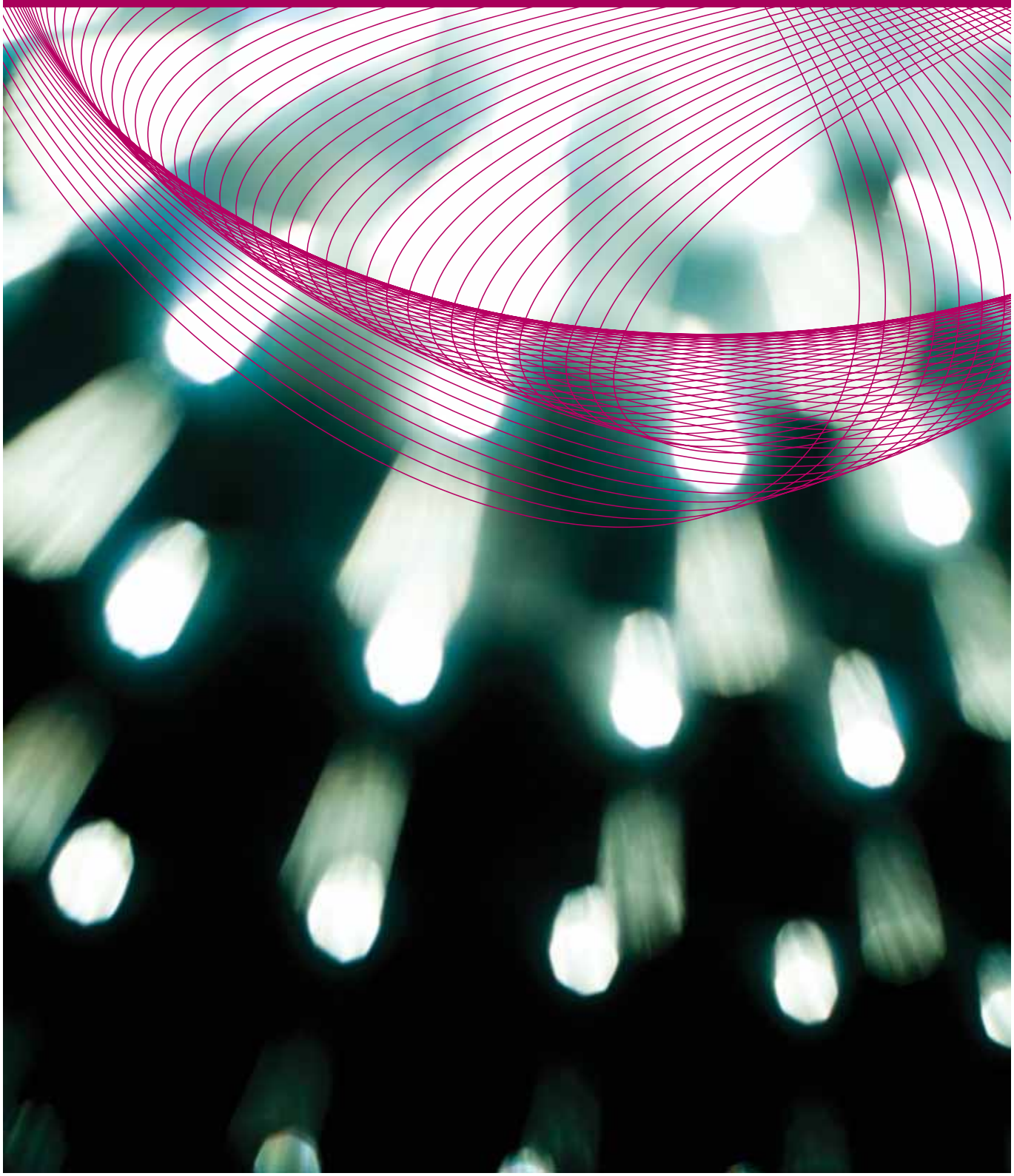
SUSTAINABLE ENERGY IRELAND

Hospitality Business

A GUIDE TO ENERGY EFFICIENT AND COST EFFECTIVE LIGHTING

UP TO 70% SAVINGS

This guide provides information on how to reduce energy costs and improve the effectiveness of lighting in hospitality premises by using energy efficient lighting technology and techniques. By following the information provided, you should be able to reduce the energy consumption of your lighting by up to 70%, cut maintenance costs and improve the appearance of your enterprise.



ENERGY EFFICIENT AND COST EFFECTIVE LIGHTING

Lighting accounts for about 30% of the total electricity used in hotels and other similar businesses. Conversion of inefficient lighting installations to more energy efficient lamps, control gear and luminaires (light fittings) saves substantially on electricity costs without reducing lighting quality. In many cases lighting quality is improved.

LIGHTING REQUIREMENTS AND TECHNIQUES

There are a number of lighting criteria which need to be considered to deliver high quality lighting designs. These are listed below and covered in the following pages.

- A colour appearance
- B colour rendering
- C lamp and luminaire efficiency
- D light distribution
- E use of daylight
- F controls
- G maintenance
- H lamp life

Fig.1 *Natural lighting providing a welcoming atmosphere at the Pie Dish Bistro, O'Callaghan Stephen's Green Hotel*

COLOUR APPEARANCE AND COLOUR RENDERING

The colour appearance (Figure 2) and colour rendering provided by the lighting is a very important issue in the hospitality industry, e.g. it helps to reproduce the desired colours of fabrics. The colour appearance i.e. 'whiteness' should be chosen to produce the right 'effect'.

A lamp's 'whiteness' which is either 'bluish' (cool) or 'reddish' (warm) in appearance; is measured on the Kelvin temperature scale (K). A colour temperature of less than 3,500 K is 'warm'; a colour temperature of 3,500 K is mid-white; and a colour temperature above 3,500 K is cooler. *The higher the colour temperature, the colder the appearance of the light produced.*

Colour rendering is the ability of a light source to give good colour representation of the colour it is illuminating. It is measured on a scale of Ra 0-100 with Ra 100 representing the best, which is equivalent to that provided by daylight. *The closer the CRI is to 100, the better the colour rendering of the light source.*

The three pictures in Figure 3 demonstrate that daylight (5,500 K) has a cool appearance on white walls and shows the red ceramics as their true colour. The tungsten light has a 'warm' appearance and therefore shows the white walls as 'warm' (2,600 K) and accentuates the colour red. Whereas the cool 'white' of the single phosphor fluorescent light has a cool appearance (6,000 K) on white walls and provides a reduced colour rendering on the ceramics. *Where accurate colour judgment is required e.g. Kitchens and laundries, Ra 80-90 is necessary, and also desirable for other hotel areas.*

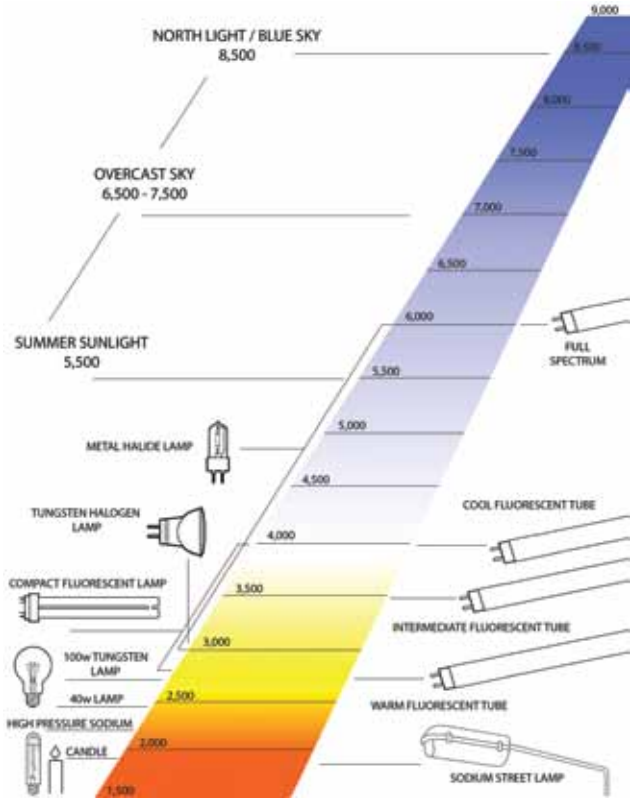


Fig.2 *Colour temperature (K) of various light sources*

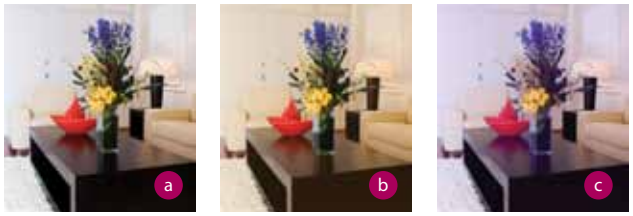


Fig.3 *Colour rendering characteristics of 3 different light sources:*
(a) *Daylight = Ra 100,* ***(b)*** *Tungsten = Ra 100,* ***(c)*** *Single phosphor 'cool' white = Ra 58*

APPLICATIONS IN HOSPITALITY AREAS

Refer to page 7 for recommended lamp technical information.

RECEPTION & LOBBY

Appropriate light sources for this area.

For 'General Lighting' use lamp 8 or 9
For 'Table Lighting' use lamp 10 or 11
For 'Accent Lighting' use lamp 6 or 7

GUEST ROOMS

Appropriate light sources for this area.

For 'Table Lighting' use lamp 10 or 11
For 'Accent Lighting' use lamp 6 or 7

MEETING & FUNCTION ROOMS

Appropriate light sources for this area.

For 'General Lighting' use lamp 8 or 9
For 'Table Lighting' use lamp 10 or 11
For 'Accent or Decorative Lighting' use lamp 6 or 7

BAR & RESTAURANT

Appropriate light sources for this area.

For 'Table Lighting' use lamp 10 or 11
For 'Accent or Decorative Lighting' use lamp 6 or 7
For 'Pendants and Chandeliers' use 3 or 4

KITCHEN & BACK OF HOUSE

Appropriate light sources for this area.

For 'General Lighting' use lamp 8 or 9
For 'Accent Lighting' use lamp 10 or 11

DAYLIGHT

Daylight can replace artificial lighting for much of the day in buildings and provides an attractively lit space for guests.

- Use daylight sensor controls (photocells) to ensure that lights are not left on unnecessarily when there is adequate daylight or to automatically dim lights.
- Consider 'daylight blinds' for areas that receive good quantities of natural light, as they can eliminate the need for artificial lighting by directing light into the space while cutting out glare.

More details on daylighting strategies are covered in SEI's document, a guide to energy efficient and cost effective lighting.

CONTROLS

Lighting controls are available to control either single or groups of luminaires. The controls can automatically switch the lighting when the area is occupied/unoccupied and also can be linked to daylight sensing when there is sufficient daylight in the area. Daylight linking can either switch the lighting off or dim it to provide a constant light level. Constant maintained lighting levels provide the maximum energy savings by automatically adjusting the lighting levels.

Area	Occupancy Level	Controls to consider
Kitchens	Usually occupied (Set hours)	Local switches Presence detection for store rooms
Meeting and Function Rooms	Variable occupation	Local switches Dimming facilities Scene setting Presence detection
Bar and Restaurant	Variable occupation	Local switches Scene setting Dimming facilities
Lobby Area	Usually occupied	Local switches Automatic Dimming of lights if daylight is adequate
Guestrooms	Variable occupation	Local switches Guest swipe cards
Corridors	Variable occupation	Time operated to part circuits Local switches Presence detection or Automatic Dimming/off lights if daylight is adequate
Back of House	Usually occupied	Time operated Automatic Dimming/off of lights if daylight is adequate Local switches

Effective control of lighting can be integrated with an hotel's existing system for waste control, a good example is the Hazard Analysis and Critical Control Points (HACCP) infrastructure, found in most kitchen management procedures.

A publication in this solution guide series on controls gives more details on lighting control strategies and techniques.

MAINTENANCE

- Choose lamps which have long life, to keep maintenance to a minimum especially in front of house areas, this would also reduce inventory and storage requirements.
- Choose luminaires which are easy to clean and provide easy access to the lamp. See example in Figure 4.
- When replacing existing recessed downlight luminaires consider the light output from the luminaire and maintenance.

A hotel guestroom converted from standard lamps to high efficiency replacements can yield a 70-80% saving on lighting energy consumption and greatly reduced maintenance costs.

Fig.4 *shows a decorative glass feature, this style, with access hole is easier to maintain as lamps can be changed without removing the 'feature glass' plus there is no glass in the central area to keep clean*

LAMP REPLACEMENT CHART

Existing Lamp Type	Replacement Lamp Type	Benefits
Incandescent GLS 40W 60W 75W 100W 150W	CFLi (integral ballast) 9W-11W 11W-14W 15W-19W 20W-25W 26W-29W	75% energy saving Up to 12 times the lamp life of incandescent lamps Use 'warm white' (2,700 K) CFLi lamps
Incandescent GLS Mains Voltage 40W 60W	Mains Voltage Tungsten Halogen GLS 28W 42W	30% energy saving Twice the lamp life Provides 'sparkle'
Incandescent GLS 40W 60W	Low Voltage (12v) GLS 20W 30W	50% energy saving Three times the lamp life Provides added 'sparkle'
Mains Voltage Halogen Dichroic Reflector 35W 50W	Low Voltage (12v) Tungsten Halogen Dichroic IRC 20W 30W	40% energy saving Three times the lamp life
Mains Voltage Halogen Dichroic Reflector 35W 50W	CFLi (GU10 fitting) 7W 11W	80% energy saving Seven times the lamp life As the light distribution differs between these two lamp types lower light levels may be expected
Mains Voltage Halogen Dichroic Reflector 35W 50W	LED (GU10) (Also available in Low Voltage) 4W 8W	90% energy saving Forty times the lamp life As the light distribution differs between these two lamp types lower light levels may be expected
T12 (38mm) or T8 (26mm) switch start luminaires	T5 (16mm) High Efficiency fluorescent tube	30% to 50% energy saving Twice the lamp life An electronic adaptor is required (see page 5)
T8 (26mm) switch start luminaires	T5 (16mm) High Efficiency fluorescent tube	10% energy saving Twice the lamp life when tubes use electronic ballasts

Note: *Always use reputable suppliers and products that comply with all National and EU lighting regulations and standards. Trial newer products for their suitability before widescale upgrades. Refer to* ***www.sei.ie/aca*** *for energy efficient products*

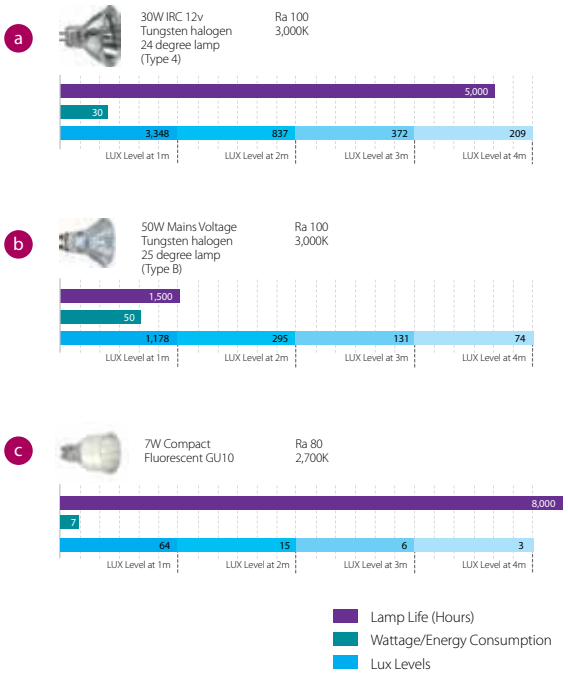


Chart showing lamp replacement options

These three lamps demonstrate the importance of selecting the correct light source for the application.

a. This lamp is the most energy efficient tungsten halogen.

b. This lamp is the least efficient tungsten halogen.

c. This lamp uses the least energy but delivers lower light levels than (a) or (b).

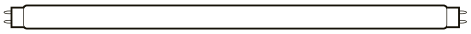
Refer to page 7 for more information on lamp types.

Comments on LED replacements.

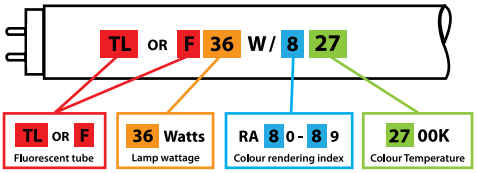
There are many LED replacements for either replacing existing Mains Voltage GU10 or Low Voltage MR16 Dichroic reflector lamps. They vary in wattage and distribution and can therefore be disappointing if the incorrect LED type is chosen. Always trial the prospective model to obtain the appropriate LED type for your application. Not only do the LED lamps vary in lumens and distribution of light but they also vary in expected life hours. An Accelerated Capital Allowance is offered for lamp types which reach a minimum efficiency requirement. Further information including a list of manufacturers and suppliers with eligible products can be found on the SEI website, **www.sei.ie**

LIGHTING TECHNICAL DETAILS

A Fluorescent Tubes



These are commonly used lamps in 'Back of House' areas. The T8 (26mm diameter) model is available in high efficiency and lower efficiency, always use the high efficiency type (Triphosphor). The T5 (16mm diameter) is only available in triphosphor. The control gear should always be electronic high frequency. Good colour rendering of 80+ is achieved when triphosphor lamps are used and the colour appearance can be chosen by selecting whether warm or cooler colour white is required. Tube markings are shown below to assist in your selection.



There are many advantages to specifying electronic high frequency ballasts when using fluorescent tubes. They optimise the lamp life by up to 50% on standard tubes, dimming versions are available and rapid-start for instantaneous light, or soft-start in which there is a moment's delay. All ballasts consume electricity, electronic high frequency ballasts consume less than wire wound equivalents.

Retrofit Adaptors

Retrofit adaptors should be considered when upgrading lamps from T8 to T5 as they eliminate the need to replace the ballast and luminaire. Retrofit adaptors should only be used to convert lamps utilising switch start control gear. T12 to T8 versions are available, however replacing the luminaire may be a more suitable option.

B Compact Fluorescents

These are only available with good colour rendering and are available with different colour appearances. The newer smaller integral ballasts (CFLi) ensure that the right size alternative to incandescent lamps are almost always available. Newer versions of CFLi lamps are dimmable. Upgrading to dedicated CFL luminaires will ensure maximum efficiency.

C Low Voltage Tungsten Halogen Dichroic Lamps

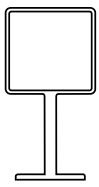
Low Voltage (12v) dichroic lamps are available in many wattages and beam angles. The IRC (infra-red coating) is the most efficient with a 35W type providing equal if not more light than a standard 50W low voltage (12v) dichroic lamp and substantially more light than the mains voltage version, see the comparison shown on page 4. Always choose the correct beam angle according to the distance to the objects to be 'highlighted' to ensure desired effect is achieved. Mains voltage tungsten halogen lamps should be avoided as they are the least efficient and have relatively shorter life than the low voltage (12v) IRC versions.

D LEDs

These are appropriate for hotel signage, exit signs, desk lamps and bedside reading lamps. Some very high efficiency types can also be used as spotlights to provide 'accent' or 'feature lighting' rather than general illumination.

E Task Lighting & Table Lighting

This may be fixed (under cabinet) or flexible arm desktop units. Fixed task lighting in offices, guestrooms, corridors, bar and lounge areas may use tubular or compact fluorescent and desk lamps or bedside lamps can employ compact fluorescents or LEDs. Table lighting in bars, restaurants and lobby areas should use CFLi lamps or alternatively where intensity of light is important a Tungsten Halogen GLS replacement lamp may be a more suitable option.



LUMINAIRE EFFICIENCY AND LIGHT DISTRIBUTION

Once you have decided on the type of luminaire you require, compare versions from different manufacturers. Choose the most efficient model – this will have the highest Light Output Ratio (LOR). The closer to 100% the better, do not choose below 65%. Some luminaires may look very similar but depending on the efficiency of the reflectors in some luminaires up to 76% of the light, and subsequently energy, is wasted. A higher Light Output Ratio means less luminaires are required to deliver the same quantity of light. Figure 5 illustrates LOR values.

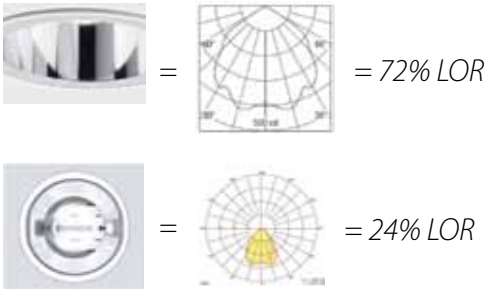


Fig.5 *shows an example of how two luminaires with similar appearance can have a variance in LOR of 48%*

LIGHTING UPGRADE CASE STUDY

Dundalk Crowne Plaza

By making small changes to the lighting scheme and choosing low energy lamp alternatives in preference to more routinely fitted lamps, the Dundalk Crowne Plaza was able to reduce its electrical load for lighting in 129 guestrooms by 70%.

After trialling a number of different low energy options the hotel embarked on a roll-out programme to make changes to the rest of the guestrooms.

Their solution consists of:

Entrance corridor (at bedroom door)

12W LED spotlights in the entrance corridor (previously 35W GU10).

Bathroom

4 x 7 W LED recessed downlights in the bathroom (previously 35W GU10).

Bedroom

Floor standing uplighter: 25W circular T5 fluorescent + a 7W CFL reading light (previously 300W+ 40W halogen).

Bedhead lighting: 58 W T8 triphosphor fluorescent lamp, with high frequency control gear (existing).

Downlighters: 20W IRC low voltage tungsten halogen (previously 35W GU10).

Bedside lamp: 1W LED (existing).

The Hotel Manager, Tom Devaney, believes that *'a low energy approach to lighting in the guestrooms can deliver good quality lighting for guests while greatly reducing the hotel's environmental impact and operation costs'.*

Fig.6 *Concealed T8 high efficiency tubular fluorescent and LED reading lights*

In other parts of the hotel there was a substantial number of 75W and 50W R111 lamps (Fig.7). As there are IRC versions of this lamp, which are substantially more efficient, the existing lamps were replaced with 50W and 35W versions respectively. The energy consumption was reduced, the effect was the same and the lamp life was improved from 2000 hours to 4000 hours.

Fig.7 *The 50W R111 Tungsten halogen was replaced with the IRC version of the same lamp which doubled the lamp life.*

Lamp Upgrade Savings Calculator	Existing Lamp Choice	Lamp Upgrade Options	Notes
Quantity of lamps	(A) 50	(B) 50*	
Lamp rating (Watts)	(C) 50	(D) 35	
	Mains Voltage Tungsten Halogen	Low voltage (12v) Tungsten Halogen IRC(new transformer required)	
Hours per year	(E) 5,500	(F) 5,500	Typical for Hotels
Energy used (kWh)= A x C x E /1000 and B x D x F/1000	(G)13,750	(H) 9,625	kWh
Electricity cost = G x K and H x K	(I) €1,925.00	(J) €1,347.50	(K) €0.14
Annual electricity saving= I-J	**(M) €577.50**		
Lamp cost	(N) €0.75	(O) €3.90	
A once-off low voltage transformer cost		(P) € 6.40	
Simple payback for the replacement lamp (lamp + transformer) = (O + P)*B / M x12		10.7	Months
Lamp life (hours)	(Q) 1,500	(R) 5,000	
Replacement quantity for each lamp (per year) = E/Q and F/R	(S) 3.67	(T) 1.1	
Replacement cost (per year)= A x N x S and B x O x T	(U) €137.50	(V) €214.50	
Total running cost= I+U and J+V	(W) €2,062.50	(X) €1,562.00	
Total annual saving = W-X	**€500.50**		

** It is often possible through the use of brighter replacement lamps to reduce the overall number of fittings and still maintain the original light levels.*

Savings on maintenance time for lamp replacement with the longer life lamps in this example account for 128 lamp changes equivalent to approximately 10 hours of labour. As well as reduced storage space requirements for new lamps, smaller lamp inventories and less guest complaints about defective lamps.

LAMP COMPARISON CHART

	Lamp Description	Lamp Image	Colour Rendering (Ra)	Colour Temperature (K)	Lighting Type			
					General	Accent	Decorative Pendant	Table Top
1	**Tungsten Lamps, GLS** Common low efficiency light source, is hot and has short life (1,000 hours)		100	2,600	✗	✗		
2	**Tungsten Halogen GU10** Mains voltage dichroic lamps provide approx. 35% of the illumination of (12V) IRC versions for the same wattage and have short life (1,500 hours)		100	3,000	✗	✗		
3	**Mains Voltage Tungsten Halogen** These lamps save 30% energy when compared with GLS and have an expected life of 2,000 hours		100	3,000			✓	✓
4	**CHLi - Low Voltage (12v) GLS** These compact halogen lamps with integral control gear save 30% energy when compared with GLS and have an expected life of 3,000 hours		100	3,000	✓		✓	✓
5	**Mains Voltage GU10 CFLi** These lamps save 80% energy but they are only available in low wattages and therefore do not have high levels of illumination (lamp life of 8,000+ hours)		80	2,700	✓	✓		
6	**Low Voltage (12v) Tungsten Halogen Infra-Red Coated (IRC)** Infra-red Coated (IRC) versions are brighter and more efficient than standard (12v) tungsten halogen lamps and 300% brighter than GU10 mains voltage models with life of 5,000 hours		100	3,000	✓	✓		
7	**Mains Voltage GU10 LED Lamps** Many models of high efficiency LEDs are available with lamp lives of 35,000-50,000 hours		70-80	3,000-6,000		✓		
8	**T8 (26mmØ) Triphosphor Fluorescent Tubes** Use T8 with Electronic High Frequency (EHF) control gear (lamp life of 20,000-60,000 hours)		80	2,700-6,000	✓			
8a	**T8 (26mmØ) Halophosphor Fluorescent Tubes** Use with Electronic High frequency (EHF) control gear (lamp life of 6,000+ hours)		58	2,700-4,000	✓			
9	**T5 (16mmØ) Triphosphor Fluorescent Tubes** These tubes are available in High Efficiency (HE) and High Output (HO) versions (lamp life of 16,000+ hours)		80	2,700-6,500	✓			
10	**Compact Fluorescent Lamps (CFLs)** Use models with electronic high frequency control gear for higher efficiency (lamp life of 8,000+ hours)		85	2,700-4,000	✓			
11	**Compact Fluorescent Lamps with Integral Control Gear (CFLi)** These lamps are available from 3W to 29W equal in lumen output as GLS from 15W to 150W (lamp life of 8,000+ hours)		85	2,700-4,000	✓		✓	✓

Low Efficiency | Low/Medium Efficiency | Medium Efficiency | Medium/High Efficiency | High Efficiency

Efficacy is the ratio of light emitted by a lamp to the power consumed by it, i.e. lumens per Watt. Lamp efficacy values are available from SEI's document, *"A guide to energy efficient and cost effective lighting."*

Lamp life Lamp life is the expected operating life hours of the lamp. When lumens fall to 80% of initial lumens, this is the rated 'life' and when the lamp should be replaced.

Lux is a measure of illuminance, where one lux is defined as an illumination of one lumen per square metre. It can be determined from manufacturer's data or measured with a handheld digital lux meter.

General Lighting: Used to provide the main light source for the space or area.

Accent Lighting: Used to highlight an object or a particular feature of the space or area.

Table Lighting: Used to provide localised lighting on table-tops.

Decorative Lighting: Typically describes lamps in fittings used for visual effect rather than general illumination.

A tax incentive is available through the Accelerated Capital Allowance (ACA) scheme for approved lighting products. Further information and details of manufacturers and suppliers of eligible products are available from **www.sei.ie/aca**

Accelerated Capital Allowance
Eligible Products www.sei.ie/aca

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