

LED Efficiency Comparison

Introduction

The Current LEDs available in the market are up to 60Lm/W and thus are already encroaching on the traditional fluorescent lamp markets for luminous efficiency. The following table shows a comparison of different light sources.

Characteristics of Common Light Sources			
Light Source	Efficiency (Lumens/Watt)	Average Lamp Life	Colour Rendering Index
Standard Incandescent	5-20	750-1,000	100
Tungsten Halogen	15-25	2,000-4,000	100
Compact Fluorescent	20-55	10,000	80
Mercury Vapour	25-50	Up to 24,000	15-30
Metal Halide	45-100	10,000-20,000	60-90
High Pressure Sodium	45-110	Up to 24,000	9-70
LED	25-60	50,000-100,000	70-95

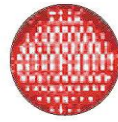
Reference: APS Business Service with LED Characteristics added

The above data can only be considered with the light source is placed into a lighting fixture that puts the light onto the area or task to be illuminated. This is where the LED light source becomes an effective alternative to Fluorescent lamps returning a higher light output efficiency for the same luminaire cost. See below.

LED Luminaire Comparison

The luminaire Light Output Efficiency for LEDs is far greater than Fluorescent lamps because the light is emitted from the surface of the LED in one direction, the fluorescent lamp emits light full circle, all round, up and down. The fluorescent lamp luminaire starts off therefore at a disadvantage, because the upward and sideways output (approximately 70% of the total) has to be redirected downwards with reflectors. The reflectors efficiency does vary from fixture to fixture and also with time, it being affected by the accumulation of dust and dirt. To maintain efficiency they therefore require regular cleaning and maintenance action, which is a costly activity given the safety requirements if the lamp is located in the ceiling.

The LED does not require these redirecting reflectors and this does not lose any of its light, so the above table requires altering in the following way to give the overall efficiency, including the luminaire e thus:



Characteristics of Common Light Sources			
Light Source	Efficiency (Lumens/Watt)	Luminaire Efficiency	Overall Efficiency
Standard Incandescent	5-20	50%	2.5-10
Tungsten Halogen	15-25	50%	7-12
Compact Fluorescent	20-55	50%	10-27
Fluorescent (T5 Covered)	60-100	65%	39-65
Mercury Vapour	25-50	80%	20-40
Metal Halide	45-100	80%	36-80
High Pressure Sodium	45-110	80%	36-88
LED	25-60	100%	25-60

The difference in total lighting efficiency is now clearly not that much in favour of the traditional Fluorescent lamp.

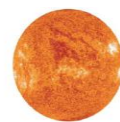
LED Operational Comparison

During operation the fluorescent lamp suffers badly with any effort to reduce costs by turning it off due to the fact that this function reduces the lamp life over and above the figures quoted above. This is further decreased by the action of low cost rapid start ballasts that head the filaments hard before striking the ark in the lamp. The LED has no such reduction in life due to re-strike and thus picks up all the benefits of off-time energy and cost savings.

Cost of Ownership Comparison

The cost of ownership is the big thing in understanding energy saving. If the government have got their figures right, then the two should be linked. This means that a low cost of ownership should equate to a low overall energy use. To look at the overall cost of ownership, one should take into account the lamp life, the maintenance actions and cost of the lamp/luminaire e/driver (ballast or power supply).

The following assumes the efficiency of the LED power supply and the ballast are about the same, and the cost of the luminaire is the same. The initial cost of the LED light source is higher but the life is far better. The calculation does make assumptions as to the lamp reduction due to on/off cycling and the number of cycles per day by gives a fair comparison for the purposes of this discussion.



Cost of Ownership over 10 Years

Light Source	Overall Efficiency	Lamp Life With On/Off Cycle	Power Cost 10 Years (43,800 hrs)	Replacement Cost Over 10 Years				Total 2000Lm Lamp
				Bulb	Qty	Lab	Sub Ttl	
Standard Incandescent	2.5-10	500-700	£4.38/Lm	30p	62	£5	£93	£8,853
Tungsten Halogen	7-12	1,300-2,600	£3.65/Lm	£5	17	£10	£850	£8,150
Compact Fluorescent	10-27	7,000	£1.62/Lm	£6	7	£5	£210	£3,450
Fluorescent (T5 Covered)	39-65	10,000-16,000	£0.67/Lm	£9	2.7	£20	£486	£1,826
Mercury Vapour	20-40	Up to 20,000	£1.10/Lm	£20	2.2	£20	£880	£3,080
Metal Halide	36-80	7,000-15,000	£0.55/Lm	£10	2.9	£20	£580	£1,680
High Pressure Sodium	36-88	Up to 20,000	£0.50/Lm	£10	2.2	£50	£1100	£2,100
LED	25-60	50,000-100,000	£0.73/Lm	£60	0.4	£10	£240	£1,700

Although not exhaustive, a trend can be seen in the 10 year life cost moving towards the LED as the long-term solution for lighting applications. Indeed, the more demanding the lighting application, the more the LED solution wins. Couple this with the fact that the traditional lighting methods have been around now for a hundred years or so and have reached maturity a long time ago; the LED is the up-and-coming star, with future predictions for lower cost and improved efficiencies still to come.

The cost is based on replacing the lamps at today's prices, but as LED technology develops further, the LED lighting cost will reduce and the fluorescent lamps will get more expensive as the environmentalist lobbyists force them to be priced out of the market.