
Leading with LEDs

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LEADING WITH LEDs

As a significant investor in transportation infrastructure, the NZ Transport Agency takes an active interest in the maintenance and upgrading of existing and new infrastructure installations. We recognise that sometimes there are barriers to the implementation of new technologies, and want to do our part to assist asset managers in their decision-making.

New technology for road lighting

One area where the Transport Agency sees potential for gains in both efficiency and safety through the progressive introduction of newer technologies is road lighting.

New Zealand has approximately 370,000 road lighting luminaires consuming approximately 116 GWh of energy per annum. Road lighting accounts for up to 70% of urban territorial authority and up to 40% of rural territorial authority total energy costs, of which approximately 80% is provided by High Pressure Sodium (HPS) luminaires.

LED (light emitting diode) road lighting offers a number of benefits compared to HPS lighting, including reduced energy (30 to 60%) costs, wider maintenance intervals, and better light quality leading to increased public safety. Based on the view of industry experts, the Transport Agency considers that LED lighting is now a proven and technically mature technology.

While the road lighting infrastructure in New Zealand is predominantly owned and operated by Councils, its maintenance and upgrading are financially assisted by the Transport Agency. With increasing demands on funds on both sides, the Transport Agency is keen to ensure that Councils and its own asset management staff are making sound decisions, based on robust information. As there are only about 6% of luminaires on State highways, LED lighting offers greater benefits for local government - Auckland Transport alone has almost a third of NZ's luminaires!

It is essential to ensure that during any push for efficiency or environmental sustainability in road lighting, the provision of appropriate levels of lighting is not forgotten. One of the benefits of LED luminaires is they can provide a means by which more light can be provided, to areas that require it, for the same or less cost as older technologies, such as HPS, metal halide and fluorescent. However, many existing lighting installations fall below the lighting levels prescribed in the current lighting standard - AS/NZS1158. Therefore, if the operational performance is to be improved, the road lighting must also be improved.

Revision of standards

The benefits of white light for public safety are well-documented and the energy saving potential of LED lighting is well known as evidenced by the rapid uptake in architectural and household lighting, but adoption as a road lighting solution has been sporadic. The development of viable solid state (LED) luminaires for Category P applications, and more recently Category V, means LED road lighting has "come of age" and is now accepted as a viable solution. However, specification of LED road lighting solutions in New Zealand has been hampered because the current New Zealand standard, AS/NZS1158.6, does not recognise LED as an accepted white light technology.

While some local authorities have developed their own road lighting specifications as a work-around to obtain the benefits offered by LED road lighting, smaller authorities have been somewhat risk averse and overly reliant on New Zealand's out-dated AS/NZS 1158 series of road lighting standards.

The inherent slow pace of the standards setting process has been a source of frustration for both the road lighting sector and the NZ members of the LG-002 committee responsible for reviewing AS/NZS 1158. Part 6 (Luminaires) is currently under review and will become a technical specification in support of the revised standard with the full text adoption of IEC 60598.2.3 as AS/NZS 60598.2.3 to replace the current AS/NZS 1158 Part 6. This change is due for completion and publication by December 2014.

Clear direction

To assist the decision-makers and give clear direction for future road lighting investment, the Transport Agency took the lead in promoting energy efficient white light solutions for road and public area lighting applications through two related approaches:

- confirmation that the Transport Agency's investment policies are aligned with the use of LED road lighting through the release of a joint statement on LED road lighting with EECA (attached at the end of this paper); and
- development of a road lighting specification - M30 Specification and Guidelines for Road Lighting Design with supporting documents for luminaire assessment and PV calculations.

From another perspective, the Transport Agency felt there was some validity to anecdotal comments that New Zealand's road lighting consultants and designers needed to shift their focus from legacy road lighting solutions and embrace solid state lighting technologies.

M30 Specification

The M30 Specification and Guidelines for Road Lighting design was released in late August 2014 on the Transport Agency's consultation web page. Use of the document in its initially released form was strongly encouraged, and a number of Transport Agency capital works contracts included M30 in their Principal's Requirements. The initial release also included a list of LED luminaires accepted by the Transport Agency for installation on State highway and local road networks covering both Category P (pedestrian traffic predominant areas) and Category V (vehicular traffic predominant areas) applications.

The M30 document is a supplement to and not a replacement for AS/NZS 1158. It primarily addresses the failure of the current standard to accommodate LED solutions on New Zealand's public roads network.

M30 draws on LED performance criteria and luminaire specifications developed in part by the Christchurch City Council and Auckland Transport. It also draws on technical advice published by the International Municipal Solid State Street Lighting Consortium and associated international standards and practices, including recent major upgrade projects undertaken by Los Angeles and New York.

Acknowledging the needs of local government and to ensure whole of sector buy-in and applicability, the M30 Specification was developed with input from a number of knowledgeable parties including the NZ members of the AS/NZS 1158 review panel, Auckland Transport (AT), Christchurch City Council, and NZ lighting designers/suppliers. The specification includes a regularly updated list of accepted luminaires that meet a robust set of acceptance criteria.

Taking a "one network" perspective, the M30 document sets out the requirements for the lighting design, technical performance, luminaire selection and installation requirements for the lighting of roads, cycle ways, footpaths, tunnels, under and over-passes, and bridges built as part of the State Highway and local authority roading networks.

Safety Benefits

The safety benefits from use of white light in areas of mixed use are significant. White light delivers vastly better colour contrast and colour recognition which has been proven to have significant impacts on driver reaction times. This improved contrast and colour rendition also provides greater pedestrian security and comfort in public areas and also has an impact on crime prevention as reporting is more accurate and CCTV coverage more effective. M30 specifies 4000K as the preferred colour temperature being an internationally accepted value that minimises blue light generation (a potential health concern) while optimising energy efficiency.

Additional benefits such as improved conspicuity of road markings are being researched both in NZ and overseas. There is also ongoing research into optimisation of the light technical parameters used in road lighting design, particularly in the area of uniformity and contrast.

Green lighting

One area where M30 will improve the standards of road lighting in New Zealand is in regard to environmental effects.

Spill light (or backlight), glare and upward waste light (sky glow) are all lighting effects that have the potential for varying degrees of intrusiveness to both vehicles and residents living near lighting installations. M30 endeavours to go further than the AS/NZS1158 series in mitigating these adverse effects by limiting luminaire tilt angles to no more than 5 degrees, and the luminaire Upward Waste Light Ratio (UWLR) to below 1% of the total light output

Adherence to the principles of the International Dark-Sky Association (IDA) must be demonstrated as part of the luminaire assessment process, and achievement of Greenroads credits is encouraged.

Smart lighting

M30 allows for the future development of “smart” networks incorporating the lighting infrastructure through the minimum requirement to use dimmable drivers compatible with a recognised open source communications protocol. The use of a central management system is not specifically required, with the specification leaving such decisions to the road controlling authority.

Leadership for change

While the benefits for improved safety are inherent in LED road lighting, the overriding drivers for change are the reduced energy costs and reduced whole of life road lighting costs.

The impetus behind the development of M30 was a desire to show leadership and encourage road controlling authorities to adopt energy efficient LED road lighting as a priority, and to provide a mechanism for local authorities to effect that change. As the principal investor in road lighting infrastructure, the authors believe the Transport Agency has a duty to ensure infrastructure funding achieves the best economic and safety outcomes. LED road lighting delivers on both.

The Transport Agency is confident that LED road lighting has reached a point where it should be the default technology for all future Category P and Category V road lighting applications. The key driver behind M30 is to accelerate that uptake.

Local government and industry were looking to the Transport Agency to take the lead in promoting white light through the use of LED road lighting but the Transport Agency's State highway lighting network represents something like approximately 22,000 luminaires out of about 350,000 in the country. Thus the Transport Agency is a small player in terms of its own assets, but the direction provided by the M30 specification should greatly assist local authorities in developing proposals for uptake of LED road lighting for both new projects and upgrades of existing lighting infrastructure.

The Transport Agency is building a 'model business case' to help lighting asset managers to fully understand all aspects of the case for investment in conversion of existing lighting to LED. The business case development process will include a comparison of the whole of life cost of the options of maintaining an existing installation and the alternative of conversion to LED. A spreadsheet to assemble the cost estimate data and perform the present value (PV) calculations is also being built. This spreadsheet tool will streamline the application of the Transport Agency's Economic Evaluation Manual (EEM) Simplified Procedure 1 (SP1) for Road Renewals.

Accelerating uptake for upgrades

The Transport Agency wishes to accelerate the uptake of LED road lighting, as the cost of switching to LED technology on the roading network is far less than the cost of doing nothing.

For new build projects, the adoption of LED road lighting is a relatively straightforward exercise, but the Transport Agency has also been assessing the economics of accelerated LED replacement programmes for existing infrastructure. In almost every scenario, and regardless of the age of existing road lighting assets, the cost of not converting to LED is far greater than the cost of retaining existing assets. This is a very rare investment opportunity.

The challenge for the Transport Agency of how to fund accelerated replacement and bring all road controlling authorities (local authorities) on board is acknowledged. As the funder of approximately half of all local and territorial authority road lighting infrastructure, the Transport Agency has a responsibility to ensure funding achieves the most cost-effective outcomes which, in the case of most Category P roads, will be LED.

REG best practice

The road lighting case study put up by the Best Practice Asset Management Team within the Road Efficiency Group – a collaborative of road-controlling authorities established in 2012 – provides conclusive evidence.

The longer the delay replacing high pressure sodium (HPS) luminaires on Category P roads the more it costs. The Transport Agency is committed to supporting road controlling authorities that can show the benefits of an accelerated replacement programme. Although there are some subtleties around accelerated replacement of HPS luminaires on Category V roads, the economics are still likely to be compelling.

The long term cost savings obtained by replacing HPS luminaires with LEDs are such that in many instances the case to replace now, rather than wait until the luminaire is at the end of its life, is also persuasive. Local authorities are nevertheless holding back. In many instances their disinclination to act reflects a reluctance to find the money needed to make the initial investment in conversion to LED.

Summary/conclusion

LED road lighting is proving to be the lowest whole of life cost lighting option in almost all situations – for new and renewal of existing installations. The Transport Agency therefore expects that LEDs will be an included option in all future road lighting investment proposals. In the Transport Agency's economic evaluation terms, LEDs may prove to be the 'do-minimum' option in most circumstances.

The issuing of a clear statement outlining the Transport Agency's position on the technical and economic viability of LED road lighting was intended to give the local government sector the confidence to move forward with investment in asset upgrades and new lighting projects using technically sound LED solutions based on guidance from M30 specification.

The Transport Agency intends to continue to work with all other road controlling authorities plus EECA and other interested parties to help ensure best value for money for all as the nation's road lighting is converted to LED.

This document is available on the NZ Transport Agency's website at www.nzta.govt.nz

NZ Transport Agency National Office

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Information about LED road lighting

LED (light emitting diode) road lighting offers a number of benefits compared to HPS (high pressure sodium) lighting, including reduced energy and maintenance costs, and better light quality leading to increased public safety. The Energy Efficiency and Conservation Authority (EECA) and the Transport Agency consider, based on the view of industry experts, that LED lighting is now proven and technically mature technology. Despite this, care is needed when purchasing LED lighting equipment to ensure that it is of suitable quality and performance that meets the requirements of AS/NZS1158 and international best practice. Auckland Transport (AT) and Christchurch City Council have both put significant effort into assessing a range of luminaires and associated equipment. We strongly recommend that any road controlling authority considering purchasing LED lighting equipment take note of this work. The soon to be published Transport Agency M30 Specification and Guidelines for Road Lighting Design will also include a list of accepted luminaires that RCA's can refer to. The list will be regularly updated as new equipment is assessed. Before purchasing equipment, other than that already assessed and accepted by either AT or Christchurch City Council or listed in the M30 specification, RCA's should use an assessment process at least as rigorous as that used by these other organisations.

The AT assessment of road lighting options has been published as a case study by REG (the Road Efficiency Group) - <http://www.nzta.govt.nz/projects/road-efficiency-group/case-studies.html>.

The Transport Agency's investment policies are aligned with the use of LED road lighting. Its application is proving to be the lowest whole of life cost lighting option in almost all situations - both for new and renewal of existing installations. The Transport Agency therefore expects that the options considered for a road lighting investment proposal will include LED. In Transport Agency economic evaluation terms, LED may prove to be the 'do-minimum' option in most circumstances.

The Transport Agency and EECA are currently exploring how the uptake of LED road lighting could be accelerated and what the barriers are to councils. We will be engaging with councils over the next few months to assist this work.



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