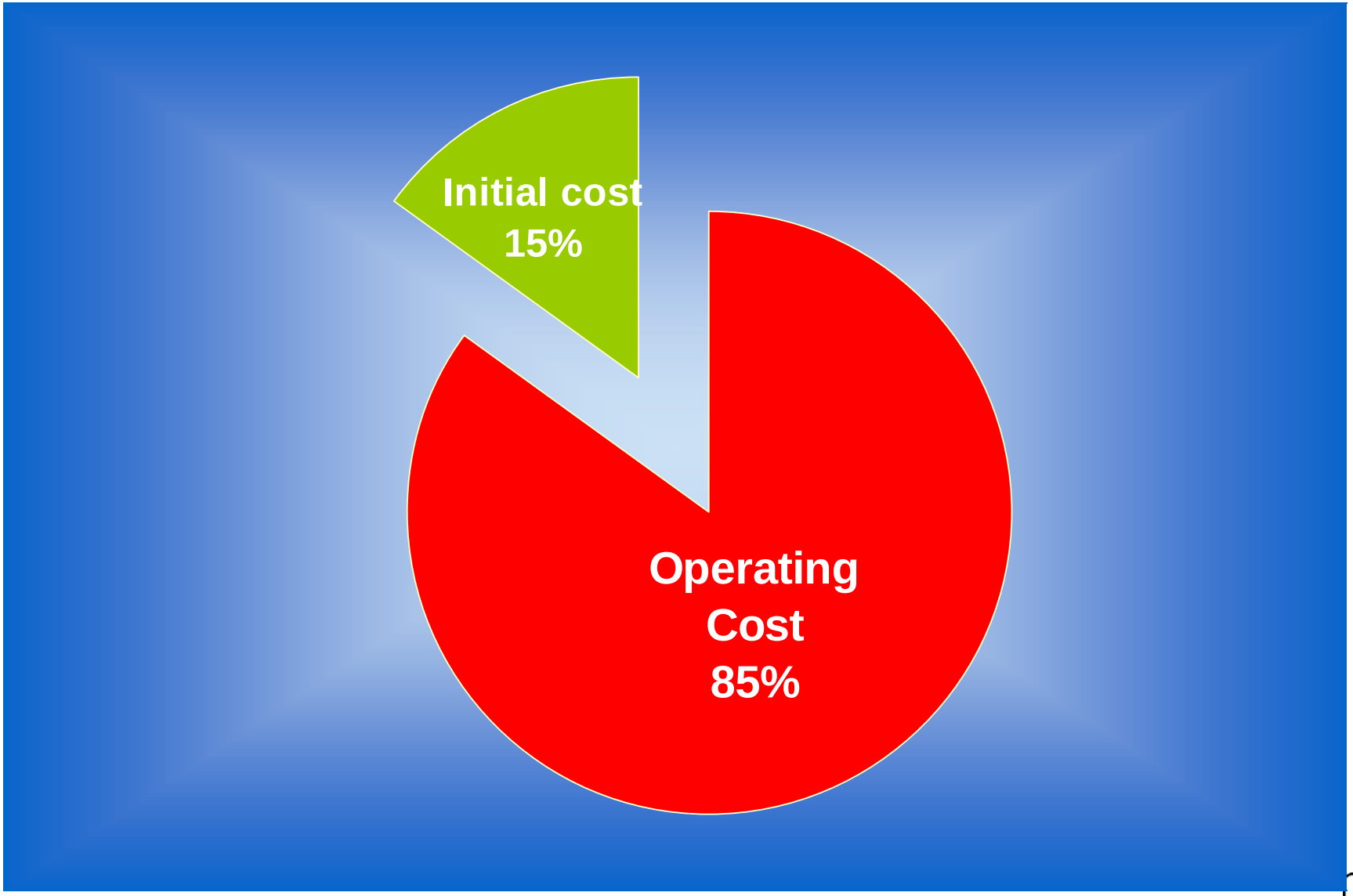
Best Practices in **Lighting System**

Lighting

- Essential for any working environment
- Power consumption **2 to 10 %** for different industries
- Commercial Buildings – 5 – 20 % of the Power Bill

Life Cycle Cost



Terminologies

- Flux emitted by lamp - lumens
- Luminous Efficacy - Lumens / Watt
- Illuminance = Lumens /sq.meter (Lux)
- Colour Rendering Index - Colours of surfaces illuminated by a given light source

Basic Components

Gears

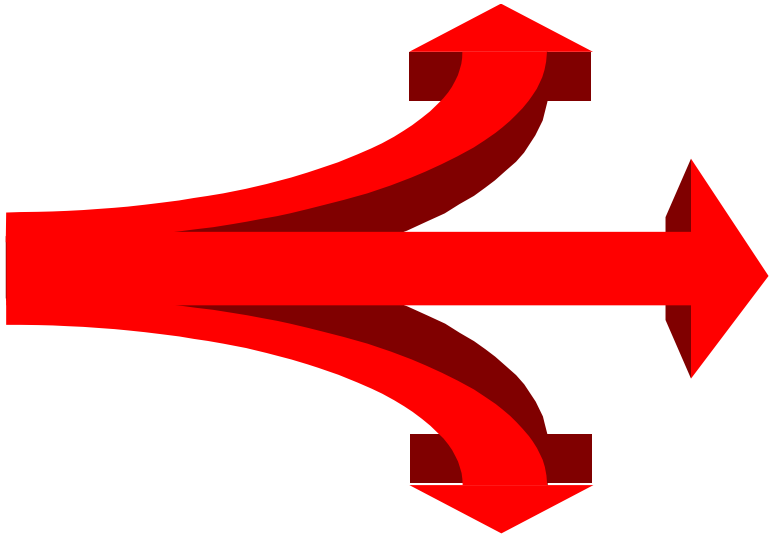
Luminaries

Lamp

Energy Conservation - Macro Level

Generation

Approach to Lighting

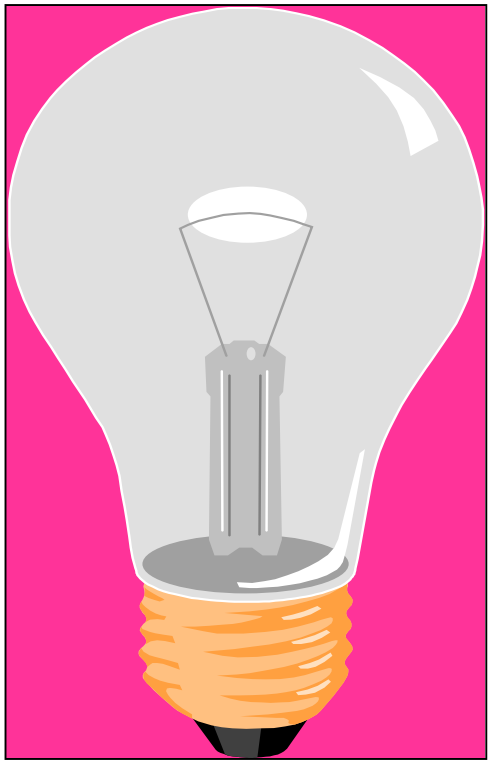


Distribution

Control

Types Of Lamps

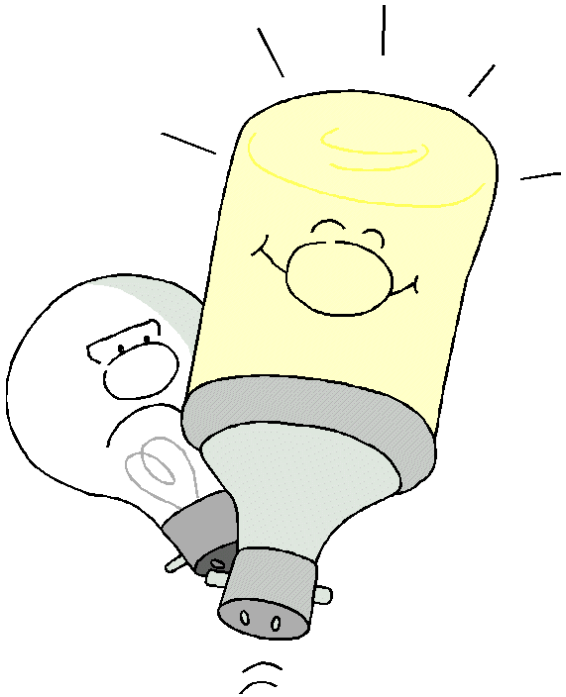
- Incandescent lamps (GLS)
- Gas discharge lamps
  - Fluorescent Lamps (FTL)
  - Compact Fluorescent Lamps
  - Mercury Vapour Lamps
  - Sodium Vapour Lamps
  - Metal Halide Lamps
- LED Lamps



Light Generation

Lamps - More Efficacy (lumens/watt)

- Compact fluorescent lamp
- T5 & Colour - 80 series FTL
- HPSV
- LED lamps

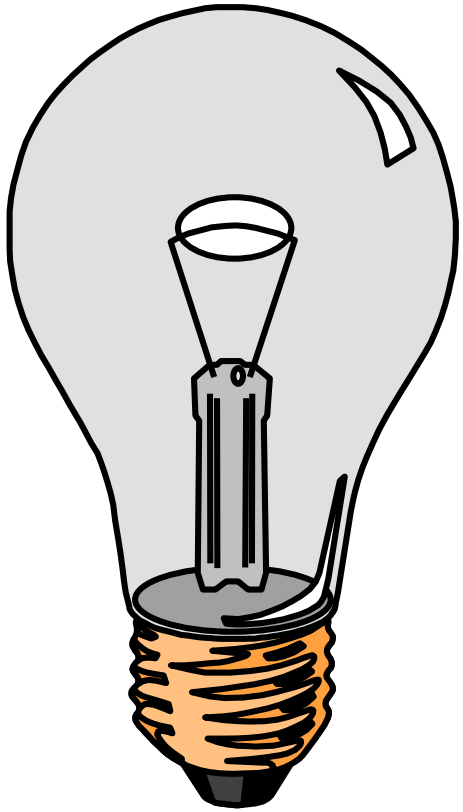


Comparison Of Various Lamps

Type	Watt	Lumens	Efficacy
LED	20	2100	105
GLS	100	1380	14
Fluorescent			
. Slim	36	2450	68
. Conventional	40	2400	60
T-5	28	2900	104
HPMV	250	13500	54
HPSV	250	27000	108
Metal halide	250	17000	68
CFL	20	1200	60

GLS - General Lighting Service Lamps

Tungsten filament



- Colour rendering - good
- Suitable for dimming
- Instantaneous operation
- Low efficacy (14)
- Lower Life – 1000 hrs

CFL Compact Fluorescent Lamps

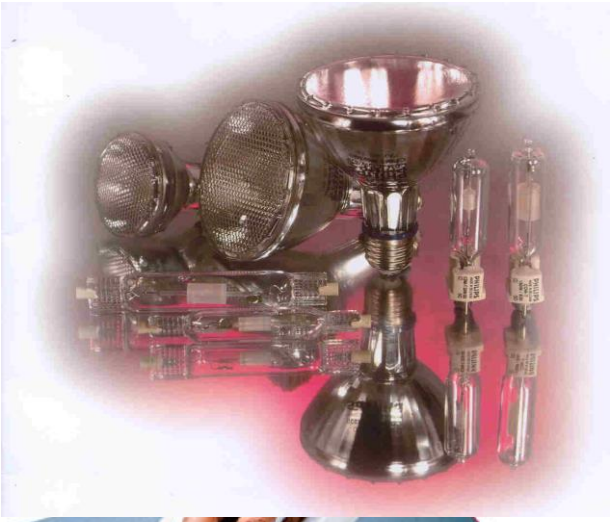
- High efficacy lamp (60)
- Low Wattage - Less heat dissipation
- Excellent colour rendering
- Long Life - 8000 - 10000 glowing hours
- Highly suitable - living rooms, lounges, corridors, hotels and canteens

Comparison Of GLS & CFL

GLS	Watts	40	60	100
	Lumens	425	720	1380
CFL	Watts	9	15	20
	Lumens	400	900	1200

Technology Focus : Light Source

- More lumens / watt
- Higher Colour Rendering
- Choice of Colour Appearance
- Slimmer Dimensions
- Longer life



- Low Mercury Fluorescent T8 Lamps/ T5 lamps
- Ceramic Discharge Metal Halides
- LED

Lamp / system developments

System developments

TL5
16 mm
1996

TLD /80
CRI > 80
1980s

TLD st
26 mm
1978

TL st
38 mm
1938

T12

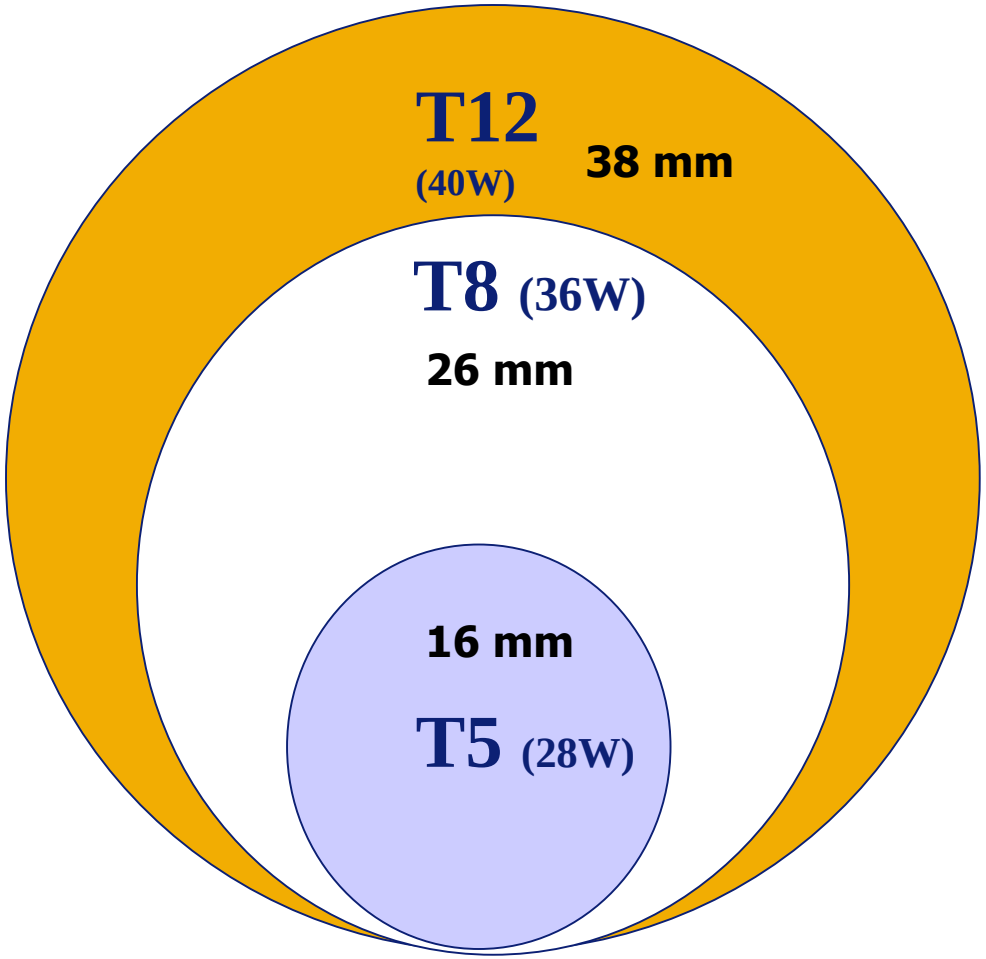
T8

T5

Lamp developments

Trend of development is towards miniaturisation; improvement in quality of light and Luminous efficacy.

From 'TL' To 'TL'5



Energy Efficient Fluorescent Lamps – T8 Lamps

- Tri-phosphor fluorescent powder technology
- High colour rendering Ra-85
- Conventional FTL (Ra-65)
- High luminuous efficacy

  Conventional Slim : 68 lumens/w

  Energy efficient : 90 lumens/w

Energy Efficient Fluorescent Lamps

- 40% more lumens
- Ideal choice - new projects and places where, existing lighting is poor
- Control room, Lab, Packing, Sub station

Results of BEE – Rating scheme – List of 5 star labeled FTLs (Sep 21 2007), excluding T5 series

OSRAM

- 36 W, 4000 K, HL TFL
- 36 W, 2700 K, HL TFL

PHILIPS

- 36 W TRULITE 6500 K TFL
- 36 W/84 TRULITE 4300 K TFL
- 36 W/82 TRULITE 2700 K, TFL

WIPRO

- 36 W 6500 K Ultralite TFL
- 36 W 4000 K Ultralite TFL
- 36 W 2700 K Ultralite TFL

CROMPTON

- 36 W HL 6500K, Power-Lux TFL

Full list available at http://www.energymanagertraining.com/Standards_Labeling/main.htm, rating excludes T5 series, list as on 21sep o7, source – www.energymanagertraining.com

Energy Efficient Fluorescent Lamps - T5 lamps

- Latest – T-5 Lamps - 16 mm dia
- Advantages
  - 40% more lumens
  - Efficacy – 105 Lumens / Watt
  - Power consumption – 28 Watts
  - Fitted only with Electronic chokes
- Retrofit / New fitting

Comparison of efficacy

FTL	dia	wattage	flux	efficacy	CRI
	mm	W	lumens	lm/W	
TL Standard (T-12)	38	40	2400	60	65
TL'D' Standard (T-8 or slim tube)	26	36	2450	68	72
TL'D' Triphos (T-8 color 80 series)	26	36	3250	90	85
TL 5 Super (T-5)	16	28	2900	104	85

© Confederation of Indian Industry

Colour Rendition

T12
65%

T8
72% - 85%

T5
85%

Lighting Distribution

- Select lamp and its luminaire depending on application
- Luminaire
  - Efficiently provide appropriate luminance pattern for the application
  - Optimum location and height of lamp
    - Low Bay < 5 meters
    - Medium bay – 5 to 7 meters
    - High Bay - > 7 meters

T5 Technology for High / Med Bay

Features of T 5 High & Medium Bay Fixture

1. Saves energy upto 45%
2. High Power factor
3. Instant Start
4. Wide Operating Voltage Range
5. Used for Medium and High bay lighting
6. Can be integrated with Day light harvesting using translucent sheets

Lighting Control

- Voltage reduction - Discharge LIGHTING
- Optimum voltage for discharge lighting – 205 - 210 Volts
- Reduction in voltage by - 15%
  - Proportional drop in power consumption - 15%
  - Insignificant drop in illumination level
  - Only digital lux meters - measure the drop (1 - 2%)

Options - Voltage Reduction

- Dedicated Lighting Transformer - different tap settings
  - Ideal at Design stage
- Automatic voltage regulation
  - servo stabilizer

Advantages

- Reduction in power consumption
- Increases - life of lamp

Case Study - Install Automatic Servo Voltage Stabilizer In Lighting Feeder

Engineering Unit

Lighting load : 120 kW

Operating lighting voltage : 240 Volts

Auto voltage stabilizer (150 kVA) - Installed

Optimum voltage : 205 - 210 Volts

Power saving : 15 kW (12.5%)

Annual Savings	**: Rs.2.20 lakhs**
Investment	**: Rs.1.50 lakhs**
Payback	**: 9 Months**

CII

Light Emitting Diode (LED)

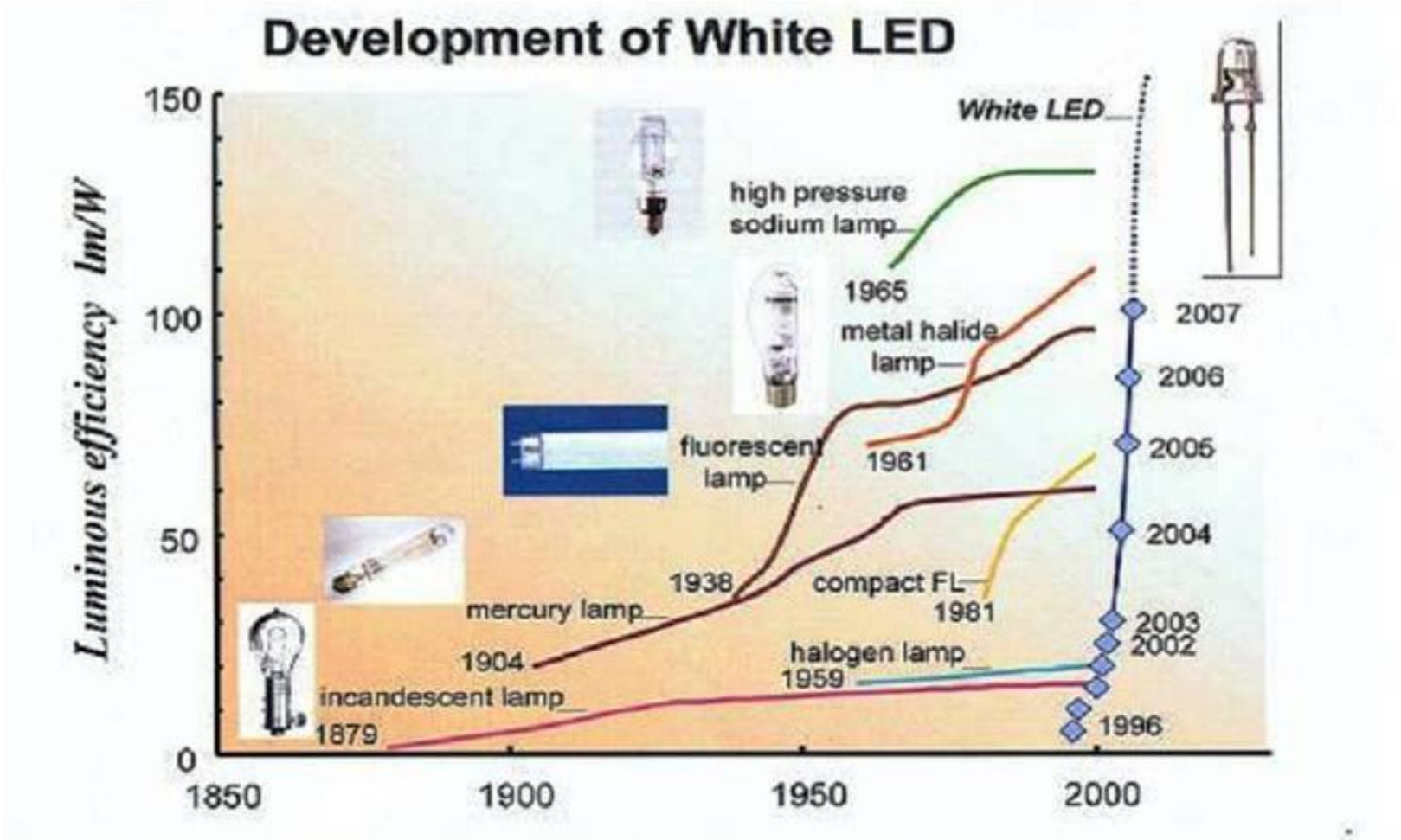
Agenda

- Introduction – LED
- Types of LED
- Applications
- Advantages/ Disadvantages

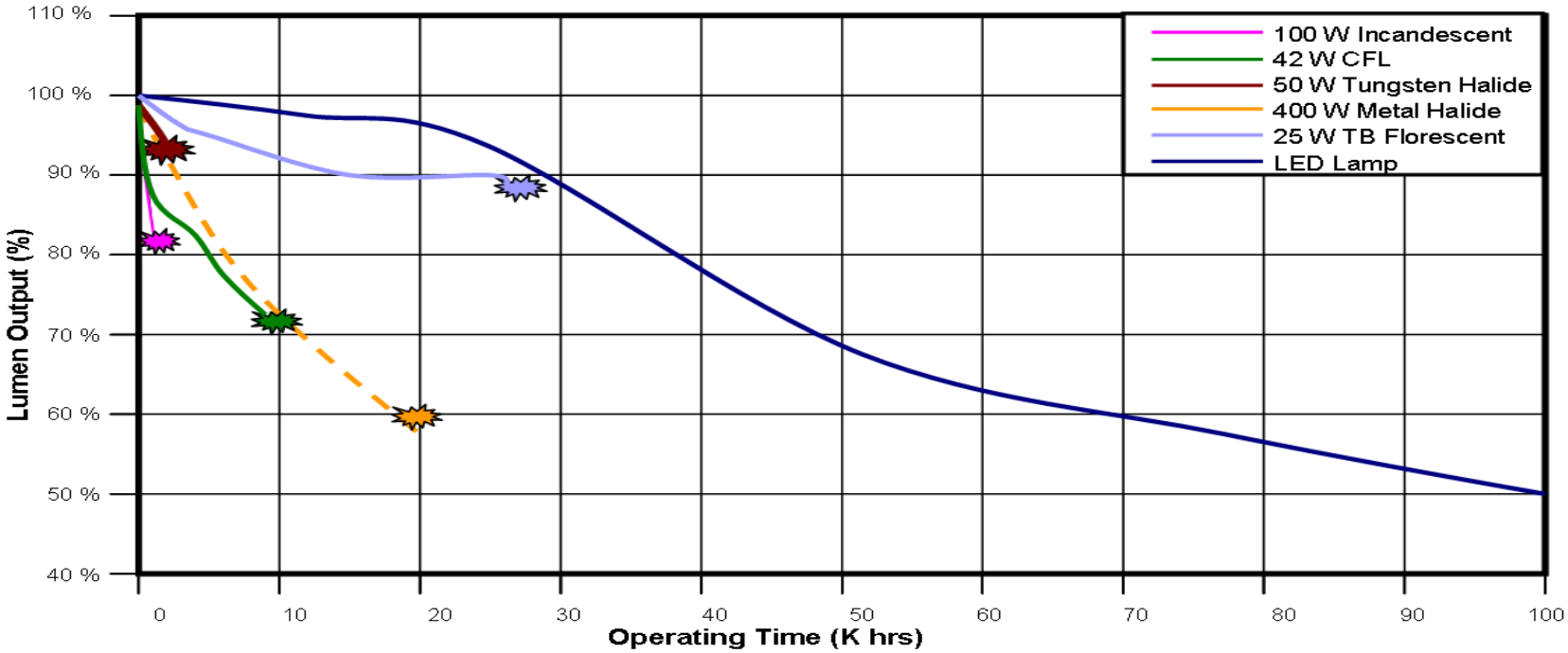
Types of LED

- **Normal LED < 1 Watt**
- **Power LED >= 1 Watt**

LED Efficiency



LED Lifetime



LEDs inherently fail "gracefully" – no burn out, catastrophic failure

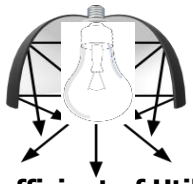
Up to 100,000 hours (>11 years continuous life) can be projected

Lighting Comparison

Incandescing

17 lm/W

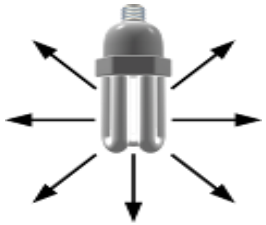
X



Coefficient of Utilization 58%

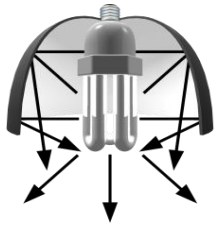
Fixture Efficacy 10 lm/W

CFL



60 lm/W

X



Coefficient of Utilization 58%

Fixture Efficacy 35 lm/W

LED

112 lm/W

X

Coefficient of Utilization **90%**

Driver Efficiency 91%

Thermal Equilibrium **88%***

Fixture Efficacy 81 lm/W

Source: Cree

Application

- Aviation
- Traffic Lights
- Automotive Lighting
- Advertisement
- General Lighting

Applications

Traffic Lights

Applications

Traffic Lights

LED Lamps

More suitable for panel indication

Power consumption of the filament panel indication lamps	**14-15 W/lamp**
Power consumption of the LED panel indication lamps	**0.5 - 1.0 W/lamp**
Power savings	**13 W/lamp**

Replace 150 W Street Light With 30 Watts LED Light

- There were more than 200 nos. of 150 watts HPSV Street Light fittings.
- Proposal :- To replace existing fittings with 30 watts LED fitting as pole height is around 6 meters.

Replace 150 W Street Light With 30 Watts LED Light

- Present System – 150 watts HPSV Lamps
- Present Power Consumption for 1 fitting = 170 watts
- Proposed System – 30 watts LED Fitting
- Proposed power consumption = 35 watts
- Power saving per fitting = 170-35 = 135 watts
- No. of fittings =200 Nos.
- Total Power saving = 200 x 135 watts = 27 KW
- No. Of operational Hours = 4500 hrs
- Unit Cost = Rs. 7.0/unit
- Total Savings = 27 x 4500 x 7 = 8.50 lacs/annum

Replace 150 W Street Light With 30 Watts LED Light

Investment = 200 x 6000 = Rs. 12 L

Annual Savings	**-**	**Rs. 8.5 Lakhs**
Investment	**-**	**Rs. 12.0 Lakhs**
Payback Period	**-**	**17 Months**

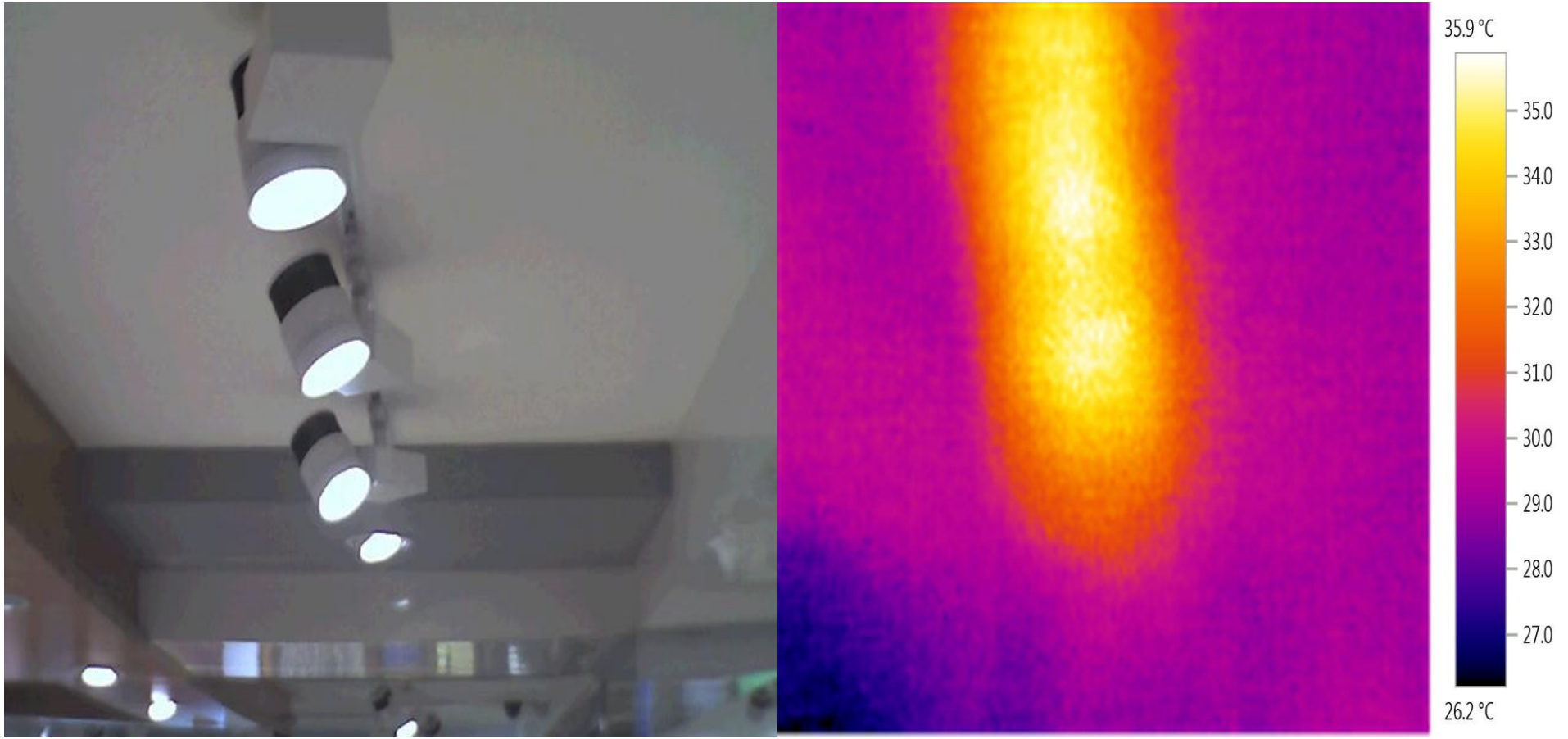
Additional Benefits

- Very Less maintenance due to Long Life
- Less Inventory cost of Lamp, choke, Capacitors etc…
- Improved Power factor

Advantages

- Lower Energy Consumption
- Longer Lifetime
- Improved Physical Robustness
- Smaller Size
- Faster Switching
- Improved Power Factor

Reduce Cooling Load by Installation of EE Lighting



24 Watt LED

Reduce Cooling Load by Installation of EE Lighting

70 Watt HID Type

Disadvantages

- Relatively Expensive
- Require more precise Current
- Heat Management

Major Suppliers

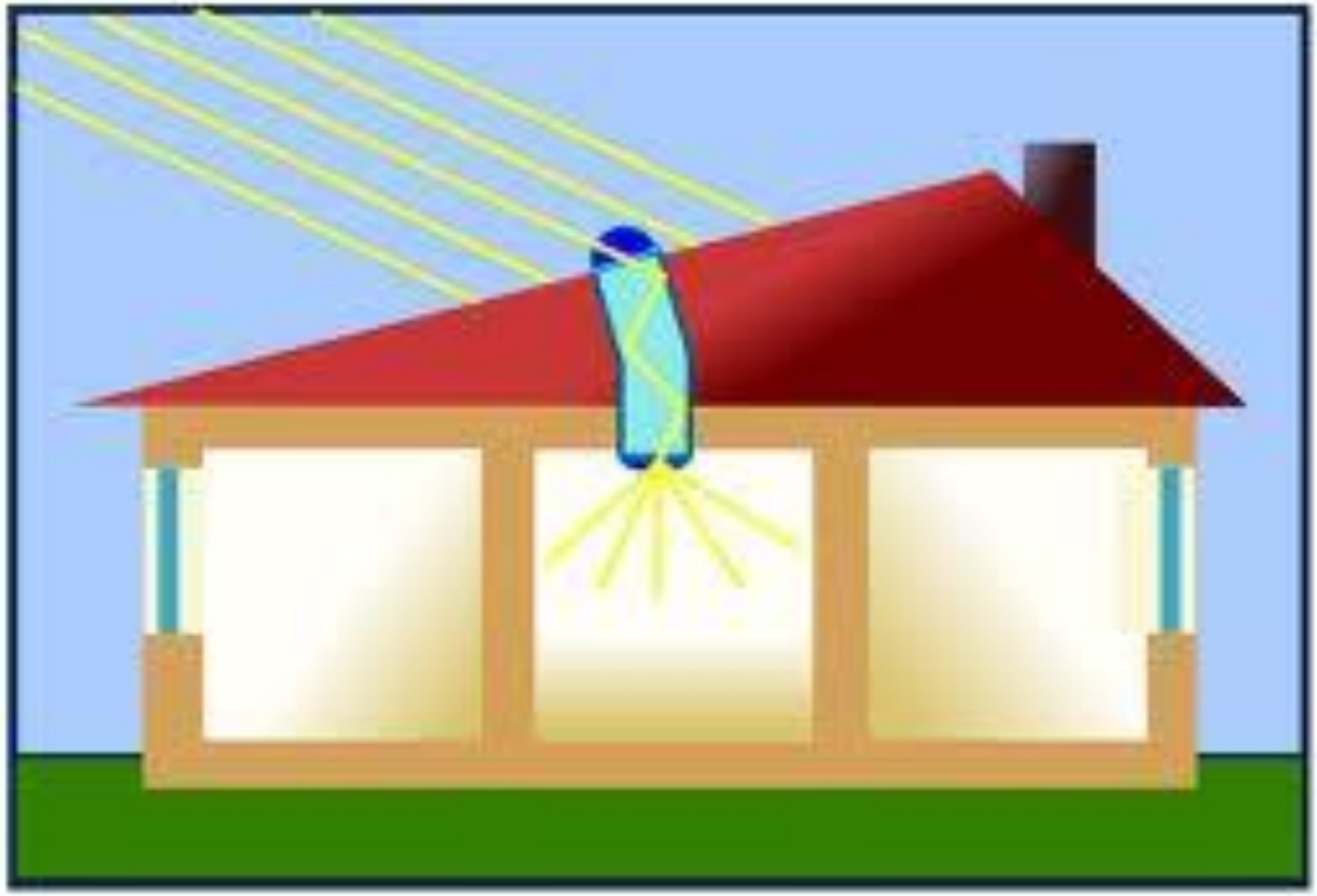
- Osram
- Philips
- Crompton Greaves
- Bajaj
- Wipro
- MIC Electronics
- Havell's

INSTALL LIGHT PIPES TO STOP OPERATION OF LIGHTS IN DAY TIME

Present System

- **More than 15 Nos. 250 Watts High Bay lights are in operation in Hammer Areas**
- **Same can be replaced with Light Pipes**

INSTALL LIGHT PIPES TO STOP OPERATION OF LIGHTS IN DAY TIME



INSTALL LIGHT PIPES TO STOP OPERATION OF LIGHTS IN DAY TIME

INSTALL LIGHT PIPES TO STOP OPERATION OF LIGHTS IN DAY TIME

INSTALL LIGHT PIPES TO STOP OPERATION OF LIGHTS IN DAY TIME

Annual Savings : Rs 1.50 Lakhs

Investment : Rs 3.00 Lakhs

Payback : 24 Months

Other Aspects on Energy Conservation

- Maximum utilisation of natural light
- Combination of Day light & Artificial light lamps
- Natural Light Controlled by Motorized Blinds
- Sensors to detect natural lighting & switch-on artificial light

Other Aspects on Energy Conservation

- Use timer control switches for out side lighting system
- Use movement sensor and dimmer control system, wherever required
- Proper grouping of lights and proper control system


Thank you
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