
Travelex
£10
Tickets
NationalTheatre

ΔΕΗ

ΛΟΓΑΡΙΑΣΜΟΣ ΗΛΕΚΤΡΙΚΟΥ ΡΕΥΜΑΤΟΣ

ΕΚΚΑΘΑΡΙΣΤΙΚΟΣ

ΑΝΑΛΥΣΗ ΧΡΕΩΣΕΩΝ

ΠΑΓΙΑ ΧΡΕΩΣΗ	8,08
ΩΧΒ 800Χ0,07518€/ΩΧΒ=	60,15
ΩΧΒ 357Χ0,09579€/ΩΧΒ=	34,20
ΜΕΙΟΝ ΑΞΙΑ ΡΕΥΜ.ΕΝΑΝΤΙ	-24,14
ΤΟΚΟΙ ΥΠΕΡΗΜΕΡΙΑΣ	0,29
ΠΟΣΟ ΣΤΡΟΓΓ.ΠΡΟΗΓ/ΝΟΥ ΛΟΓ.	-0,31
ΣΤΡΟΓΓ/ΣΗ ΠΛΗΡΩΤΕΟΥ ΠΟΣΟΥ	-0,21
ΓΙΑ ΤΟ ΗΛΕΚΤΡΙΚΟ ΡΕΥΜΑ ΠΛΗΡΩΝΕΤΕ	78,06
ΦΠΑ 78,64 x 9% =	7,08
ΤΕΛΙΚΟ ΠΟΣΟ ΗΛΕΚΤΡ. ΡΕΥΜΑΤΟΣ ΚΑΙ ΦΠΑ	85,14

ΕΝΔΕΙΞΕΙΣ ΜΕΤΡΗΤΗ

ΚΤ	ΤΕΛΕΥΤΑΙΑ	ΠΡΟΗΓΟΥΜΕΝΗ	ΔΙΑΦΟΡΑ	ΠΡΟΣΘ.KWH	ΣΥΝΟΛΟ
10	7967	6810	1157	0	1157

ΚΩΔ. ΤΙΜ.	ΣΙ ΚVA	ΣΥΝΤ. KWH	ΧΡ. ΖΗΤ. KW
Γ1		1	

ΕΠΟΜΕΝΗ ΜΕΤΡΗΣΗ: 02/01/2008

ΛΟΓΑΡΙΑΣΜΟΙ ΔΗΜΟΥ - ΕΡΤ - ΚΑΠ

ΑΝΑΛΥΣΗ ΧΡΕΩΣΕΩΝ

ΔΗΜΟΤΙΚΑ ΤΕΛΗ - ΦΟΡΟΣ

	Μ²		ΕΥΡΩ/Μ²		ΣΥΝΤ. ΗΜΕΡΩΝ		
Δ.Τ.	34	x	2,00	x	63/365	=	11,74
Δ.Φ.	34	x	0,33	x	63/365	=	1,94

ΤΕΛΟΣ ΑΚΙΝΗΤΗΣ ΠΕΡΙΟΥΣΙΑΣ

Μ² ΤΙΜΗ ΖΩΝΗΣ ΠΑΛΑΙΟΤΗΤΑ

34 x 1250,00 x 0,80 x

ΣΥΝΤ.Τ.Α.Π. ΣΥΝΤ.ΗΜΕΡΩΝ

0,00035 x 63/365 = 2,05

• ΓΙΑ ΤΟ ΔΗΜΟ ΠΛΗΡΩΝΕΤΕ: 15,73

Ε.Ρ.Τ

ΕΤΗΣΙΑ ΧΡΕΩΣΗ ΣΥΝΤ. ΗΜΕΡΩΝ

50,88 x 120/365 = 16,73

ΜΕΙΟΝ ΕΝΑΝΤΙ ΕΡΤ -7,95

• ΓΙΑ ΤΗΝ ΕΡΤ ΠΛΗΡΩΝΕΤΕ: 8,78

• ΕΙΔΙΚΟ ΤΕΛΟΣ ΑΠΕ Ν. 2773/99 Αρθ. 40

1157 x 0,00030 = 0,35

ΓΙΑ ΔΗΜΟ - ΕΡΤ - ΚΑΠ ΠΛΗΡΩΝΕΤΕ	24,86
ΑΝΕΞΟΦΛΗΤΟΙ ΛΟΓΑΡΙΑΣΜΟΙ	
ΤΕΛΙΚΟ ΠΟΣΟ ΠΛΗΡΩΜΗΣ	*110,00 €

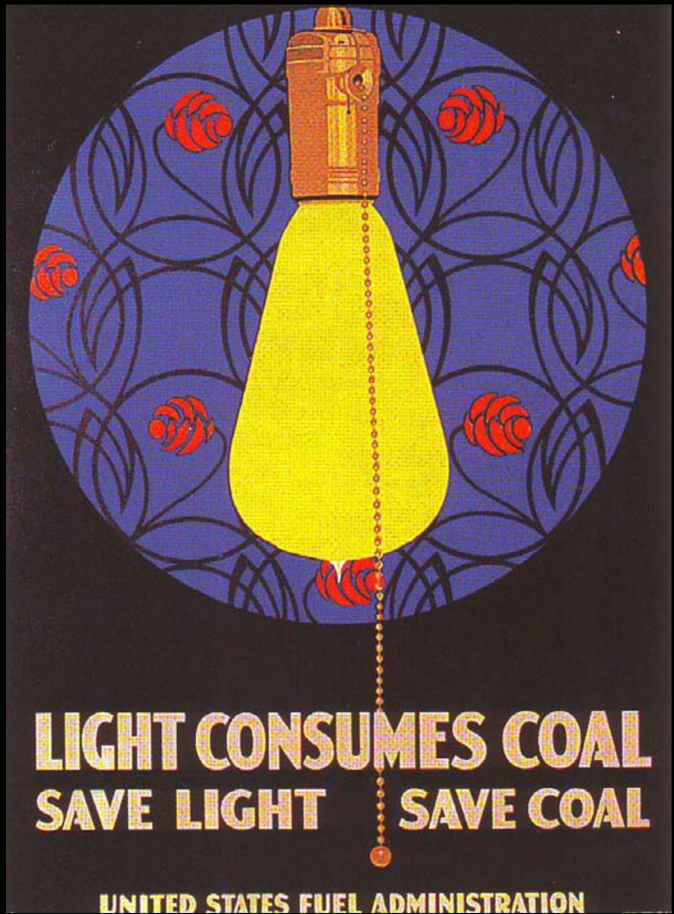
ΠΑΠΑΧΡΗΣΤΟΥ ΗΡΩ ΧΑΡΑΛΑΜΠΟΣ
ΣΕΒΙΛΗΣ 6
546 32 ΘΕΣΣΑΛΟΝΙΚΗ
Α.Φ.Μ. 100831959 Α.Π. 2 20195223-01 4

ΚΩΔΙΚΟΣ ΗΛΕΚΤΡ. ΠΛΗΡΩΜΗΣ 220195223017

Σας παρακαλούμε να εξοφλήσετε το λογαριασμό σας μέχρι τη

ΛΗΞΗ ΠΡΟΘΕΣΜΙΑΣ ΠΛΗΡΩΜΗΣ: 24/09/2007

ENERGY EFFICIENT LIGHTING



Speaker: Papachristou Iro, Electrical Engineer, MSc

Lighting consumes around 30% of all the electricity generated.

The majority of the existing lighting installations use inefficient lighting equipment.

Conversion of these inefficient installations to efficient lighting equipment (lamps, control gears, luminaires) and the use of lighting control systems could save up to 30% of the electricity consumed, without reducing lighting standards.

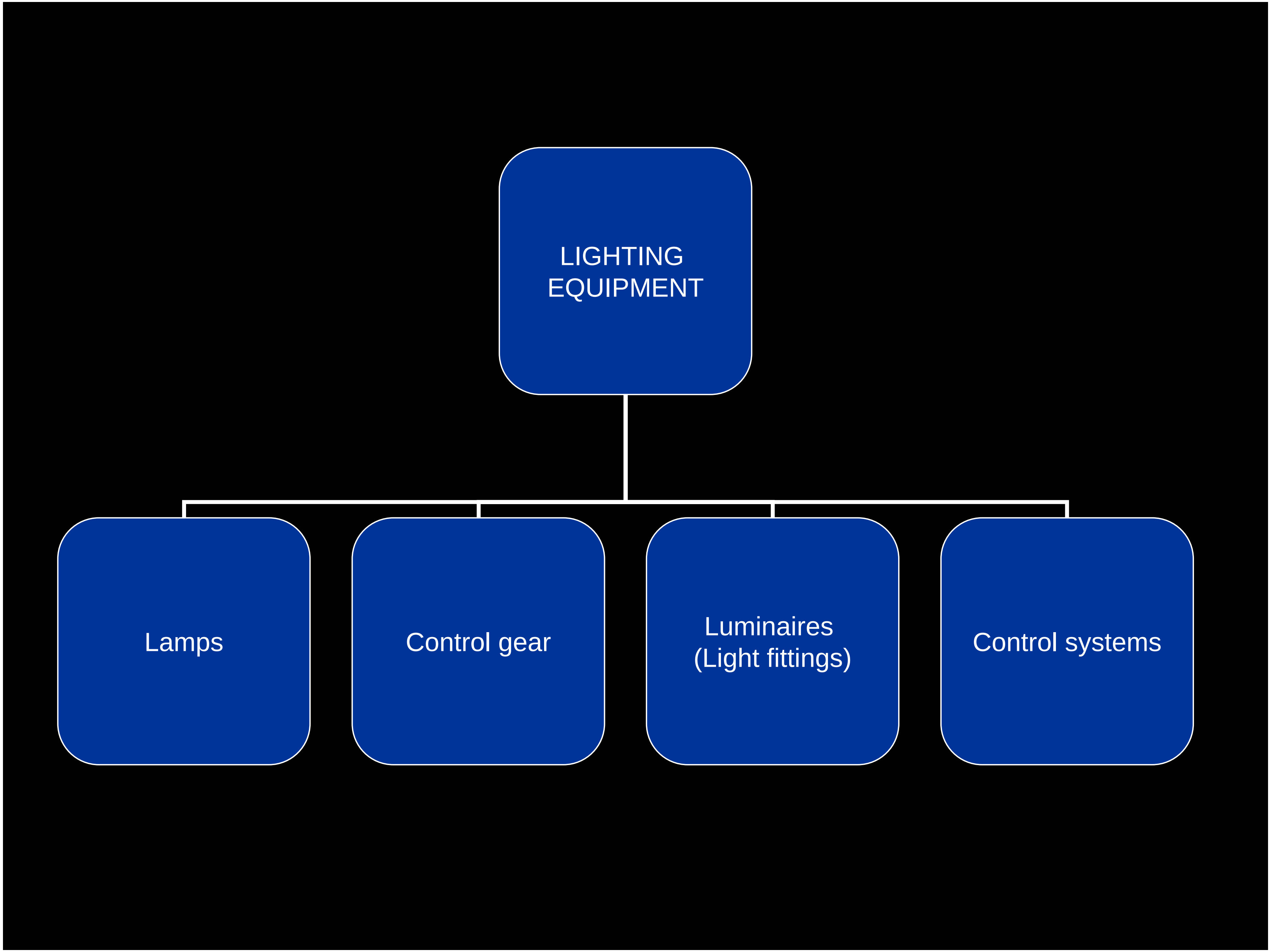
The way a building is lit (daylight, artificial light) will affect the performance and the well-being of its occupants. This means that the human requirement aspect of lighting is of key importance.

But as electric lighting is a major consumer of electricity, the energy efficiency of an installation must also be a prime consideration.

It is the designer's duty to balance the sometimes contradicting requirements raised by these two aspects.

Energy efficiency not only vital at an international level.

Benefits for the individual through improved running and maintenance costs. This saving could go on throughout the life of the installation.



LIGHTING EQUIPMENT
Lamps
Control gear
Luminaires (Light fittings)
Control systems

1. Lamps

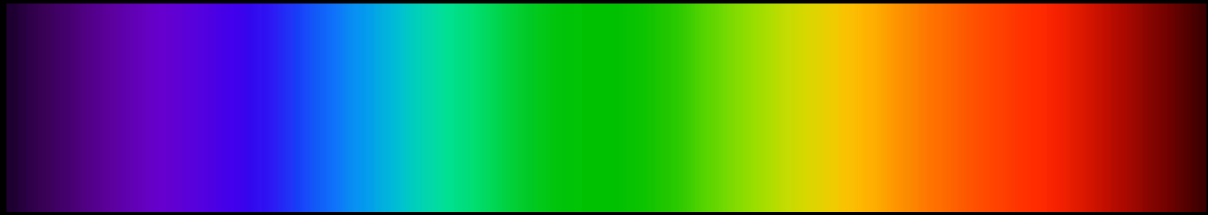
1. INCADESCENT
2. DISCHARGE (fluorescent, HID)

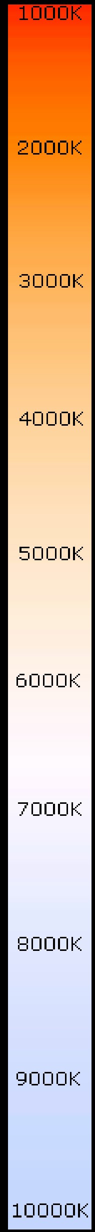
…and

3. LED’s

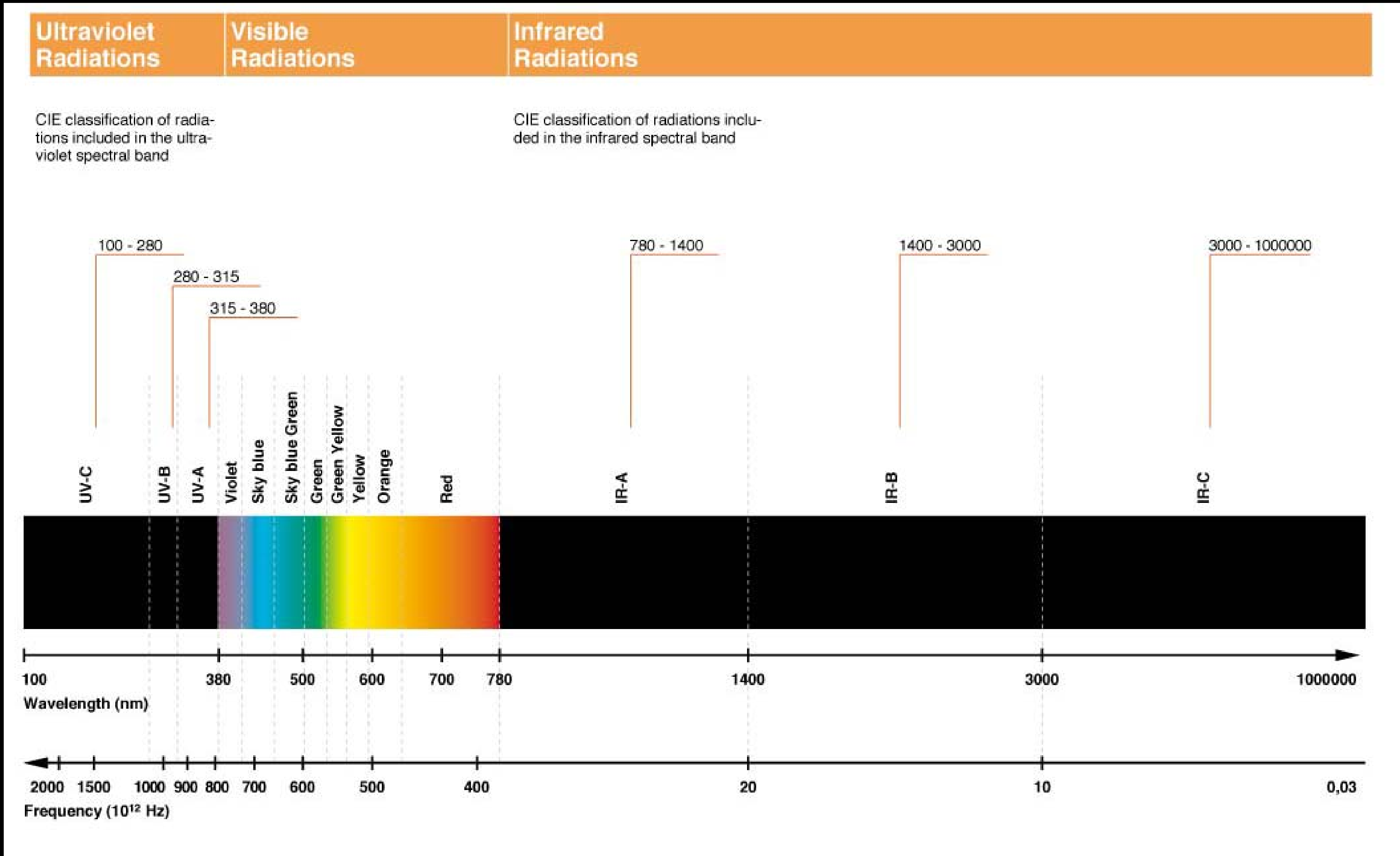
A great variety of different lamps available.

The Color of Light



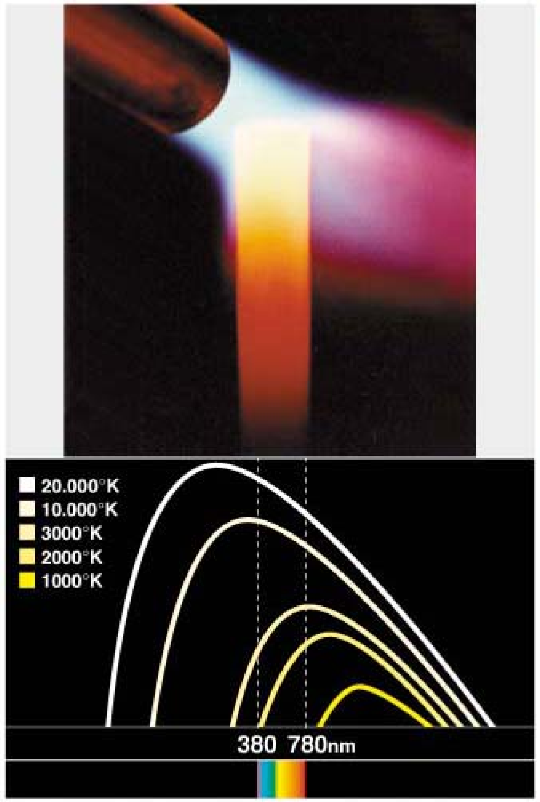


Visible Spectrum



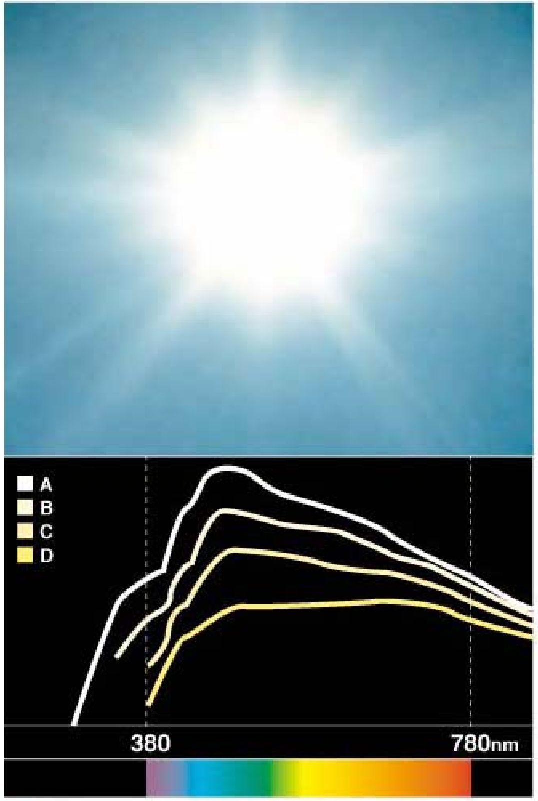
Light Temperature

Black body



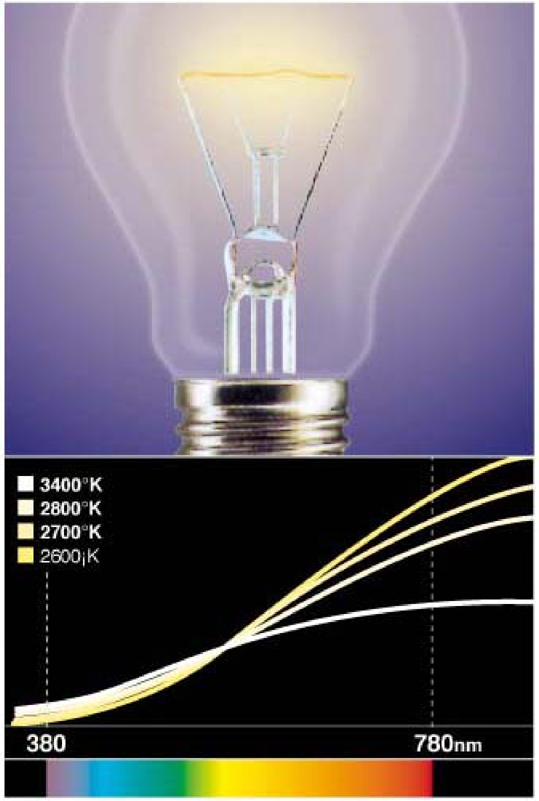
Radiation of a black body at different wavelengths for increasing temperature values

Sun



A - Out of the atmosphere
B - At a high altitude (5000 m above sea level with sun at zenith)
C - At 0 m above sea level with sun at zenith
D - At 0 m above sea level with sun at 60° from zenith

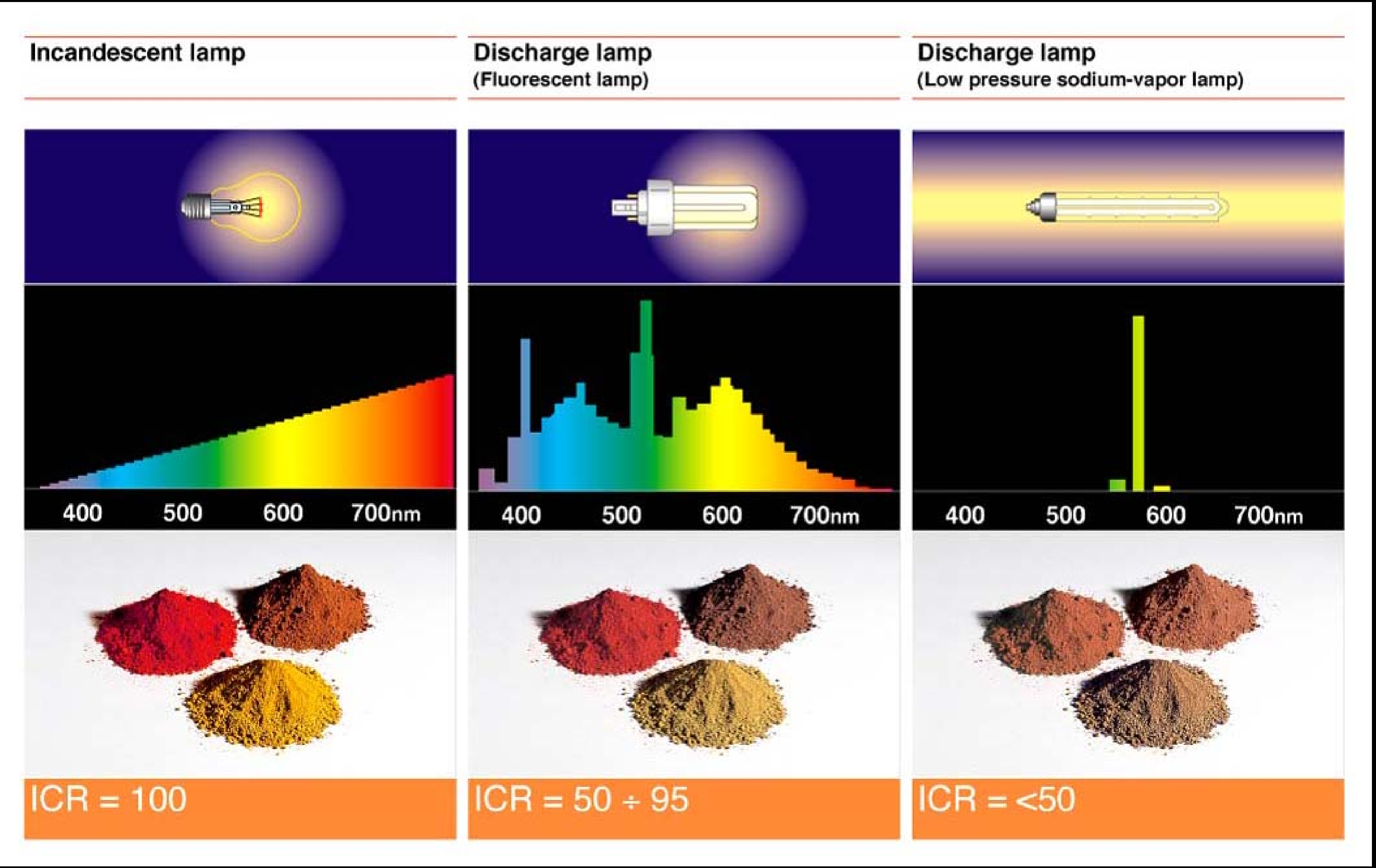
Artificial light



Emission curves of the tungsten filament for different colour temperatures

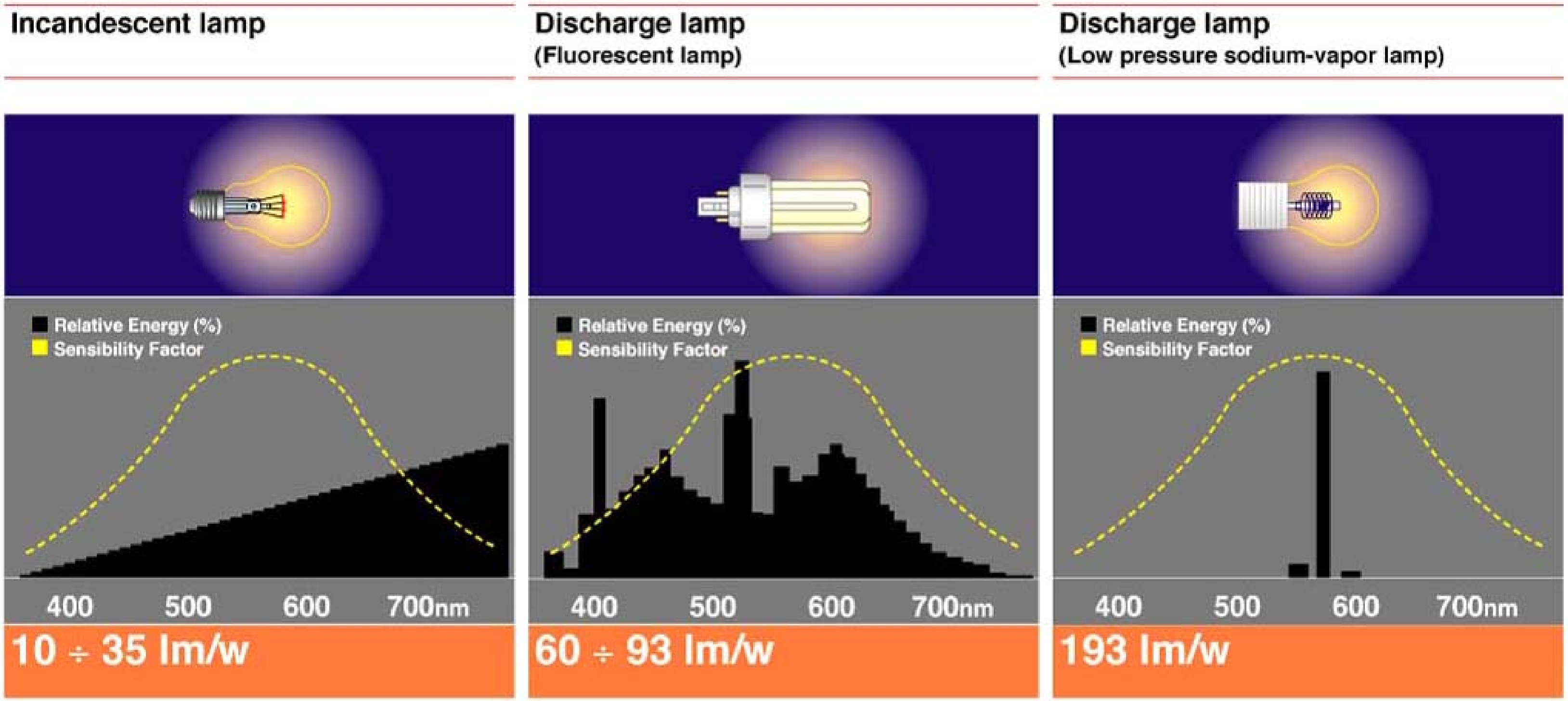
Main lamps characteristics

Color Rendering Index (CRI)



Main lamps characteristics

efficacy



$$\eta = \frac{\text{Luminous Flux}}{\text{Electrical Power}} = \frac{\phi}{P} \left[\frac{lm}{W}\right]$$

Main lamps characteristics

Choosing the right lamp

Main characteristics of light sources

Lamp type	Colour rendering index Ra	Colour rendering	Colour temp. Tk(K)	Colour impression
Incandescent	100	excellent	2800	white-warm
PAR	100	excellent	2800	white-warm
Halogen	100	excellent	3000	white-warm
Fluorescent	up to 90	excellent	2700 - 6500	white-warm daylight
Compact fluorescent	85	excellent	2700	white-warm
			3000	white
			4000	white-cold
HP	15	poor	6000	daylight
HPL-N(R)	45 (37)	moderate	4000	white-cold
HPL-C	52	moderate	3400	white
HPI-(T)	68 (65)	good	4100	white-cold
MHN-(W)	85 (75)	excellent	4200	white-cold
MHD	92	excellent	5600	daylight
CDM	80	excellent	3000	white-warm
SON	23	poor	1950	yellow
SON-Comfort	60	good	2200	yellow
SDW-T	85	excellent	2500	white-cwarm

2. Ballasts

All discharge lamps require an ancillary circuit called a ballast for the lamp to start and operate correctly.

The ballast significantly affects the lamp's efficacy, the lamp life and the overall consumption of electricity.

In the past, ballasts were relatively simple devices with an ignitor and capacitor (magnetic ballasts) and consumed an appreciable amount of energy- typically 10-20% of the lamp wattage.

Modern ballasts use HF electronic circuits

Benefits:

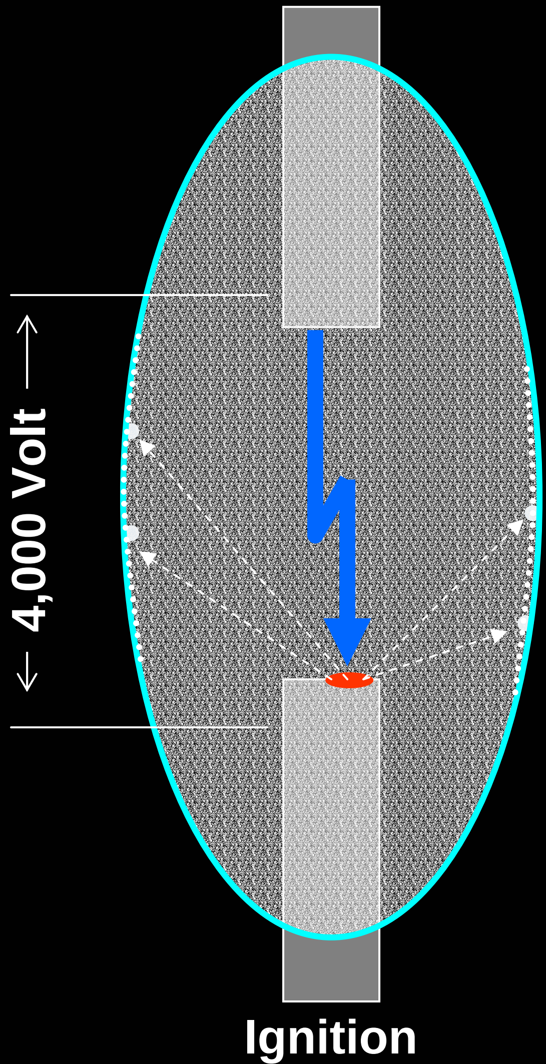
• High frequency operation (>30 kHz) has the effect of running the lamp more efficiently (e.g. prevents electrode erosion), but it also reduces the degree of perceptible flicker.

• They can reduce the lamp light output through step switching or dimming. This results in further energy savings.

• They consume much less energy than their earlier versions.

• They reduce lumen degradation (caused by lamp wall blackening) and preserve the lamp's color temperature, increase it's life and therefore lower maintenance costs.

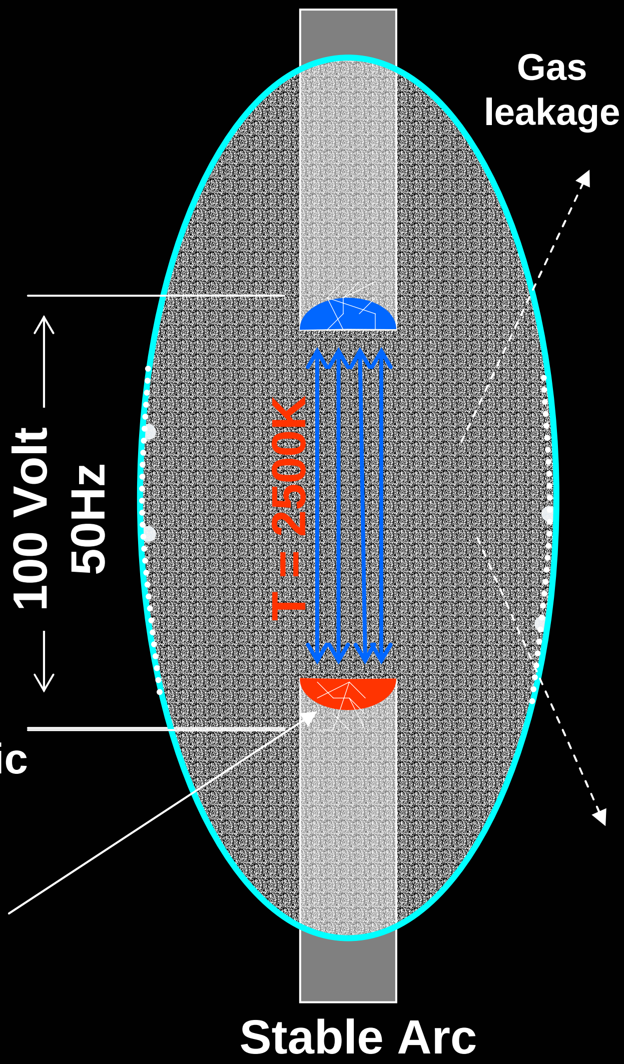
Conventional Ignition & Operation

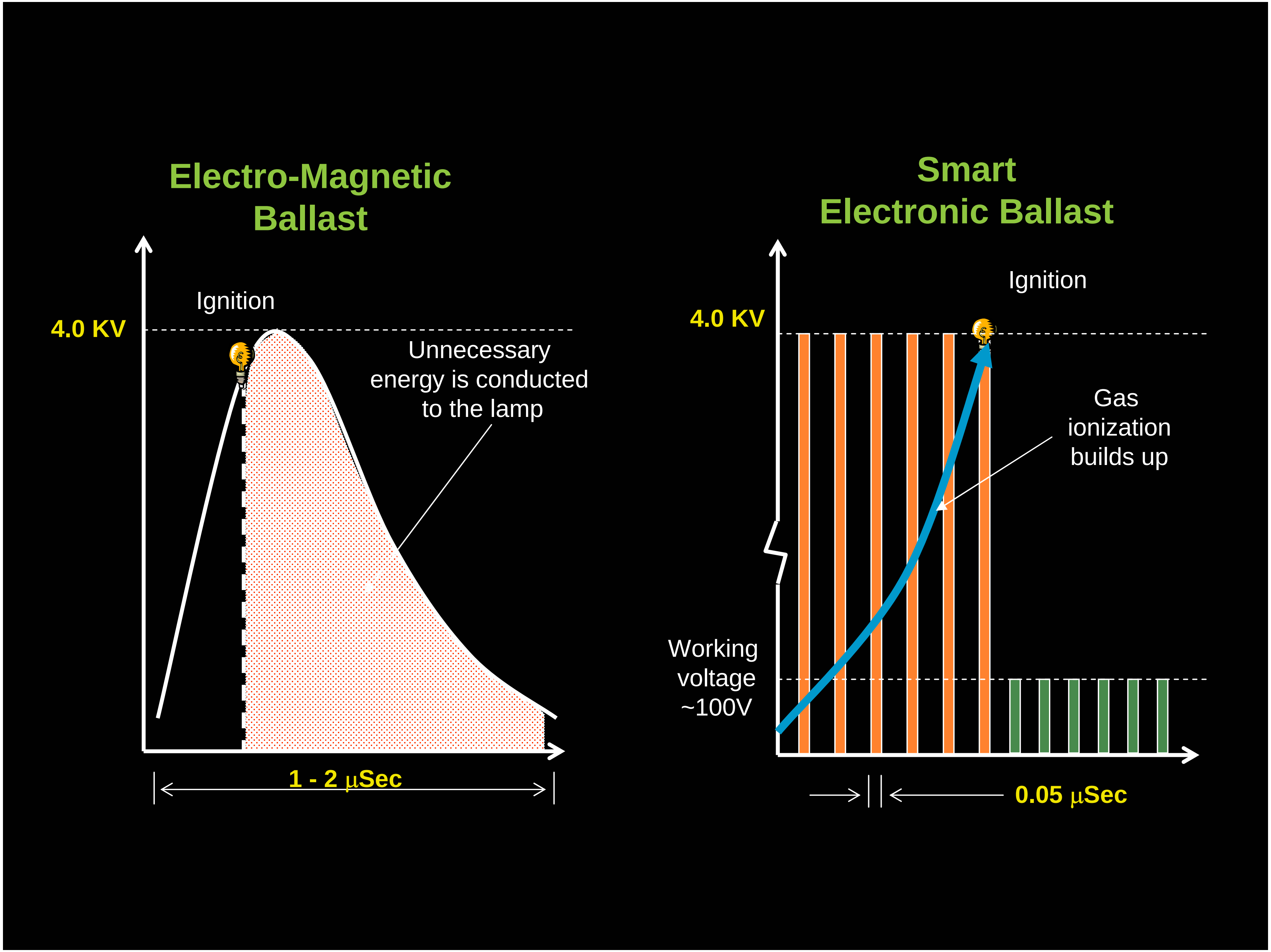


Metal splats on the burner walls causes walls blackening effect

Walls blackening results in increase of envelope temperature and accelerates gas leakage

LF sine wave causes drastic temperature changes and results in further erosion of electrodes




Electro-Magnetic Ballast
Ignition
4.0 KV
Unnecessary energy is conducted to the lamp
1 - 2 µSec
Smart Electronic Ballast
Ignition
4.0 KV
Gas ionization builds up
Working voltage ~100V
0.05 µSec

1. Select the lamp type for the specific application with regard to its color performance and it’s operating characteristics.

2. Then select the lamp with the highest efficacy (lumen/Watt).

3. Use the most energy efficient ballast units.

3. Luminaires (light fittings)

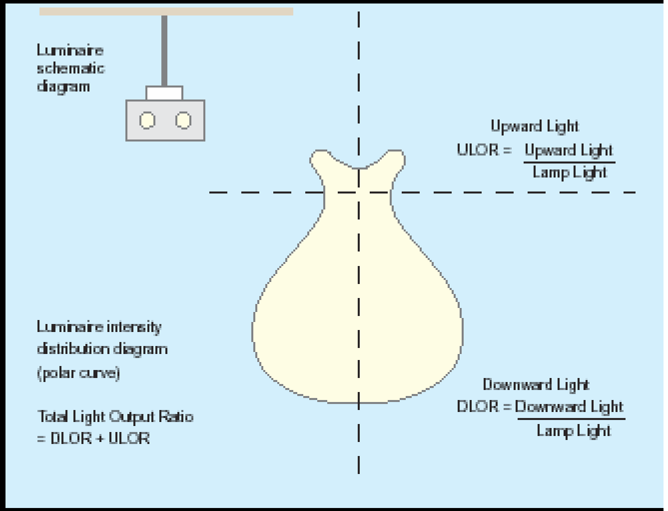
It provides the optical control that ensures that light is directed to where it is needed. This involves the use of reflectors, refractors and diffusers.

The optical elements of the luminaire absorb light.

How do we best define the optical efficiency of a luminaire?

Light Output Ratio (LOR)

- Compares the total light output of the luminaire with respect to the total light output of the lamp(s) and is expressed as a percentage.
- However, it takes no account of where the light is going!



For luminaires providing both upward and downward light, the LOR can be divided to an upward and a downward component.

These are described as the Upward Light Output Ratio (ULOR) and the Downward Light Output Ratio (DLOR). The sum of the two gives the Total Light Output Ratio.

Utilisation Factor (UF)

Since many lighting installations comprise a regular array of identical luminaires fitted on, or recessed into a ceiling, the industry has devised a way of estimating the number of luminaires that are required to provide a particular illuminance [lux].

To achieve this it is necessary to know the proportion of the lamp light output that will arrive on the horizontal plane. This depends not only on the luminaire performance but the room size and its proportions, as well as the reflectance of the room surfaces.

This installation performance characteristic is known as the Utilisation Factor (UF). In this case two luminaires can be compared, in terms of efficiency, by comparing their Utilisation Factors for the same room conditions. The luminaire with the higher UF will be the most efficient.

Select the luminaire for the particular lighting requirement, and hence its light output distribution shape, and assess its efficiency in terms of either:

1. Light Output Ratio using either total LOR or Downward LOR and Upward LOR as appropriate.

2. For luminaires to be used to provide a general illumination from a regular ceiling array use Utilisation Factor (UF).

3. For spotlights and similar, use illumination performance data.

Lighting control systems

The fourth item of equipment in terms of energy efficient lighting is control systems. But this time we are not concerned about the energy efficiency of the item itself but what it can do in terms of creating an energy efficient lighting installation by ensuring that lights are only used when they are needed.

The potential for substantial energy savings has made the use of automated lighting controls such as timers, occupancy sensors and photosensors commonplace in modern buildings, similarly like HVAC controls.

Manual controls like switches and dimmers are also part of the discussion, but in order to be effective they must be easy and logical to use so that don’t be ignored. However, people are notoriously bad at switching lights off when they are not needed!

[redacted]

Limited lighting control applications, due to:

- High initial costs
- complexity of these systems
- Interoperability concerns

The benefits coming from their use are much more significant:

- Detailed report on occupancy and energy use
- Enhanced operation scheduling
- Ability to share information with other building systems
- Diagnosis of lighting system problems
- Manual control options for building occupants (customization of lighting to the users needs)
- The ability to monitor and control lighting throughout a building, thereby reducing energy costs

Lighting control systems

Conventional lighting control systems often control lighting equipment over a limited area -> centralized control systems.

This means that all the controlled circuits must be wired to a single control panel.

Modern building automation systems are distributed control systems. In this case, the control modules are distributed as a network and use direct digital control technology to communicate with each other and act together as an intelligent whole.

Lighting control systems

Direct digital control systems are theoretically extendable without limit, so that all the lighting in a facility can be controlled via a single system – the same system that can also control the building’s HVAC , security systems and more.

Building automation systems require a computer and thus are only as useful as their programming. The sophistication of software for these systems varies greatly.

Lighting control systems

Key elements:

The availability of manual controls (like control pads or remote controls) easy to use is of key importance in occupant acceptance of a new lighting system. People will very soon become annoyed if they fell that they are being dictated to by the control system and may often try to sabotage the process.

The control system must be logical to the occupants and its actions should be hardly noticeable. The supplier will also need to provide an operation manual to ensure ongoing satisfaction.

The system can be programmed to let manual controls override signals from sensors.

Lighting control systems

Key elements:

Occupancy sensors are a means by which the lighting system can share information with other building systems. Great energy savings and user satisfaction may result from using occupancy sensors. Allowing occupancy sensors to also control the HVAC system may substantially increase the total savings.

Photosensors are another key element of a lighting c.s.. There are 2 types of photosensors: those used for switching and those used for dimming. The latter is a great means of compensating daylight with artificial light in a building, which leads to reduced running and maintenance costs.

Good lighting controls, including switches and dimmers, operated either manually or automatically via light and occupancy sensors, can provide important benefits in terms of energy efficiency but they must be user friendly – in other words they must be seen by the occupants as an important benefit and should hardly be noticeable in their operation.

Take full advantage of the available daylight!

intermission