

ENERGY EFFICIENT LIGHTING IN BUILDINGS

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Importance Of Lighting Efficiencies

- Adequate lighting provides adequate information
- Consumes 17% Electrical generation
- Economy in costs
- Economy in Scarce resource consumption
- Carbon credit Generation

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Lighting Characteristics

Lighting is

- Most visible building service
- Expresses concern for employees
- Employers pride in building
- Good Lighting generates tangible benefits primarily from employee satisfaction.

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Elements Of Lighting System

- Generation of electricity
- Lamp Lumens
- Luminaire
- Room Reflectance factors

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Maximum possible Theoretical efficiencies

- ❑ Generation basis 1 Kg coal = 6.67 KWH
- ❑ Lamp Lumens 1 watt = 621 lumens
- ❑ Luminaire DLOR+ULOR = 100%
- ❑ Room Reflectance = 100%

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Current Efficiencies of the system

- ❑ Generation 1 Kg coal = 2 KWH i.e. 30% efficiency.
 - ❑ Lamp lumens 60 lumens/watt ~ 100 lumen/Watt at unity power factor 16% efficiency.
 - ❑ Luminaire = 80~85% light output ratio
 - ❑ Light at working plane = 60~70%
- Overall utilization efficiency = 3~ 5%

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Facts on energy Conservation

- ❑ Fact 1
Insignificant lamp cost compared to energy consumed.
- ❑ Fact 2
Lumen depreciation and lamp survival factors are always present.
- ❑ Fact 3
Presence of dust reduces the efficiency.

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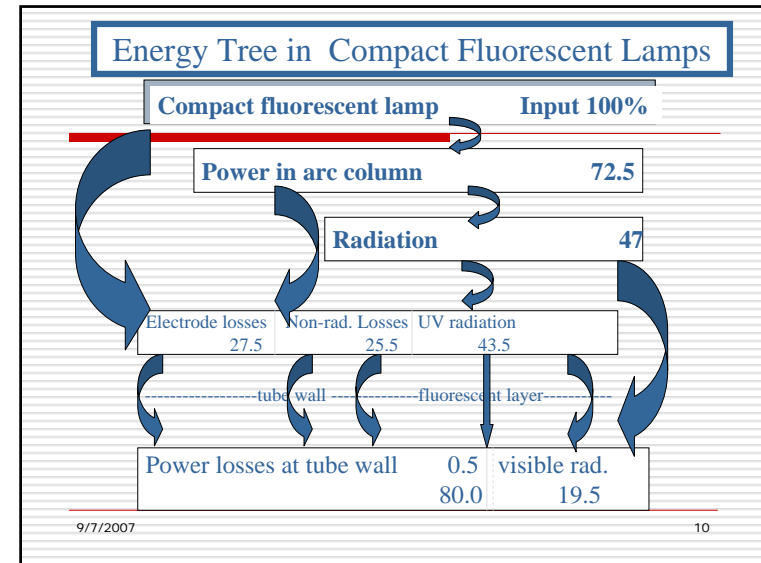
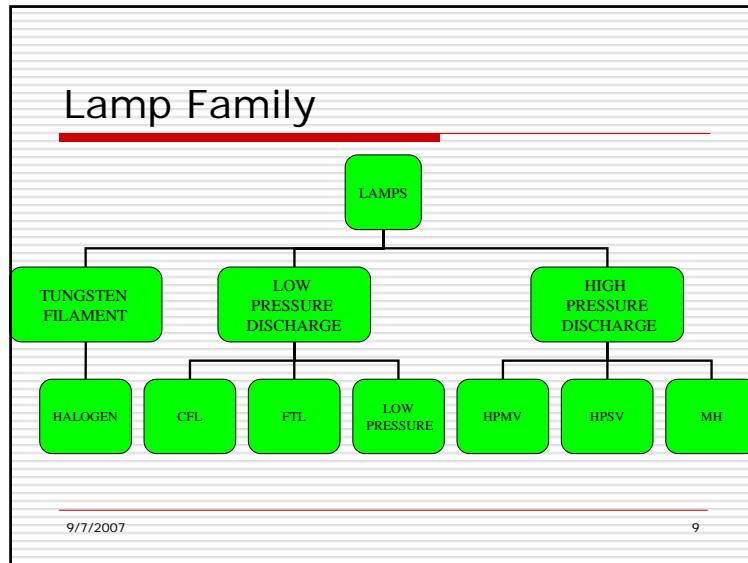
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Controlling factors

- ❑ We have control on
 - ❑ Lamp Lumen varying from 60~100Lumen/watt
 - ❑ Luminaire efficiencies is 80~85%
 - ❑ Room & Reflectance factors

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Value is improved Energy Efficiency

- Enhancing power in arc column
- Enhancing ultraviolet conversion to visible radiation efficiency

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For Enhancement of light out put

- Three band phosphors 80 lumen/watt
- Color rendition 80 ~ 85
- High lumen single ended FTL lamp
- Reducing diameter & geometry
- Reducing the tube diameter from 12 to 6 mm (T2)

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RESULT ACHEIVED

- Lumens per watt exceeds 100
- Color rendering index > 90
- Compact structure

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Average lamp lumen maintenance factors (LLMF) and lamp survival factors (LSF)

		operation Time (1000 hours)															
		0.1	0.5	1	1.5	2	4	6	8	10	12	14	16	18	20	22	24
Fluorescent																	
multi- and tri	LLMF	1	0.98	0.96	0.95	0.94	0.91	0.87	0.86	0.85	0.84	0.83	0.81				
-phosphor	LSF	1	1	1	1	1	1	0.99	0.95	0.85	0.75	0.64	0.5				
Fluorescent																	
	LLMF	1	0.97	0.94	0.91	0.89	0.83	0.8	0.78	0.76	0.74	0.72	0.7				
Halophosphate	LSF	1	1	1	1	1	1	0.99	0.95	0.85	0.75	0.64	0.5				

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Measurement of lumen

We measure lumen by

- Substitution method
- Integrating Photometer

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Photometer Principle

- Photometer principal is
- $E = \text{Flux}/\text{Area} \ (\rho/1 - \rho)$

Where

E = Illumination level on Photometer wall in Lux

F = Flux in Lumens

A = Area in meters

ρ = reflector factor

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Efficiency on the working surface is increased many fold

- ❑ Consider F&A constant

$E = K (\rho / 1 - \rho)$ where E is Illumination level i.e. Lux

At $\rho = 0.9$, E will be 9K

At $\rho = 0.99$, E will be 99K

At $\rho = 0.999$, E will be 999K

At $\rho = 1$, E will be ∞

- ❑ The lux level can be magnified many times without increase in wattage

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Critical factors

- ❑ The critical contribution to energy efficient lighting in building is
- ❑ Reflection factors of wall/ceiling & floor
- ❑ This is a factor under the user control.
- ❑ Matt white colour with diffuse reflection is the best for generating high illumination levels.

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CONCLUSION

- ❑ Lighting efficiency will be predominantly dependent on
- ❑ Reflection factors of walls/ceilings/floor
- ❑ Saving through switching On & Off by sensors.
- ❑ Using efficient equipment interms of good cleaning characteristics and low depreciation.

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