Advantages of LED Signal Heads

LED signal heads are three to five times more expensive than standard signal heads. However, the following advantages help to justify the additional investment:

- **LED bulbs save energy**
  Converting from a halogen bulb to the LED type reduces energy consumption by approximately 73%
- **LED bulbs last for years**
  The average life for a LED bulb is ten years rather than six months for a halogen bulb. LEDs operate very smoothly below their nominal current, which results in extended diode life and postpones the natural LED degradation. The optimised thermal conditions inside the signal head support the signal's long-term performance. Failures of individual LEDs are detected electronically, and immediately, the intact LEDs compensate for the loss in light by adjusting their intensity. However, if two adjacent LEDs fail, then the entire head turns off.
- **LED bulbs save money**
  As well as energy and relamping costs an additional 10% savings in maintenance cost is possible. Since LED signals draw very low power, the intersection wiring will not deteriorate as rapidly resulting in less maintenance.
- **LED bulbs are brighter**
  LED array has equal brightness across the entire surface making them brighter overall. Due to their low wattage, LED bulbs do not burn and darken the lens cover as can be the case with halogen bulbs, after a few years of operation.
- **LED bulbs can improve safety**
  As well as improved brightness, LED bulbs provide quicker on/off times and thus enhance safety. LED bulbs do not require reflectors behind the bulbs and therefore eliminate sunlight and phantom effects reducing the possibility of driver error.

Conclusion

The conversion of the 400 traffic signal heads will have the following impact:

- Savings of 1,400 MWh of electricity over the lifetime of the LED bulbs
- Cost savings of €322,000 over the lifetime of the LED bulbs
- Reduced carbon dioxide emissions of 910 tonnes over the lifetime of the LED bulbs

The key objective of the project has been to demonstrate the use of LED signals as an energy efficient option to the traditional halogen signal lamps. Dublin City Council has experienced significantly reduced electric power consumption, dramatically lower maintenance costs and improved safety due to the greater brightness. This superior performance has convinced the traffic department to expand the project throughout the city with LED signal heads becoming a standard for any new junctions as well as implementing a replacement programme as existing heads are renewed over their lifetime. The LED conversion project represents cutting edge technology in energy efficiency and will have tremendous economic and environmental impact within towns and cities if implemented throughout the country.

In fact, Dublin City Council has now specified the LED signal head as the standard for all new works within the City Centre and it is the intention to convert nearly all signal heads to the LED type.

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Dublin City Traffic Signal Conversion Project

Traffic signals are a necessary integral part of any city street network and provide a safe means of regulating and controlling the flow of vehicles, cyclists, trams and pedestrians. Halogen light bulbs provide the familiar red, amber and green lights but more recently, LED technology is used and has become a standard feature in many cities throughout Europe.

Between the years of 2001 and 2003, Dublin City Council's Road and Traffic department installed several test sets of LED signals. In 2004, in consultation with ESB Customer Supply and Sustainable Energy Ireland it was decided to replace approximately 400 signal heads at numerous junctions as part of a set of urban rejuvenation projects underway throughout the city centre.

Traditional Halogen Bulb System

Dublin City Council Road and Traffic department is responsible for the safe operation and maintenance of 680 sets of traffic signal installations throughout the city. Traditionally, the Council have been using halogen bulbs, which consume 55 Watts of electricity per bulb.

In a typical pedestrian crossing a minimum of six signal groups are used at a large junction such as O'Connell Bridge South where there are 34 signal heads. The wattage of each signal group is a minimum of 60 Watts and one lamp is permanently displayed at all times giving a load at this junction of 2kW. This results in annual energy costs for the entire network of traffic signals in excess of €200,000.

There are also additional replacement costs as the Council has found it necessary to adopt a preventative maintenance regime whereby the lamps are changed in the traffic signal every six months to help reduce problems associated with bulb failures.

Example of the new LED signal heads

Traffic signal conversion is an integral part of all new projects

The LED Signal Technology

The new traffic signal bulbs use Light Emitting Diodes (LED), rather than incandescent halogen bulbs. The LEDs are small individual electronic lights, which are energy efficient and have a very long life. The signals can comprise of either a multiple array of LEDs over the viewing area of the signal head or a cluster of high intensity LED's with an optical diffusion system.

The Council opted for the latter for the following two reasons:

1. Allows Monitoring of Operation

In the event of a failure of a diode, the unit automatically adjusts the light intensity. If two adjacent diodes fail, the unit will automatically turn off allowing the traffic controller to carefully monitor correct operation. In contrast for the case of the array of multiple LEDs, failure of any of the diodes would result in an uneven intensity pattern with no means to accurately control the operation.

2. Elimination of Phantom Light

Phantom light occurs where sunlight striking the signal head can give the impression that the signal is lit. The use of an optical diffusion system along with a fresnel lens eliminates the appearance of the phantom image while no light is wasted in the upward direction.

LEDs radiate light in 'batwing' pattern, which optimally uses the emitted useful light while the front lens always radiates a very uniform bright light. This also allows the integration of any symbol by either using mask inserts or varnishing the lens. The optical design feature of the unit means that a motorist should not perceive spot-like LEDs, or notice individual failures of LED.

Interface with Existing Traffic Controller

A key consideration in planning for the new lamps was compatibility with existing electronic communication and safety systems. It is vital that the council incorporates a safety element with regard to red lamp monitoring. When approaching a junction, a driver should see a number of red lamps to indicate that traffic on the opposing approach is signalled green. In the event that a red lamp fails then a driver approaching a junction may not realise that another approach is signalled green, which clearly has serious safety implications. For this reason, each signal is connected to a traffic signal controller that monitors each lamp and automatically detects lamp failure. Software and hardware modification were required for the Lamp Control Board current monitoring circuit so that LEDs could be used in place of halogen bulbs. The LED bulbs provide opportunities for retrofitting with existing signal heads or replacement of complete signal head as the traffic controller can be adapted to work with the more efficient LEDs.

Updated traffic signals at O'Connell Street

Dublin Project Implementation

The first junction to be completely fitted with the new LED signal heads was in conjunction with the completion of the new James Joyce Bridge on the Quays. To complement the architectural design of the bridge a stainless steel mounting pole was used complete with an aluminium body.

Operational trials of the junction were carried out and proved successful resulting in the installation of more than 400 signal heads in prime central business districts throughout the city such as the refurbished O'Connell Street, St. Stephen's Green and parts of the Luas Line.

Benefits:

Energy Savings

The energy saving for the LED signal is significant. The LED signal bulb uses approximately 15 watts of power, compared to the average 55 watts of power used by the halogen or incandescent bulb representing a saving of 40 watts per bulb. Each signal head operates 24 hours per day every day of the year. With always one of the bulbs illuminated the wattage saving thus results in annual savings of 350 kWh per signal head. For 400 signals this represents an annual saving of 140 MWh and a saving of 1,400MWh over the ten-year life of the LEDs.

James Joyce Bridge, Dublin

CO_2 Savings

In 2004, 1kWh of electricity was responsible for 651g of CO_2 (Energy in Ireland, 2005). The above energy saving thus represents an annual saving of 91 Tonnes CO_2 and a saving of 910 tonnes over the ten-year life of the LEDs.

Cost Savings

The energy cost saving for each signal head amounts to €38.50 per head (this is at Average Unit Price of 11 cents per kWh). There would also be a reduced relamping and maintenance cost of €42 per signal head giving a total annual cost saving for the 400 signal heads of €32,200. Over the lifetime of the LEDs a total saving of €322,000 is expected.

Cost-Benefit Assessment		
Total Project Investment	€500 per signal head	¤€200,000
Enabling Works		€30,000
		€230,000
Annual Cost Savings	Electricity Savings	€15,400
	Relamping & Maintenance Savings	€16,800
		€32,200
Simple Payback on Total Project Investment 7 Years		
Total cost savings over 10 year minimum life for this project		
400 Signal Heads		€322,000
Potential cost savings over 10 year minimum life for Dublin City region		
7,000 Signal Heads		¤€5.6 million
Potential cost savings over 10 year minimum life for nationwide implementation		
14,000-15,000 Signal heads		Up to €12 million