costs”**

**The broad set of DSM practices that fall under the scope of this definition is mentioned below.**

## **1. Load management techniques**

- Dynamic or real-time pricing - Time of day (TOD) tariffs, load factor and power factor incentives
- Demand response - Voluntary load curtailment measure adopted to manage peak system load.

## **2. Load reduction techniques**

- Utility sponsored incentives to adopt energy-efficient technologies, equipment, appliances across various classes of end-users in the state's economy

Loss reduction techniques like infrastructure up-gradation, feeder segregation and many other interventions, which are not actions beyond the customer's meter, cannot be considered under the scope of this DSM definition.

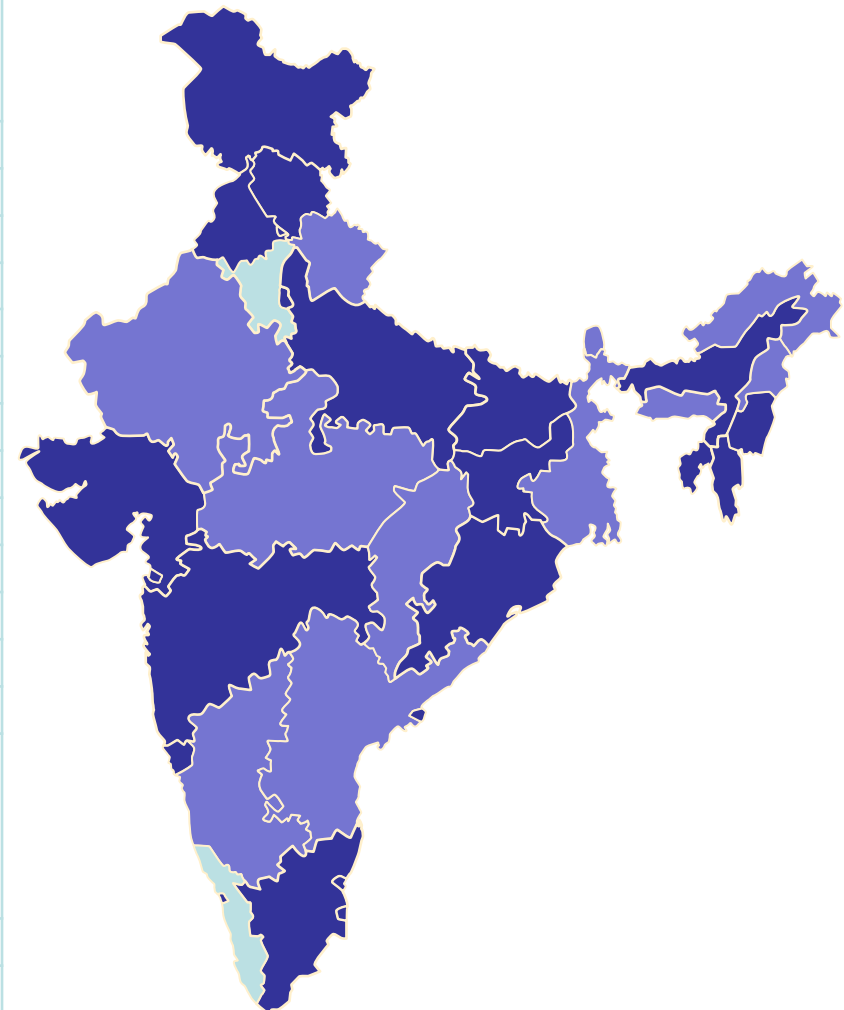
# EVOLUTION OF DSM REGULATIONS

May 2010 – Model DSM regulations by Forum of Regulators

15 states - notified DSM regulations

2 states - published draft regulations

State	Year of gazetted notification	Year of draft publication
Maharashtra	April 2010	×
Tripura	July 2010	×
Jharkhand	September 2010	×
Kerala	×	May 2011
Jammu and Kashmir	August 2011	×
Orissa	August 2011	×
Himachal Pradesh	September 2011	×
Assam	March 2012	×
Punjab	March 2012	×
Gujarat	May 2012	×
Mizoram and Manipur	June 2012	×
Tamil Nadu	February 2013	×
Uttar Pradesh	April 2014	
State of Goa and Union Territories of Dadra & Nagar Haveli, Daman & Diu, Puducherry, Chandigarh, Andaman & Nicobar Islands, Lakshadweep	May 2014	×
Bihar	August 2014	×
Haryana	×	August 2014
Delhi	October 2014	×



# DSM PLANNING PROCESS

## DSM regulations states:

**Distribution Licensee shall undertake load research to identify the target consumer segment/s and end uses for DSM programmes to build the necessary database**

## Load Research:

**Activity embracing the measurement and study of the characteristics of electric loads to provide a thorough and reliable knowledge of trends, and general behavior of the load characteristics of the customers serviced by the electrical industry**



- ▶ Domestic
- ▶ Urban/Rural



- ▶ Industry
- ▶ HT/LT/industry output



- ▶ Agriculture
- ▶ HT/LT/agro-climatic profile



- ▶ Commercial
- ▶ Large/small

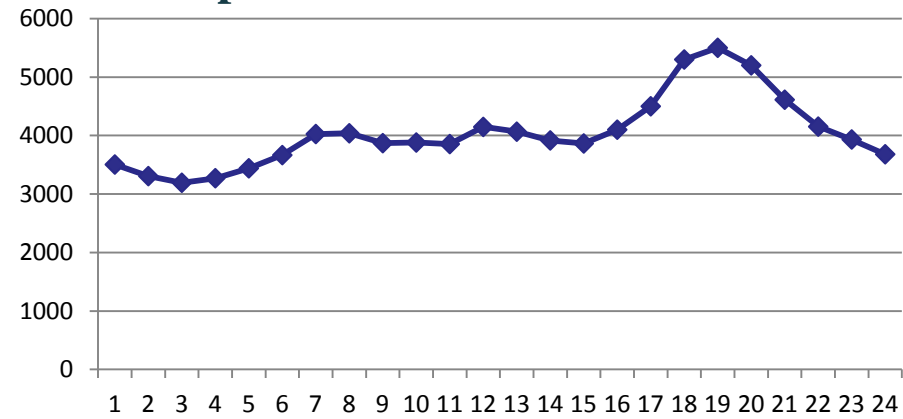
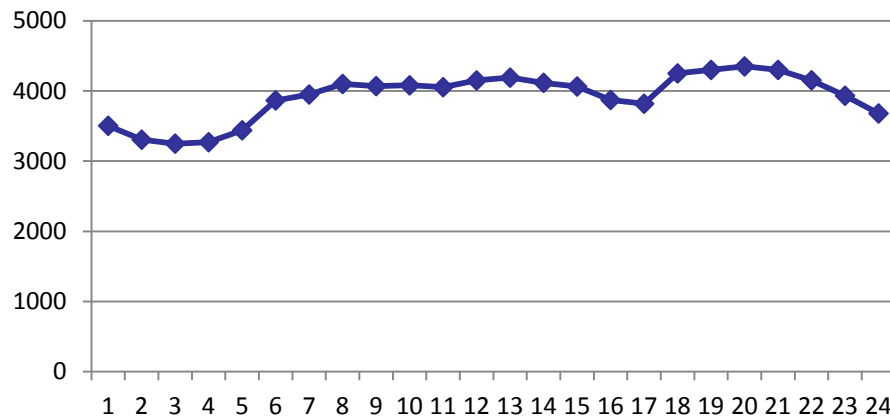


- ▶ Municipal

# DSM PLANNING PROCESS

## Why load research?

Flat vs skewed load shape



### Flat curve

- Even distribution of fixed costs of generators
- Reduced loss of surplus power during off peak periods
- Reduced costs of short/medium term power

### Skewed curve

- Uneven distribution of fixed costs of generators
- High loss of surplus power during off peak periods
- High costs of short/medium term power

▶ Flattening the load curve helps DISCOMs to optimize its power procurements costs

Load research

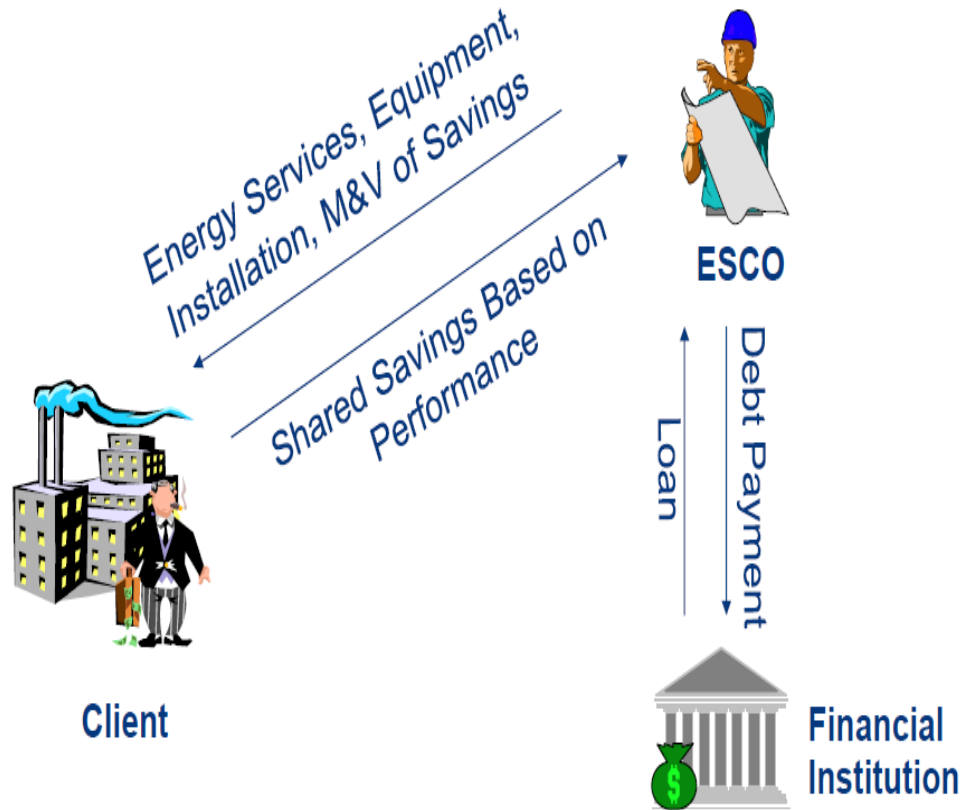
Resource potential assessment

*Cost effectiveness assessment*

Design of DSM programs

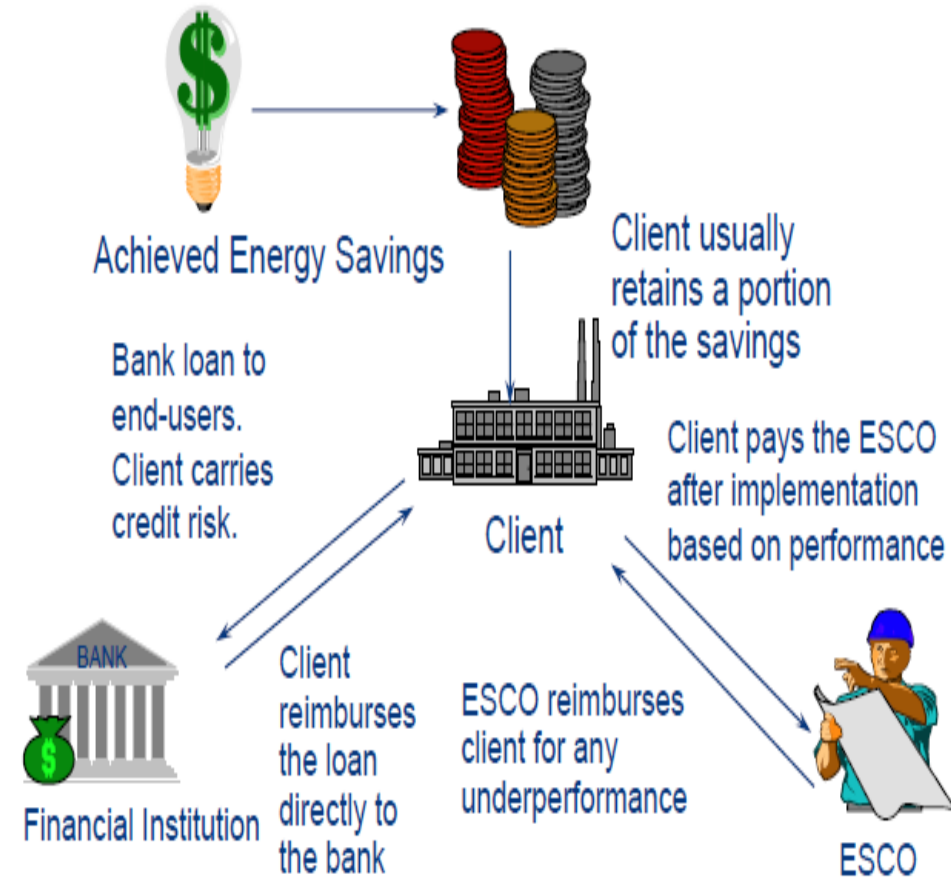
# DSM IMPLEMENTATION MODELS - ESCO APPROACH

## Shared Savings



OR

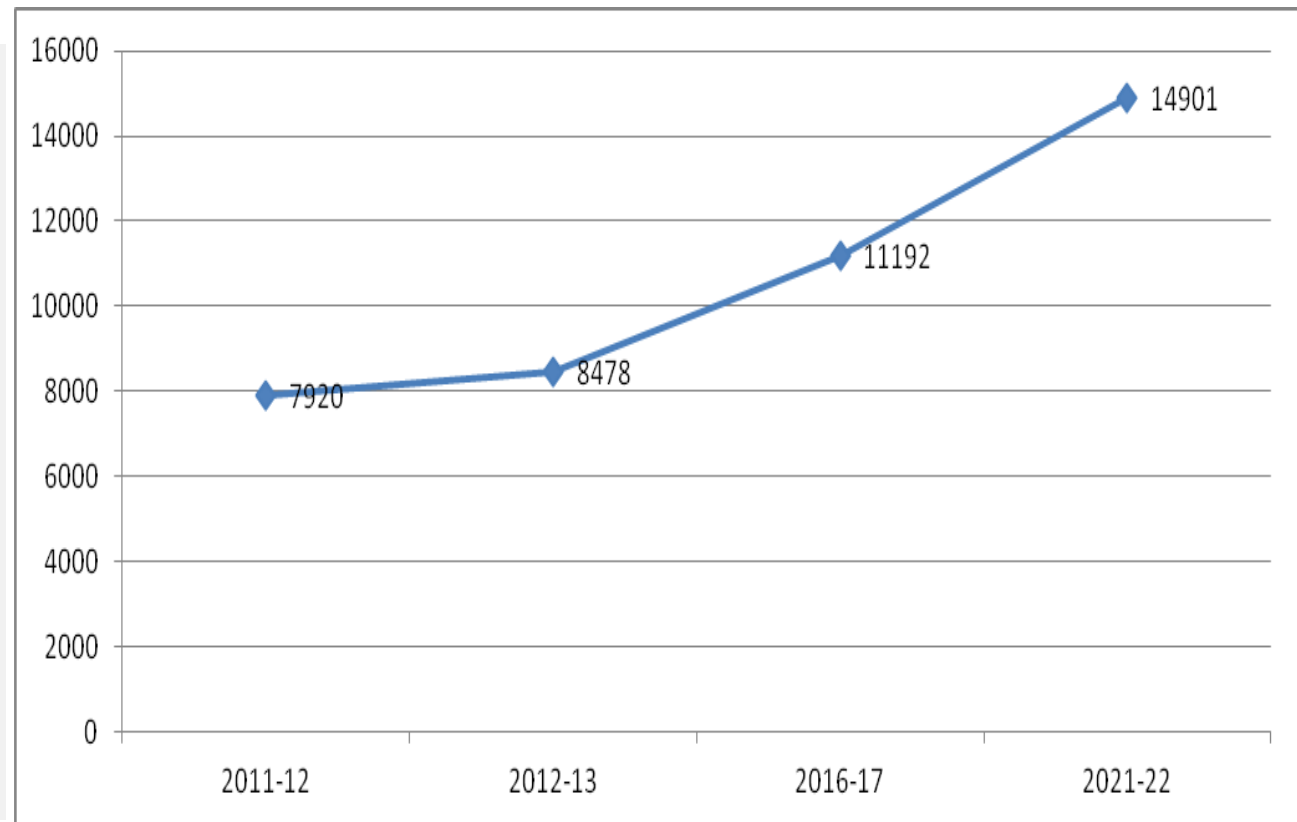
## Guaranteed Savings





# ENERGY EFFICIENCY IN STREET LIGHTS - OPPORTUNITY

**Projected Growth in Consumption of energy by Street Lights (m KWh) per annum**



- 8.5 b KWh consumption annually (2012-13) – growing at CAGR of 7%
- Potential savings of upto 55% possible by retrofits by LEDs
- Additional 15-25% savings by intelligent street light management – daylight savings/ dimming, etc
- Savings of **5 b KWh** possible at national level
- Cost savings of **Rs. 2500 crores** annually

► Source: 18<sup>th</sup> EPS, CEA

# ESCO - MAJOR CHALLENGES FOR STREETLIGHT IMPLEMENTATION



**Baseline:** Inadequate data availability

**Billing:** Wide variation in billed load & actual load - 30-50%

**Conforming to Standard:** Lumen output not as per BIS standard.

**Manual operation:** Variation in operating hours results in additional usage of 10-15%

**Payments linked to bill reduction:** In the absence of proper baseline – enhances the technical and financial risk of ESCO

**Payment Security:** Absence of it increase cost of capital and viability

**M&V:** Detailed M&V plan, in the current situation, makes is very difficult for ESCO to arrange finances

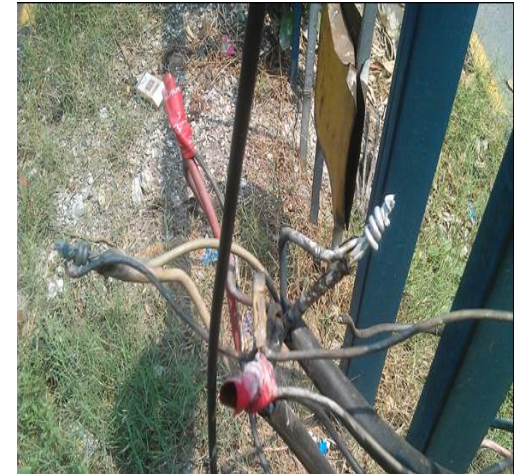
# STREETLIGHT INFRASTRUCTURE CHALLENGES



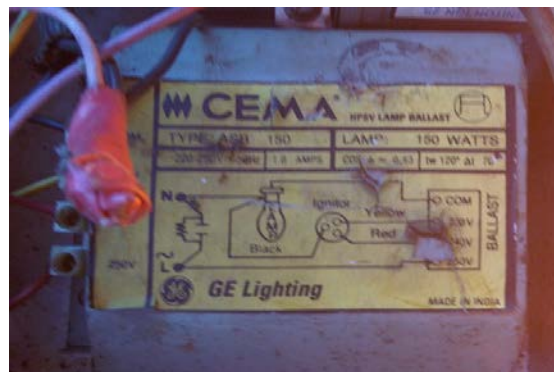
**Conventional switching Points**



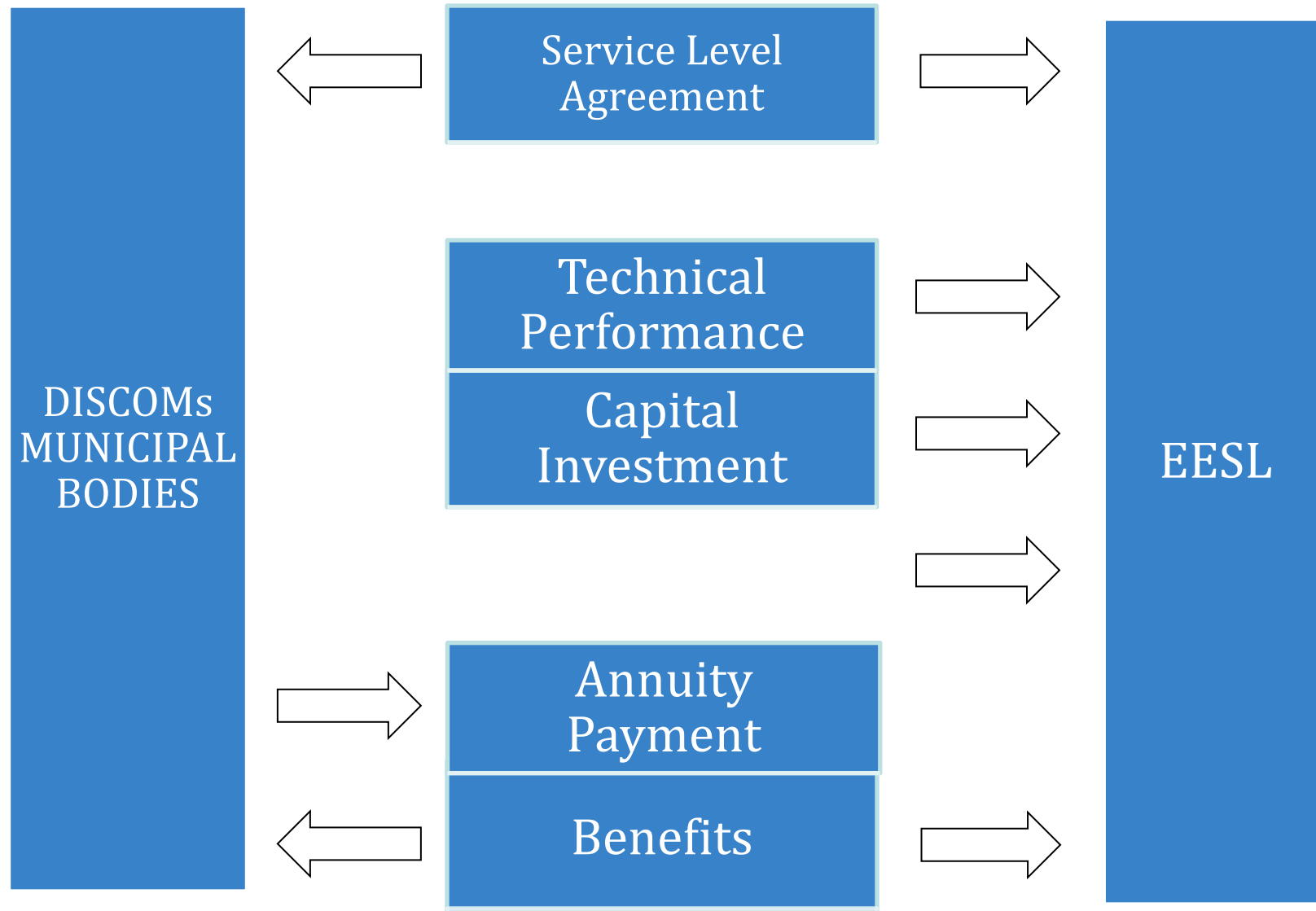
**Poor wiring arrangements**



**Under wattage Ballast**



# DEEMED SAVINGS ESCO APPROACH



# STREETLIGHT IMPLEMENTATION METHODOLOGY



## MOU

- MOU to be signed between Municipalities & EESL

## DPR/ Re Validation Of DPR

- Detailed walk through energy assessment for data validation of existing DPR and Joint Verification

## Technology Demonstration

- To assess actual energy savings and determination of annuity payments and finalising 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

# TECHNOLOGY DEMONSTRATION PRINCIPLE



- ▶ LED 120W
- ▶ Light output: 30.13lux

- ▶ HPSV 250W
- ▶ Light output: 25.00 lux

## EESL OFFERINGS

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### **Technical Performance**

- Free O&M during contract period
- Free replacement warranty for entire contract
- Centralised Monitoring & Control for operational efficiency
- Uptime of lights >95%

### **Annuity Determination**

- Actual cost of procurement
- Actual cost upon rate of debt
- PMC charge up to 5%
- ROE of 16% post tax

**Overall savings by accounting electricity bill + O&M charges**

# Case Study of Streetlight Project

## Project Area – Greater Vishakhapatnam Municipal Corporation

• Total number of streetlights	- 91775
• Existing annual energy consumption	- 36.01MU
• Post LED retrofit annual energy consumption	- 14.92MU
Energy Savings per annum	- 21.09MU
• Existing expenditure on energy consumption	- 23.63Cr
• Existing maintenance expenses	- 6.49Cr
Total existing expenditure on streetlights	30.12Cr
• Post LED retrofit energy consumption	- 9.79Cr
• EESL annuity payment	- 18.40Cr
Total revised expenditure on streetlights	- 28.19Cr
• Net benefit to GVMC	- 1.93Cr
• Project period	- 7 years.



# STREETLIGHT PROJECT STATUS

Sl. No	Name of the ULB	Project Status	No. of streetlights (Nos.)	Estimated Investment (Rs. Crs)
1	Nashik Municipal Corporation	Under Implementation	70,000	80
2	Electricity Department, Puducherry	Project agreement under execution	46,000	37
3	Greater Vishakhapatnam Municipal Corporation (GVMC)	Under Implementation	90,000	65
4	Municipal Corporation of Delhi (SDMC)	Project agreement signed	198,000	180
5	Agartala, Tripura	Project implementation under progress	33,000	13
6	Andhra Pradesh – 13ULBs	Project under approval phase	38,000	17
7	Rajasthan – 13ULBs	Project under approval phase	240,000	104
			Total	496

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# DOMESTIC SECTOR

## DSM BASED EFFICIENT LIGHTING PROGRAM



# DELP SCHEME STRUCTURE

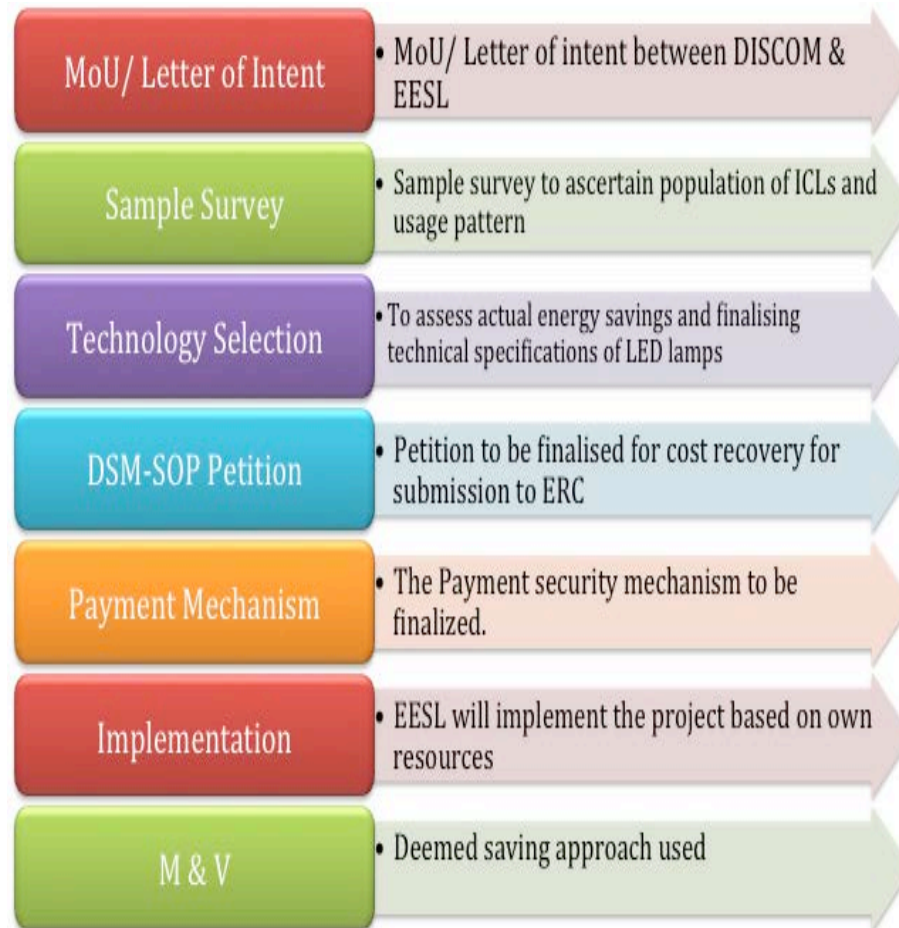
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- Provide each grid-connect household up to 4 LEDs as replacement of incandescent bulbs.
- Treats EE as a resource – enhances the value for policy makers/ stakeholders
- Long term contract with Regulatory approvals – reduces investment risks
- Contracts akin to PPAs – easy to understand for Utilities/ regulators
- Payment security in-built – use of revolving LCs
- Obviates the need for Regulators to levy DSM charge which may result in higher tariffs – acceptability of the approach increases
- First Project under DELP-SOP in India approved by Joint Electricity Regulatory Commission on – May, 2014 – **650,000 incandescent bulbs replaced by LEDs – LEDs given at a cost of INR 10**
- No upfront cost for utilities in implementing the measures

# IMPLEMENTATION MODELS

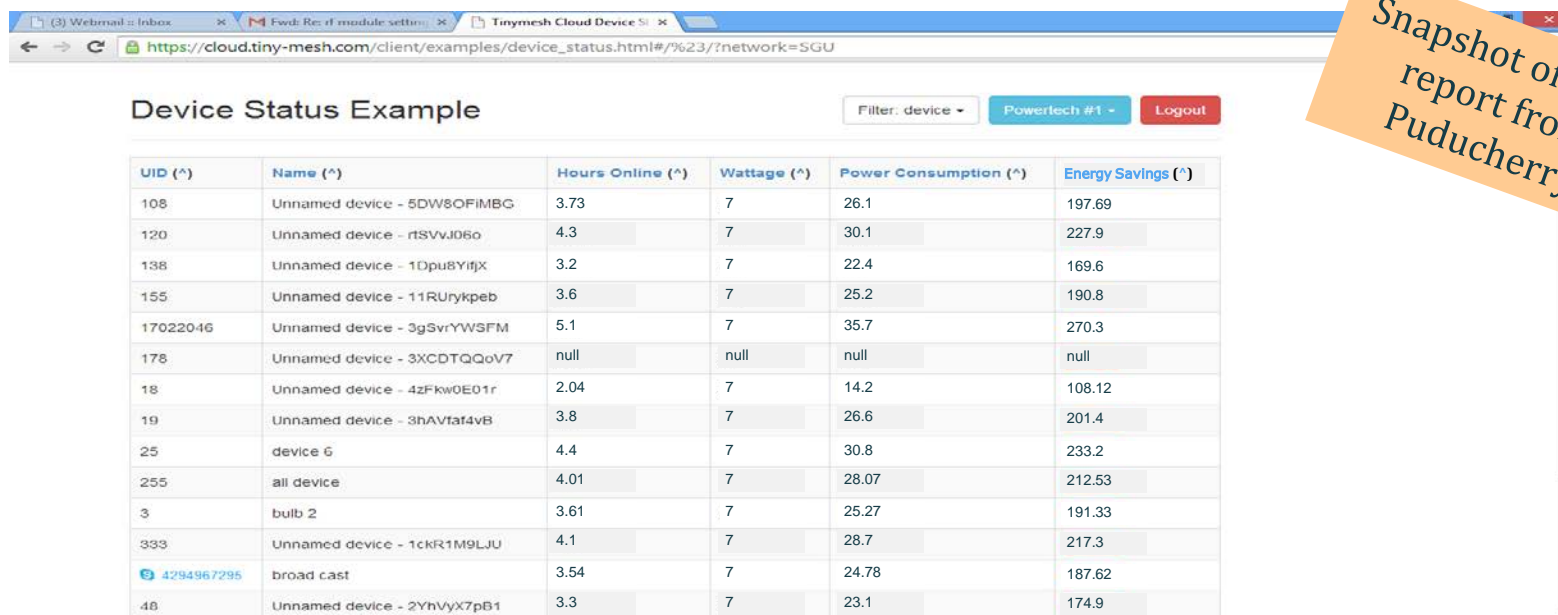
<b>DELP-SOP Model</b>	<b>DELP-On Bill Financing Model</b>
<p>Both DELP models are designed under the Demand Side Management (DSM) regulatory framework of DISCOMs.</p>	
<p>Project investment would be recovered from DISCOMs from the resultant energy savings as specified in the DSM project duly approved by the Regulatory Commission.</p>	<p>Implementation will not have any financial burden to the ARR of the DISCOMs, as project investment would be recovered from consumers and through subsidy of Government.</p>
<p>The scheme proposes to provide up to four 7-Watt LED bulbs to household consumers at a cost of Rs.10 each as replacements to 60W ICLs and/or 11~14W CFL and investment of EESL is recovered through sharing of resultant energy savings with the DISCOM under a regulatory oversight.</p>	<p>The scheme proposes to provide up to four 7-Watt LED bulbs to household consumers at an upfront cost of Rs.10 each and the balance Rs.120 will be recovered from the consumers' electricity bill over a period of 12 months at the rate of Rs. 10 every month. Any gap between the total project cost and amount to be recovered from consumers, shall be recovered from subsidy by Government or Ministry of Power.</p>
<p>Consumer participation would be encouraging, as scheme provide LED bulbs at Rs. 10 each.</p>	<p>Limited participation owing to liability on consumers for monthly repayment for LED Bulbs over 1 year.</p>
<p>No pre-registration formalities required.</p>	<p>Pre-registration of all consumers in order to make them eligible for the scheme.</p>
<p>Energy savings will be shared to repay the project investment of EESL.</p>	<p>Entire energy savings will be retained by DISCOMs.</p>

# DELP METHODOLOGY OF EESL



- EESL will, in consultation with DISCOM, select an area for implementation of DELP.
- EESL, DISCOM and Regulatory Body, will agree on a DSM based mechanism to service investments
- EESL will undertake awareness and outreach of the scheme to household. It will provide up to 4 LEDs per household at Rs.10/ lamp as replacement for working ICLs
- EESL and DISCOM will undertake distribution of LEDs to every household and maintain a list of such distribution.
- For monitoring purposes, third-party verifier will select a random sample of household for annual verification.
- Robust mechanism will be built to prevent LED leakage
- ICLs will be collected and destroyed as per relevant environmental norms

- A representative sample of houses will be selected for continuous real-time measurement
- Usage hours and energy savings of the installed 7W LEDs that replace 60 W incandescent are recorded and monitored
- RFID tags are fixed on LEDs that in turn uses a computer chip and antennas to record and transmit measurements to a web enabled system that is remotely accessible
- Readings will be taken for ascertaining the usage pattern in real-time.



UID (^)	Name (^)	Hours Online (^)	Wattage (^)	Power Consumption (^)	Energy Savings (^)
108	Unnamed device - 5DWSOFIMBG	3.73	7	26.1	197.69
120	Unnamed device - rTSVvJ06o	4.3	7	30.1	227.9
138	Unnamed device - 10pu8YitjX	3.2	7	22.4	169.6
155	Unnamed device - 11RUrykpeb	3.6	7	25.2	190.8
17022046	Unnamed device - 3g5vYWSFM	5.1	7	35.7	270.3
178	Unnamed device - 3XCdTQqoV7	null	null	null	null
18	Unnamed device - 4zFkw0E01r	2.04	7	14.2	108.12
19	Unnamed device - 3hAVt4vB	3.8	7	26.6	201.4
25	device 6	4.4	7	30.8	233.2
255	all device	4.01	7	28.07	212.53
3	bulb 2	3.61	7	25.27	191.33
333	Unnamed device - 1ckR1M9LJU	4.1	7	28.7	217.3
4294967295	broad cast	3.54	7	24.78	187.62
48	Unnamed device - 2YhVyX7pB1	3.3	7	23.1	174.9

On average 1.1 lakh units per day savings will be achieved in Pudicherry . Based on the results, the annual savings for 6.5 Lakhs will be 43 MU



# Case Study DELP

## Project Scenario

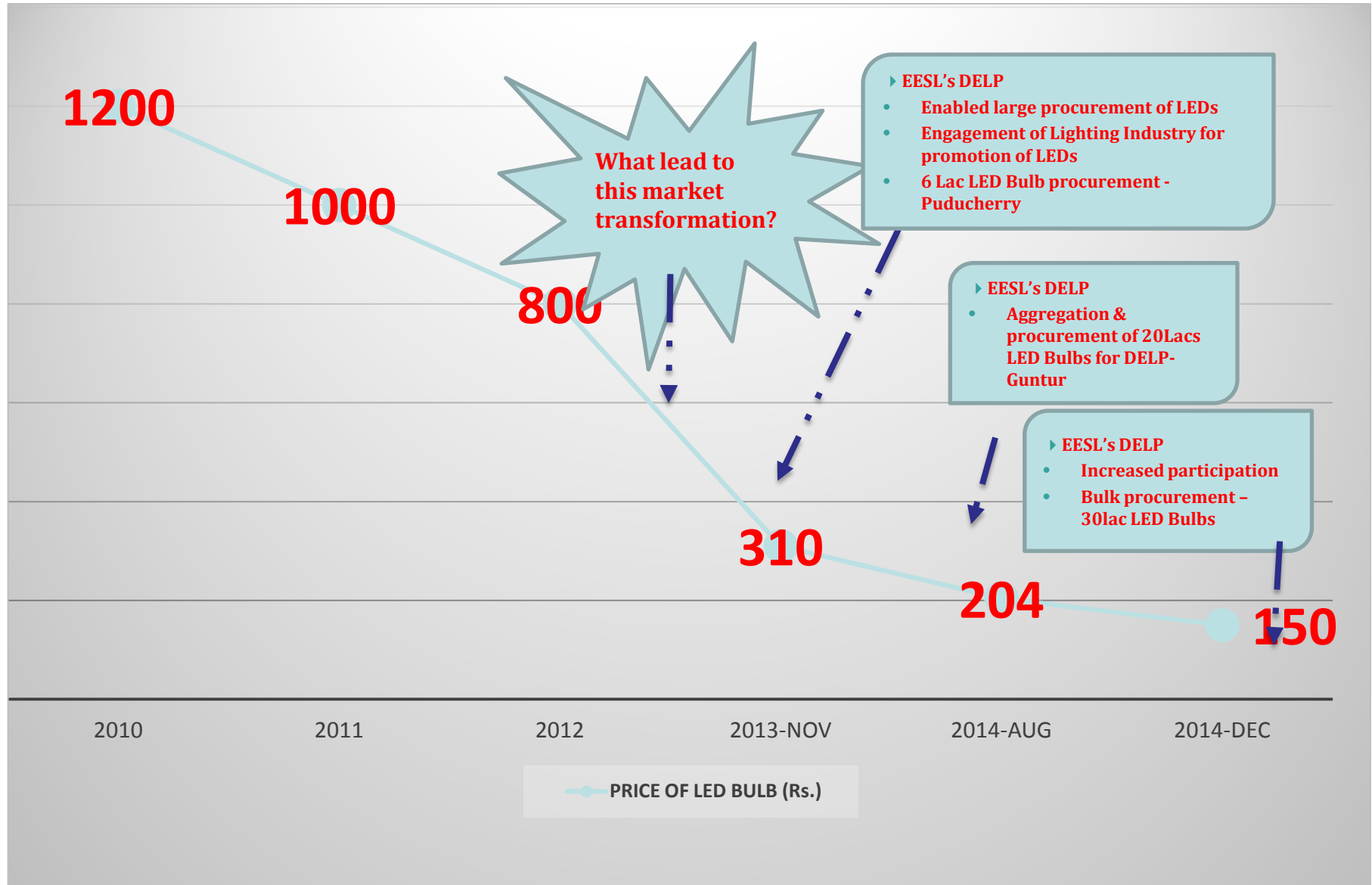
Particulars	Unit	Guntur	Anantapur	Total
Number of LED Bulbs offered per Household	Number	2	2	2
Number of LED Bulbs offered under this Scheme	Number	1,842,000	1,240,000	3,082,000

Energy Savings per Annum under the Scheme on account of Demand Reduction (MUs) -Guntur				114.53
Energy Savings per Annum under the Scheme on account of Demand Reduction (MUs) -Anantpur				77.10
Power Procurement Cost per Unit (INR)			2.00%	5.6304
Benefit- Savings in Power Procurement Cost per Annum (INR Crores)- Guntur				64.49
Benefit- Savings in Power Procurement Cost per Annum (INR Crores)- Anantapur				43.41
Payout- Payment to EESL through ARR (INR Crores)				30.76
Net Impact on ARR				77.14

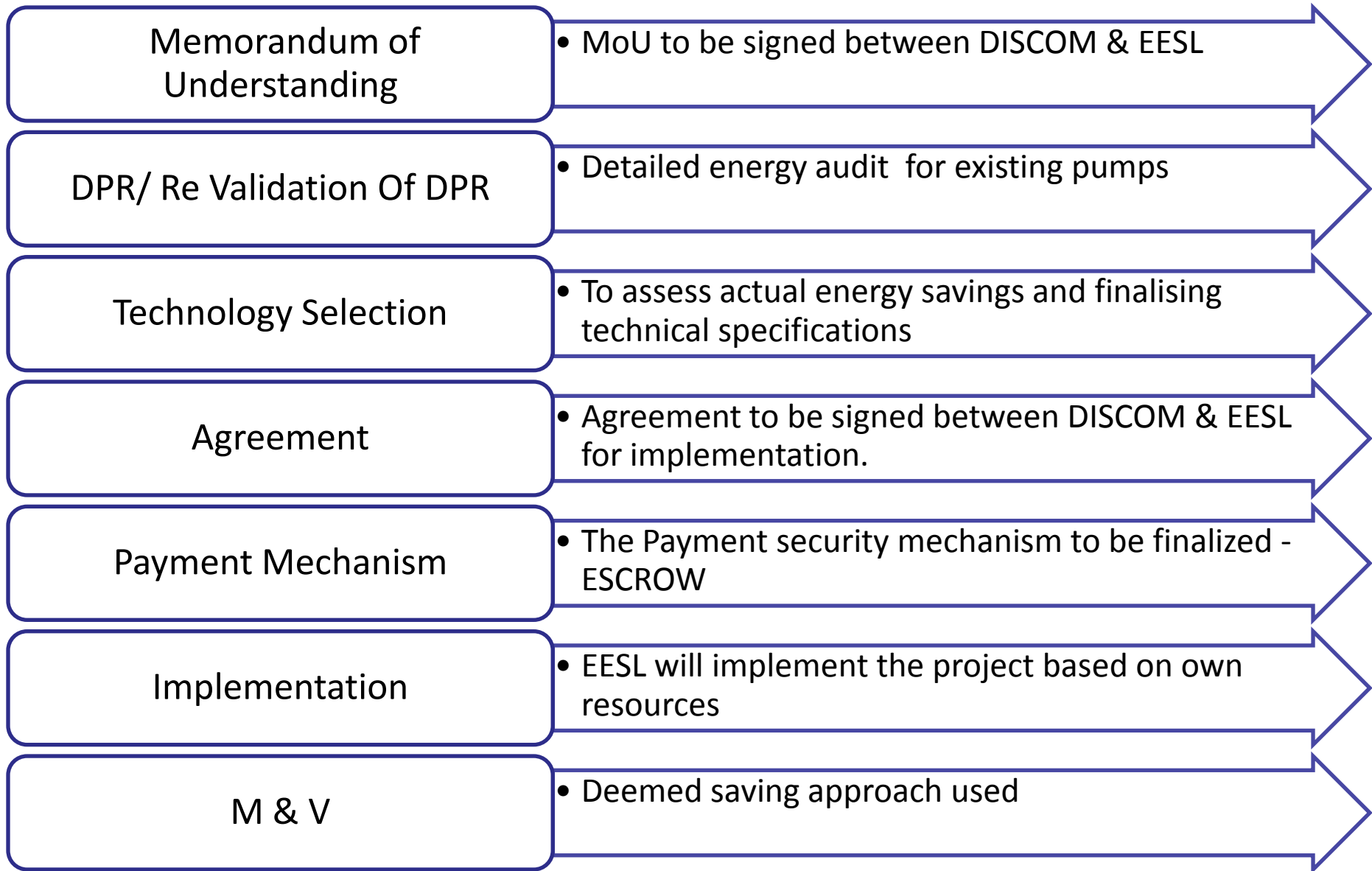
**DELP SOP Price per Unit**

**1.6050**

# PRICE TREND OF LED BULBS







# AGRICULTURE DSM



AgDSM HESCOM		
Particulars	Units	Value
Number of pumps replaced	Nos.	599
Energy Savings achieved per annum	MUs	29.9
Total Investment	INR Crores	2.61
Debt-Equity Ratio	%	0:100
Monthly Payments to EESL	INR Crores	0.10
Payment Mechanism		Through ESCROW
Return on Equity or Equity IRR per annum	%	15.49%
Present status	Implementation completed on 31.12.2013. Regular payment are being received.	

Sl. No.	Name of Electricity Distribution Company	Nos. of pump sets	Estimated Investment (Rs. Crore)	Present Status
1	Hubli Electricity Supply Company Limited (HESCOM), Hubli, Karnataka	11013	55	First phase of the project completed – 37% savings achieved consistently for last 6 months. Second phase implementation under finalisation.
2	Chamundeshwari Electricity Supply Company (CESC), Mysore, Karnataka	1337	5	Project under implementation. POWERGRID is the implementing partner – to be completed by December, 2014.
3	Bangalore Electricity Supply Company (BESCOM), Bangalore, Karnataka	100,000	400	DPR for 25,000 pumps submitted – final decision of implementation and M&V awaited.
4	APEDCL	3,000	15	DPR revalidation under process – implementation to start by November, 2014
5	APEDCL, APSPDCL	30,000	150	Segregated feeders being identified. DPR preparation to commence in August
	<b>Total</b>	<b>1,45,350</b>	<b>625</b>	

## Yojana Bhawan Snapshot

- Total energy consumption before retrofit 29 Lac KWh
- Total energy bill before retrofit Rs. 170 Lac
- Main equipment replaced
  - 591 nos. of old fans with BEE 5 star fans
  - 2176 lighting points with LED retrofits
  - 22 ACs retrofits (all 1.5 TR) — 15 window and 7 split
  - 15 window AC 1.5 TR BEE 5 star for 1<sup>st</sup> floor to replace ductable units usages
  - 328 nos. of micro processor AC energy savers
  - 1 no. of 15 HP water pump replaced with energy efficient 12.5 HP pump
  - Energy Management System (EMS) to optimize operational controls and enhance savings
- Total capital cost Rs. 85 Lac (EMS cost excluded about Rs. 10 Lac)
- Energy consumption after retrofit 21.5 Lac KWh
- Electricity bill after retrofit Rs. 113 Lac
- Energy Savings – 7.5 Lac KWh



Work in Shram Shakti Bhavan under progress  
15 other buildings taken up

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**Thank You**

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