

Energy efficient systems and renewable energy technologies

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Energy efficient systems and renewable energy systems

- Energy efficient lighting systems
- Energy efficient appliances e.g air conditioners, refrigerators, washing machines etc.
- Solar water heating system
- Solar photovoltaic systems

Good Lighting Design

“Right light at the right time and the right place”

Right light	———	Lighting levels, color rendering, contrast
Right time	———	Controls
Right place	———	Fixture placement, Lighting simulation

Energy Efficient Lighting

Optimize Good Lighting Design

Installed Power	———	Efficient conversion of energy to visible light
Hours of Use	———	Adequate controls

Components of Lighting System

1. Light sources or lamps
2. Luminaries or fixtures
3. Ballasts

Each component affects the performance, energy use and annual operating cost of the lighting system

Lamp Characteristics

- | Luminous Efficacy (lm/W)
- | Light colour- Correlated Color Temperature (CCT-K)
- | Color Rendering Index (CRI)
- | Cost
- | Rated life

Incandescent (GLS) Lamps

Luminous Efficacy (lm/W) : 6 - 16
Color Temperature (CCT-K) : 2700K
Color Rendering Index (Ra) : 100
Rated life (hrs) : 1000



- | Coated GLS lamps give less (5%) light than comparable normal GLS clear lamps
- | Krypton filled GLS lamps give 10% more light than comparable normal GLS clear lamps
- | 5% over-voltage reduces the lamp life by almost 50%

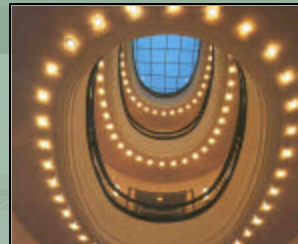


Tungsten Halogen Lamps

Luminous Efficacy (lm/W) : 12 - 22
Color Temperature (CCT-K) : 3000
Color Rendering Index (Ra) : 100
Rated life (hrs) : 2000



Aluminum halogen reflector lamps with clear/frosted/colored front glass add heat to the room. Dichroic, cold-light halogen reflector lamps with clear front glasses add only light to the room.



Fluorescent Lamps

Luminous Efficacy (lm/W)	: 50 - 85
Color Temperature (CCT-K)	: 2700 - 6500K
Color Rendering Index (Ra)	: 50 - 85
Rated life	: 5000 - 10000hrs



The light output of T-12/T-8 lamp is maximum at 25°C. At temperature below 15 °C the output rapidly decreases. Output also decreases above 25 °C but at a slower rate.

T-5 achieves its maximum output between 33 to 37°C.

Life and light out put of TL increases from with electronic control gear.

T-8 with tri-phosphor coating gives 30% more light output And saves 10% energy as compared to 40 W TL.



Compact Fluorescent Lamps (CFL)

Luminous Efficacy (lm/W)	: 36 - 88
Color Temperature (CCT-K)	: 2700-6500
Color Rendering Index (Ra)	: 70-82
Rated life (hrs)	: 5000 - 10000



Warm white CFL has slightly better colour rendition as compared to cool daylight



Mercury Lamps

Luminous Efficacy (lm/W) : 44 - 58
Color Temperature (CCT-K) : 3300 - 4300
Color Rendering Index (Ra) : 40-60
Rated life (hrs) : 8000



Blended Lamps

Luminous Efficacy (lm/W) : 17
Color Temperature (CCT-K) : 3600 K
Color Rendering Index (Ra) : 61
Rated life : 6000 hrs



High Pressure Sodium Lamps

Luminous Efficacy (lm/W) : 80-130
Color Temperature (CCT-K) : 1950 K
Color Rendering Index (Ra) : 20-39
Rated life (hrs) : 10000



Light from sodium lamps attracts around 85% fewer insects than light from mercury vapour lamp



Low Pressure Sodium Lamps

Luminous Efficacy (lm/W) : 100-178
Color Temperature (CCT-K) : -
Color Rendering Index (Ra) : -
Rated life (hrs) : 10000



Low pressure sodium lamps emits monochromatic yellow colour for high contrast visibility even in mist and fog



Ballasts

Power Loss

Electromagnetic : 10 -12 W

Low loss electromagnetic: 4.5 W

Electronic choke : 1-3 W

- Electronic ballast increases the life of the fluorescent lamps
- Electronic ballast increase the lumen output of the fluorescent lamps



ECO – Relamping (GLS to CFL)



25 W

40 W

60 W

100 W

150 W

200 W

20 W

50 W

5 W

7 W

11 W

20 W

32 W

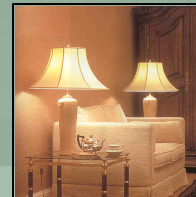
42 W

Saving potential : 80 %

Payback Period

10-5 Operation : 5 months

24-7 Operation : 2 months



ECO – Relamping (T12 to T8/T-5)



40 W TL



28 W T-5

Saving Potential : 50 %

Payback period

10-5 Operation : 1.8 yrs

24-7 Operation : 7 months



ECO – Replace electromagnetic choke



40 W TL



36 W T-8 with electronic choke

Saving Potential : 29 %

Payback period

10-5 Operation : 2.4 yrs

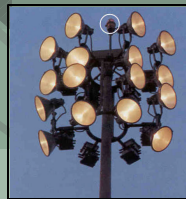
24-7 Operation : 9 months

ECO – Install photo sensors



Saving Potential : 40 to 60 %

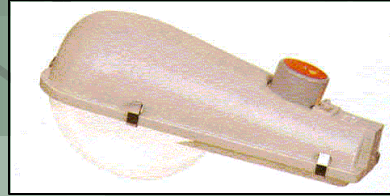
ECO – Install IR timers



Payback period : 9 months



ECO – Street Lighting Control



Saving Potential : 20 %

Payback period per pole

12 hrs night Operation : 1.3 yrs



Recommendations for Pune

- Site level and common areas
 - Design as per BIS norms
 - Restrict luminous efficacy for external application (60-80lm/W for environment lighting e.g bollards or corridor lighting, 80-100 lm/W or more for others e.g street lights, security lights)
 - Fixtures should not allow retrofit with inefficient lamps at a later date.
 - Usage of electronic /low loss chokes wherever applicable
 - Usage of photo sensors for auto switch-off of lights.
 - LED based lighting.

Recommendations for Pune

■ Building level

- Restrict power density (10 W/sq.m)
- Provide pre wired CFL fixtures

Appliances

- Could be tied up with outputs from appliance labeling programme of the Bureau of energy efficiency.

Renewable energy systems

- Use of solar water heating system
- Ensure solar access in roof to facilitate installation
- Solar PV powered lighting for common areas/street lights, signage.

Discussion point: Has to be integrated with existing byelaws and schemes/
incentives of govt. bodies

Discussions....