Lighting Research Center at Rensselaer

SARI / Energy

UNDERSTANDING LIGHTING

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Increasing interest in…

Health

Safety

Security

Increasing interest in…

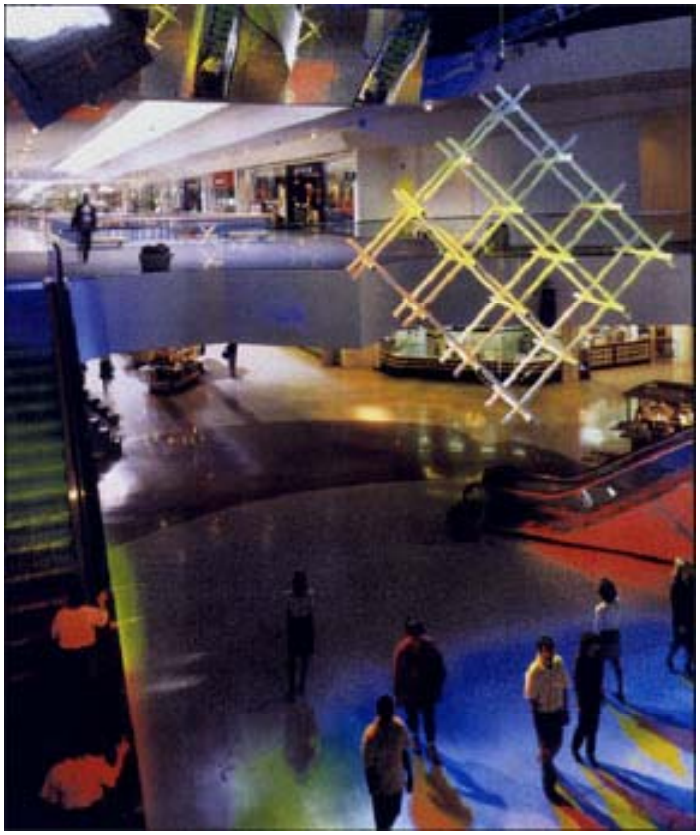
Sales

Productivity

Independence

Increasing interest in…

Entertainment

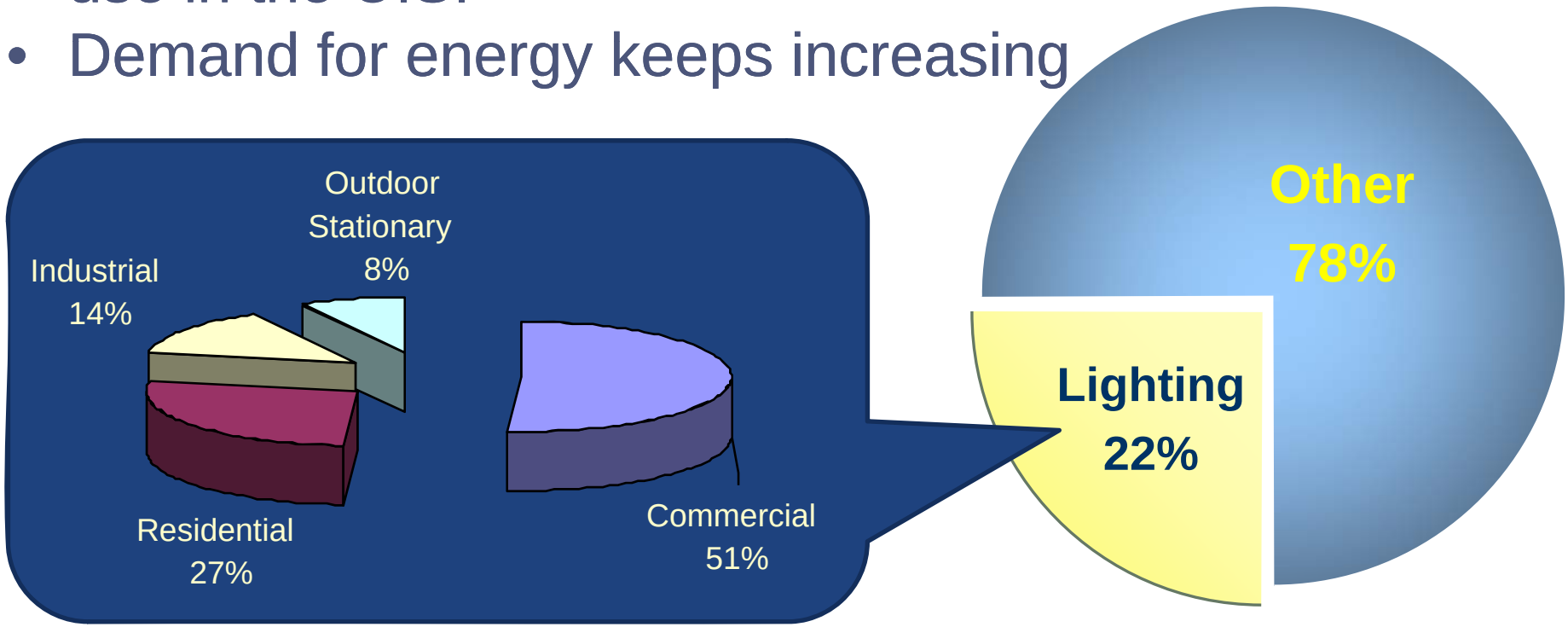


Sustainability

Economic Development

Energy

- Lighting accounts for about 22% of the total energy use in the U.S.
- Demand for energy keeps increasing



Source: U.S. DOE

Effective, Energy-Efficient Lighting

- Considers:
  - The needs of people using the space
  - Visibility, visual comfort, and safety
  - Architectural characteristics
  - Economics
  - Environmental concerns

Photo: Courtesy of FineLite

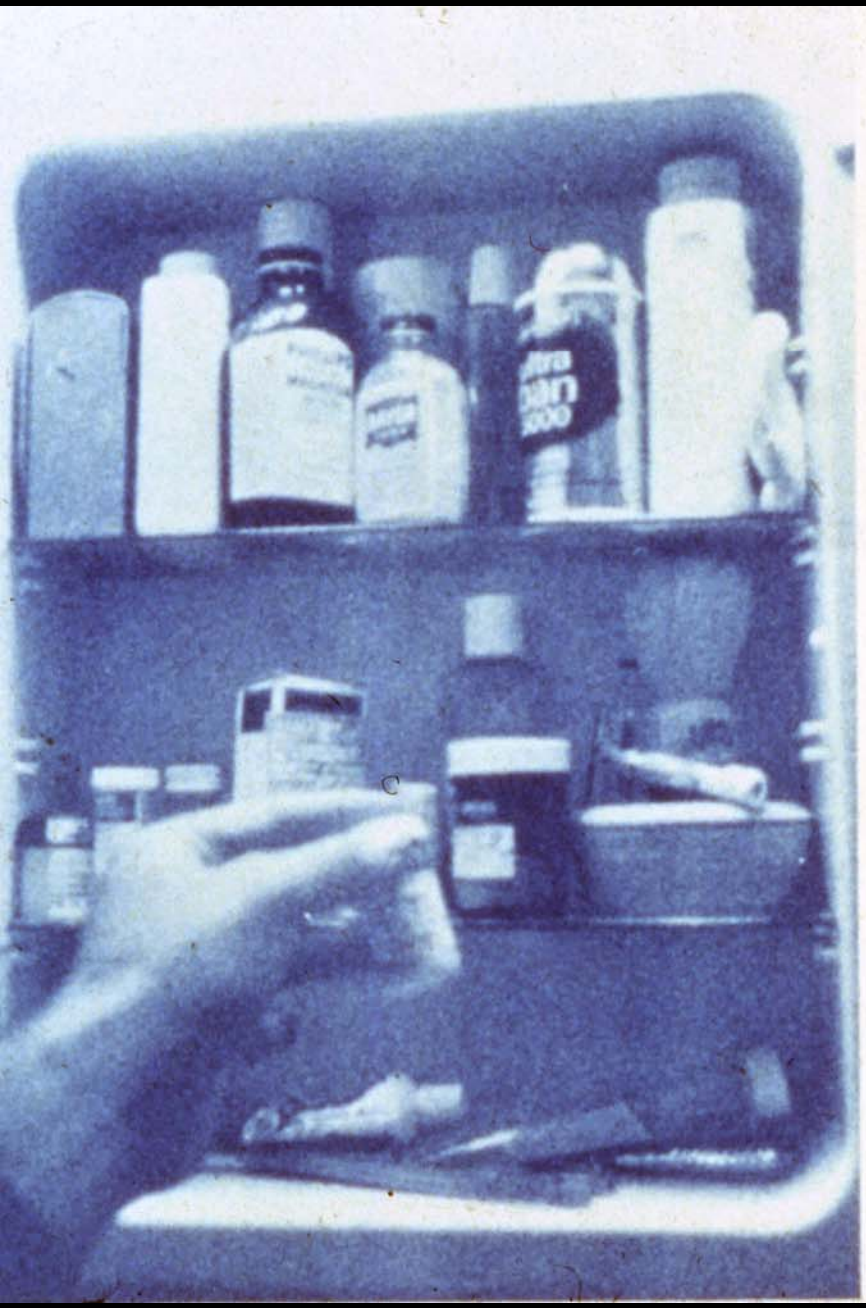
In addition, businesses want…

- Reasonable return on investment
- Easy to install, operate and maintain
- Substantiated proof of product claims
- Fully developed & tested products
- Successful demonstration of the technology elsewhere


FOOT
CANDLE

Illuminance

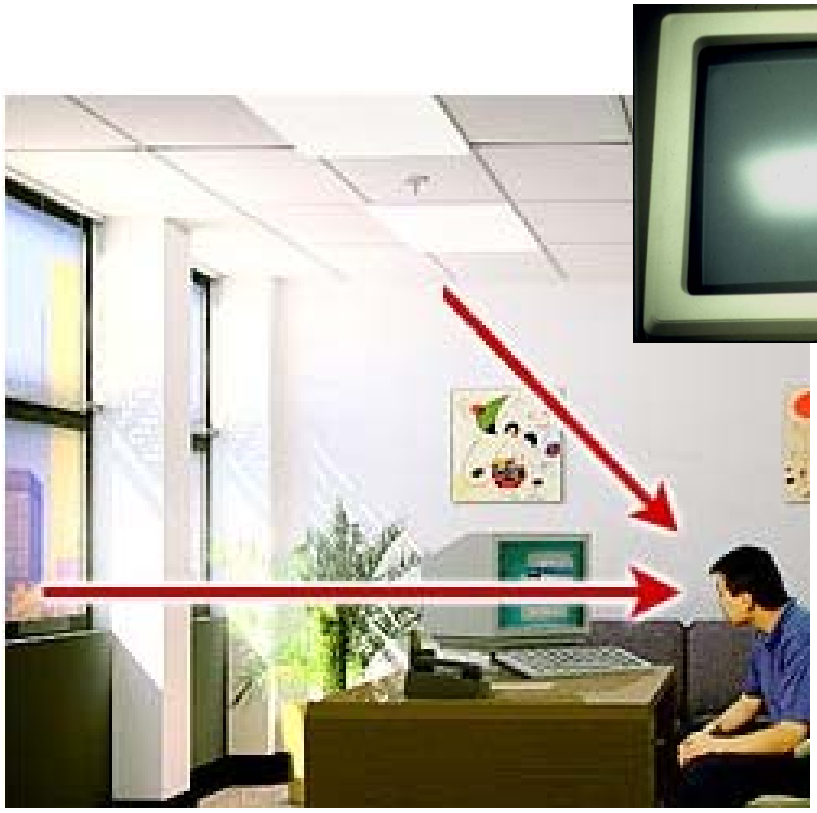
- Lumens (lm) per unit area
- Unit:
  - Lux (lx)
    - lumens/meter²
  - Footcandle (fc)
    - lumens/foot²




B

END GLARE

Glare

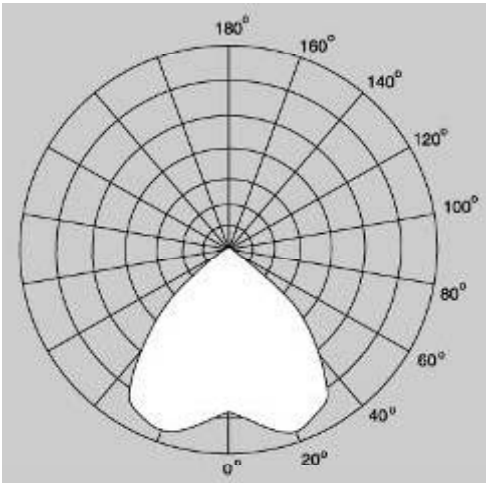


Direct glare from windows and luminaires

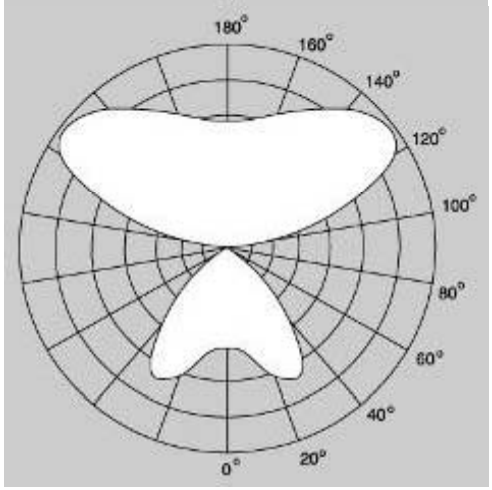
Reflected glare on the computer screen from ceiling luminaires

Light Distribution

Direct:
90-100%
downward

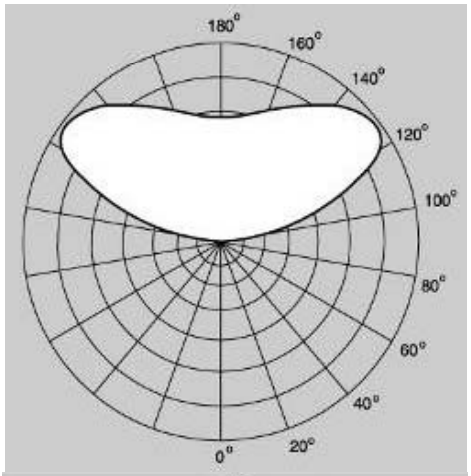


Semi-indirect:
10-40%
downward;
60-90% upward

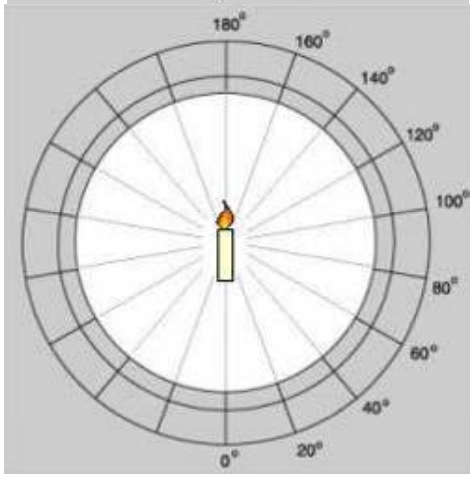


Light Distribution

Indirect lighting: 90-100% upward

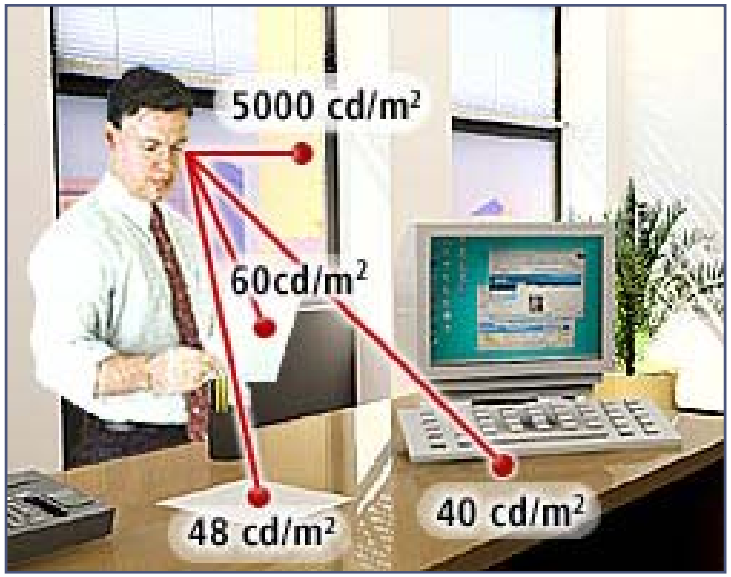


General diffuse: 40-60% downward; 40-60% upward

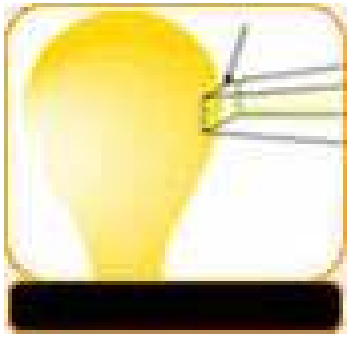



Chemistry

Luminance



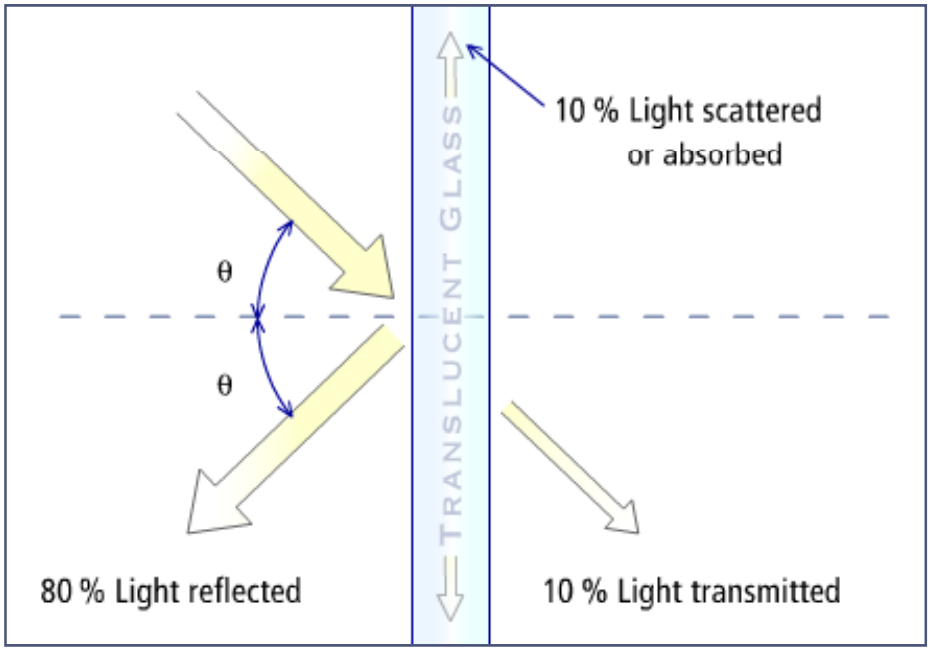
- Light reflected from a surface in a given direction (back towards the eyes) When we see an object, we see luminance
- Unit: $\frac{\text{Candelas (cd)}}{\text{meter}^2}$



Luminance of Room Surfaces

Reflectance

- Percentage of light reflected back from a surface, the difference having been absorbed or transmitted by the surface

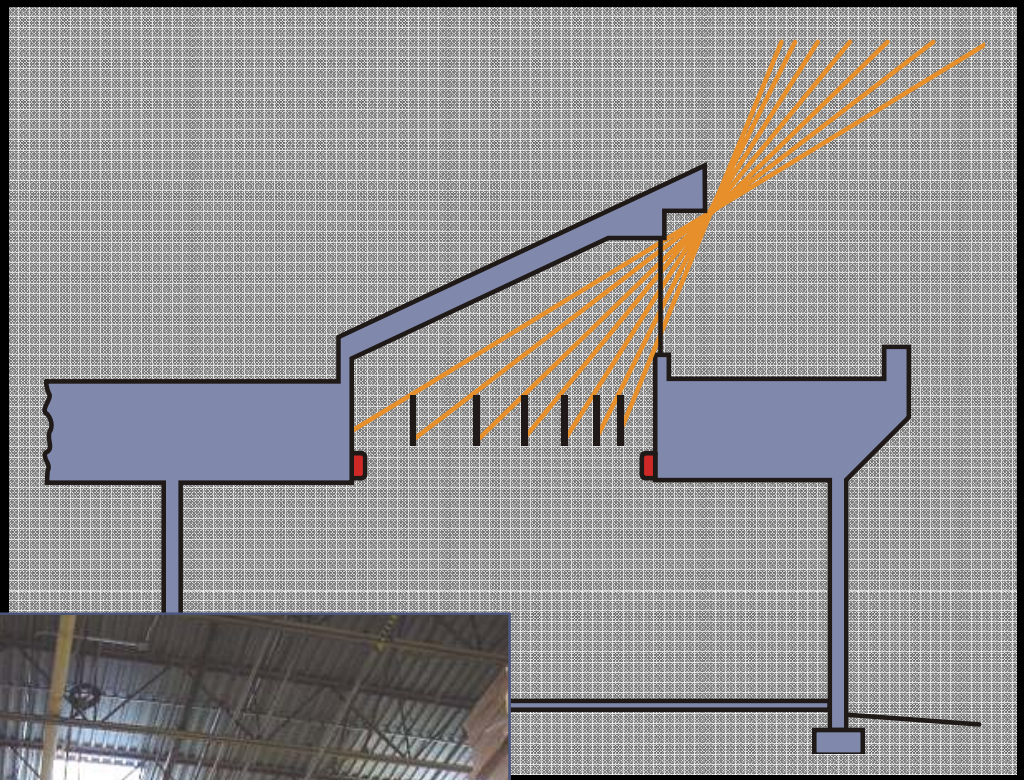


Room Surface	Reflectance Value
white acoustic-tiled ceilings	70 to 80%
light-colored walls	40 to 60%
carpeting	15 to 30%

Enhanced Brightness

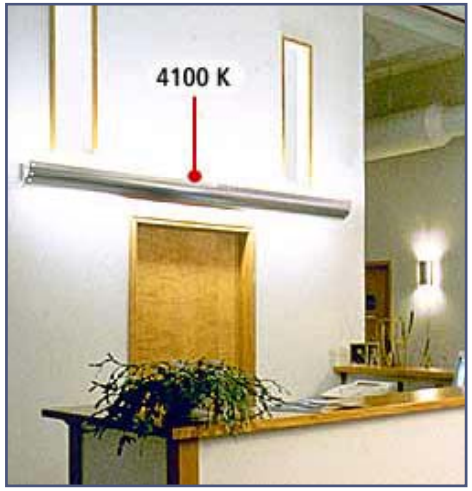
- Light the walls
- Hide the source


cigarettes
FILTER CIGARETTES
PALL MALL



Correlated Color Temperature – CCT

- Color appearance of a lamp measured in Kelvin (K)
- The CCT rating for a lamp is a measure of warmth or coolness of its appearance
  - Below 3200 K - warm (yellowish-white)
  - Between 3200 and 4000 K - neutral
  - Above 4000 K - cool (bluish-white)



Color Rendering Index – CRI

- Light sources differ in their ability to render the color of objects “correctly”

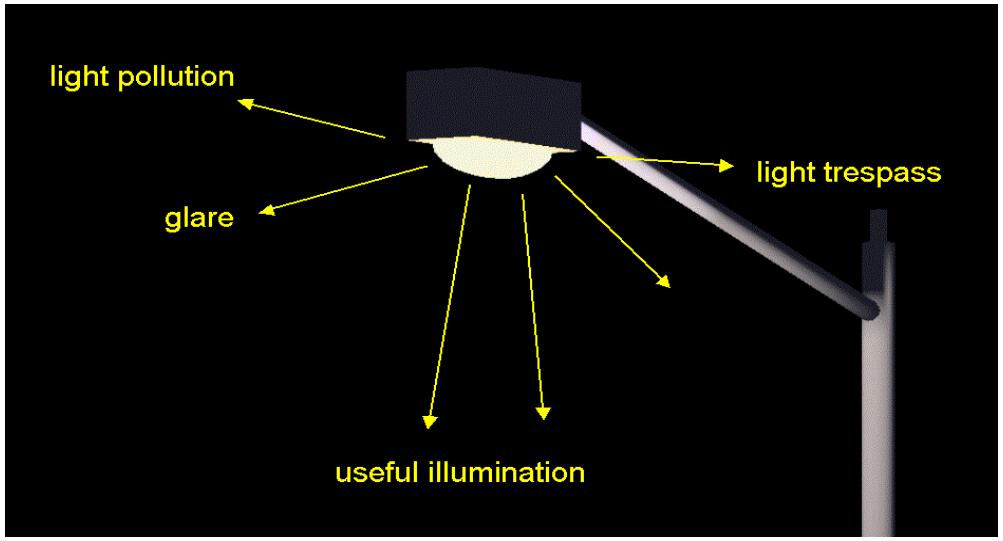
CRI = 90

CRI = 70

CRI = 50

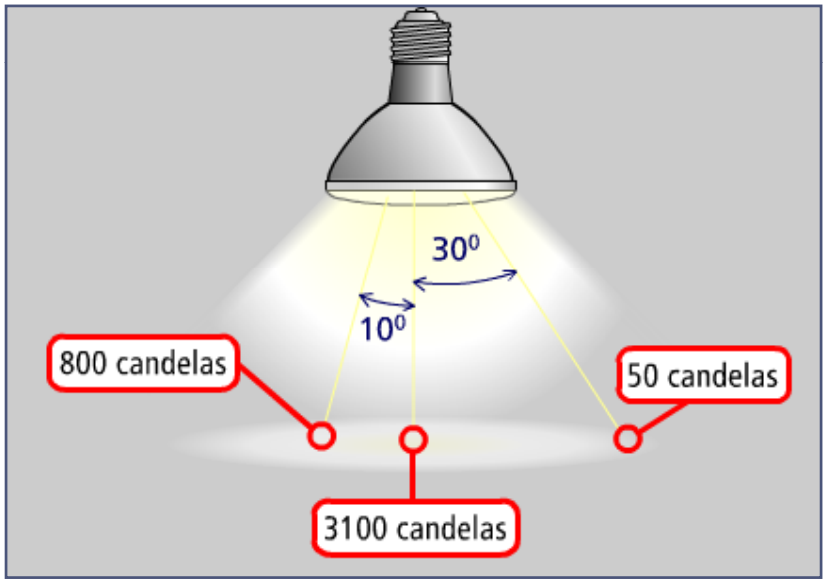
Light Pollution

- Sky glow
- Light trespass
- Glare



Intensity (Candlepower)

- Light emitted by a source in a specific direction
- Property of the source, it remains the same regardless of distance
- Many intensities depending on the direction
- Provided in photometric reports
- Unit: candela (cd)



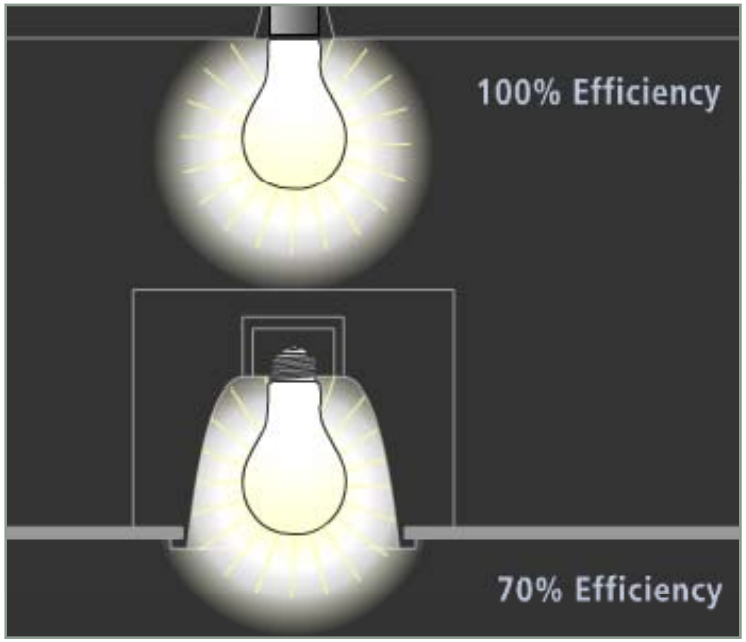
Efficacy

- Lamp efficacy

$$\frac{\text{total luminous flux (lm)}}{\text{total lamp power input (W)}}$$

Luminaire Efficiency

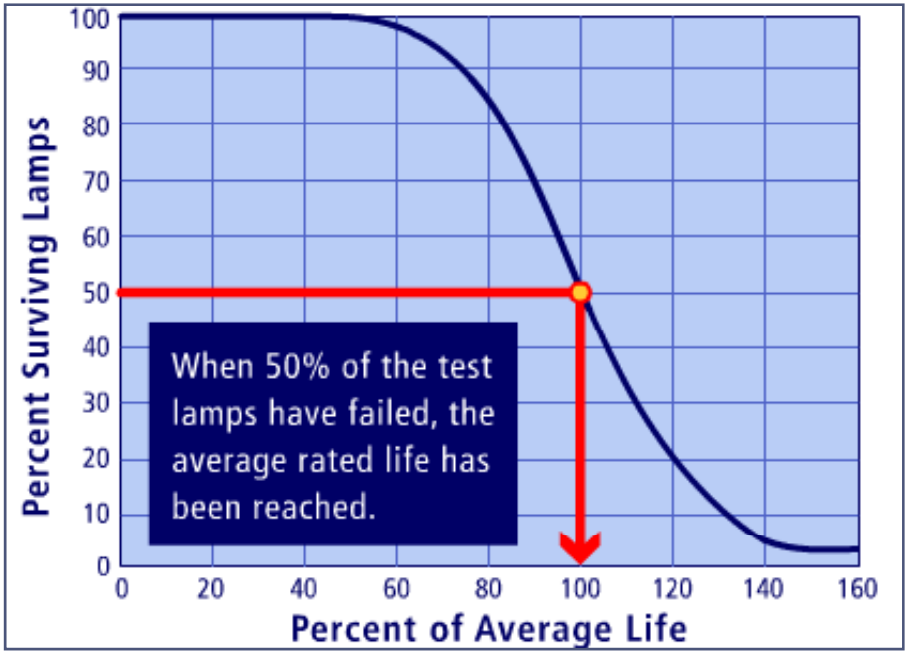
- Percentage of initial lamp lumens that are ultimately emitted by the luminaire



$$\text{Efficiency} = \frac{\text{Lumens emitted by a luminaire}}{\text{Lumens emitted by the lamp(s)}}$$

Average Rated Life

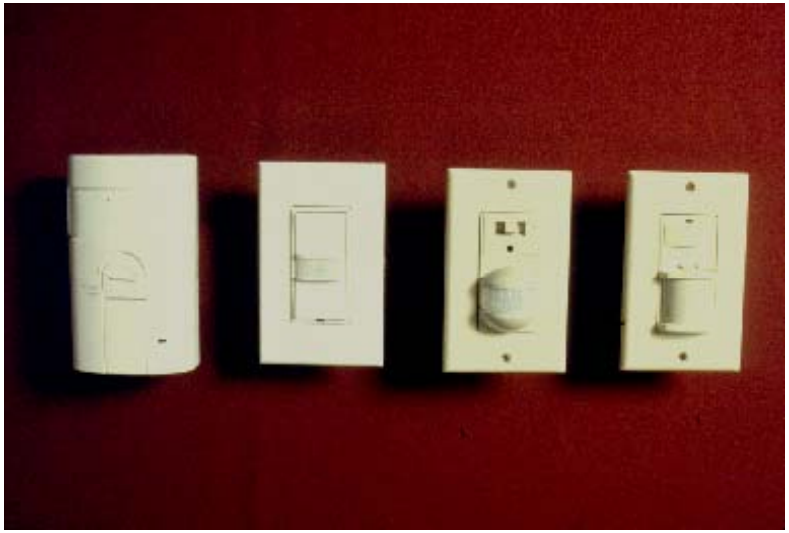
- The number of operating hours when 50% of a large group of lamps have failed when operated at nominal lamp and voltage current



Number of hours per start:

- Incandescent – minimum impact
- Fluorescent - 3 hours per start
- HID - 11 hours per start

Energy = Power × Time



Thank you.