Assessing the potential cost savings from accelerating the roll-out of LED road lights

Energy Efficiency and Conservation Authority

28 October 2014

pwc

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28 October 2014

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Dear Terry

In accordance with the Contract for Services dated 10 October 2014, we attach our report on the potential cost savings from accelerating the roll-out of LED road lights.

Please do not hesitate to contact us if you would like to discuss any aspect of this draft report

Our report should be read in conjunction with the important notice set out in appendix A.

Kind regards

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Executive summary

Over the next decade, Road Controlling Authorities (RCA) and the New Zealand Transport Agency (NZTA) expect to replace most of the road lights they own with lights based on light emitting diode (LED) technology. LED road lights are expected to deliver road lighting at a lower whole-of-life cost than current road lights, while performing better.

Around 2% of the around 370,0000 road lights in New Zealand use LED technology. The Energy Efficiency and Conservation Authority (EECA) and NZTA, the co-sponsors of this project, have asked PwC to assess whether there are strategic and economic reasons for intervening in the roll-out of LED road lights.

Main findings

The main findings from our analysis are that:

- LED road lights are expected to deliver road lighting at a lower whole-of-life cost than current road lights.
- Over the next decade most road lights in New Zealand are expected to be replaced by road lights using LED technology.
- There is not a strong case for using crown funding to accelerate the roll-out of LED road lights.
- However, there is likely to be a valuable role for EECA and NZTA for targeted interventions such as providing advice to RCAs to ensure the roll-out occurs at the lowest cost to rate payers.
- A comparison of the cash flows under business-as-usual and an EECA intervention scenario shows that an intervention (involving 97,000 road lights) may deliver cost savings of up to net present value$7.5 million over 20 years. The estimate assumes that these savings are:
  - the result of a 15% bulk discount on the purchase price of LED luminaires; and
  - installation cost savings of 5%.

Recommendations

Based on our findings we recommend that:

- EECA and NZTA continue providing support to RCAs (for example by providing advice to RCA in developing business cases).
- EECA and NZTA consider which types of targeted interventions are likely to be effective in promoting the roll-out of LED road lights.

1. Introduction

Over the next decade, Road Controlling Authorities and NZTA expect to replace most of the road lights they own with lights based on LED technology. LED road lights are expected to deliver road lighting at a lower whole-of-life cost than current road lights, while performing better.

Around 2% of the approximately 370,0000 road lights in New Zealand currently use LED technology.[1] The EECA and NZTA, the co-sponsors of this project, have asked PwC to assess whether there are strategic and economic reasons for intervening in the roll-out of LED road lights, so as to accelerate the adoption of this technology.

The purpose of this report is to:

- summarise the economic case for adopting LED technology for road lighting
- provide an overview of the stated intentions of RCAs to roll out LED road lights
- set out potential strategic reasons for intervening in the roll-out of LED road lights
- assess the potential from a targeted intervention to increase the economic benefit from the roll-out of LED road lighting above which will occur without such an intervention.

Process for developing this report

We developed this report based on discussions with stakeholders of LED road lighting, desktop research and economic modelling. As part of the work for this report we:

- reviewed and assessed reports, technical information and cost modelling provided to us by EECA and NZTA
- reviewed information published by larger New Zealand cities to assess their investment plans for road lighting
- held weekly meetings with EECA to discuss emerging ideas and progress
- agreed the inputs used in our economic modelling with NZTA and EECA
- discussed LED related issues and received feedback on key findings of our work from EECA, NZTA, Auckland Transport, and the Ministry of Business, Innovation, and Employment.

[1] Source: EECA and Lighting Council NZ.

2. Findings and recommendations

In this chapter we set out the main findings and recommendations from the analysis in this report. In the remainder of this report we explain how we have reached these findings and recommendations.

Main findings

The main findings from our analysis are that:

- LED road lights are expected to deliver road lighting at a lower whole-of-life cost than current road lights.
- Over the next decade most road lights in New Zealand are expected to be replaced by road lights using LED technology.
- There is not a strong case for using Crown funding to accelerate the roll-out of LED road lights.
- However, there is likely to be a valuable role for EECA and NZTA for targeted interventions such as providing advice to RCAs to ensure the roll-out occurs at the lowest cost to rate payers.
- A comparison of the cash flows under business-as-usual and an EECA intervention scenario shows that an intervention (involving 97,000 road lights) may deliver cost savings of up to net present value$7.5 million over 20 years. The estimate assumes that these savings are
  - the result of a 15% bulk discount on the purchase price of LED luminaires,
  - and installation cost savings of 5%.

Recommendations

Based on our findings we recommend that:

- EECA and NZTA continue providing support to RCAs (for example by providing advice to RCAs in developing business cases).
- EECA and NZTA consider which types of targeted intervention are likely to be effective in promoting the roll-out of LED road lights.

3. Economic case for adopting LED technology for road lighting

Findings

LED road lights are expected to deliver road lighting at a lower whole-of-life cost than current road lights.

In this section we summarise the economic case for adopting LED technology for road lighting.

Cost structure of providing road lighting

The cost of road lighting depends on a range of factors, including:

- the number of road lights needed to provide the quality of lighting required
- the characteristics of the network of roads for which road lighting is provided; this determines the performance characteristics of the road lights that are required to deliver the desired quality of road lighting to major roads, footpaths, etc
- the condition of the road lights currently in operation; the condition affects the amount of maintenance, renewal and enhancement expenditure needed to provide similar or better levels of lighting service to road users
- the road lighting technology used; most current road lights in New Zealand use high pressure sodium (HPS) lights but there is broad agreement that LED is the technology that will replace HPS as the main technology
- operating characteristics, such as the number of hours of operation
- the purchase cost of road lights, the cost of electricity, and the costs of installing and maintaining the lights.

LED technology reduces the whole-of-life cost of road lighting

LED technology provides road lighting services at a lower whole-of-life cost than HPS technology. This means that when considering all the capital, operating and maintenance costs associated with providing road lighting over a representative period to a required level of quality, LED based road lights are cheaper than HPS based road lights.

Whole-of-life cost of road lighting

In figure 3.1 below we compare the whole-of life-cost of a representative LED and a HPS light-bulb representative of New Zealand road lighting needs.

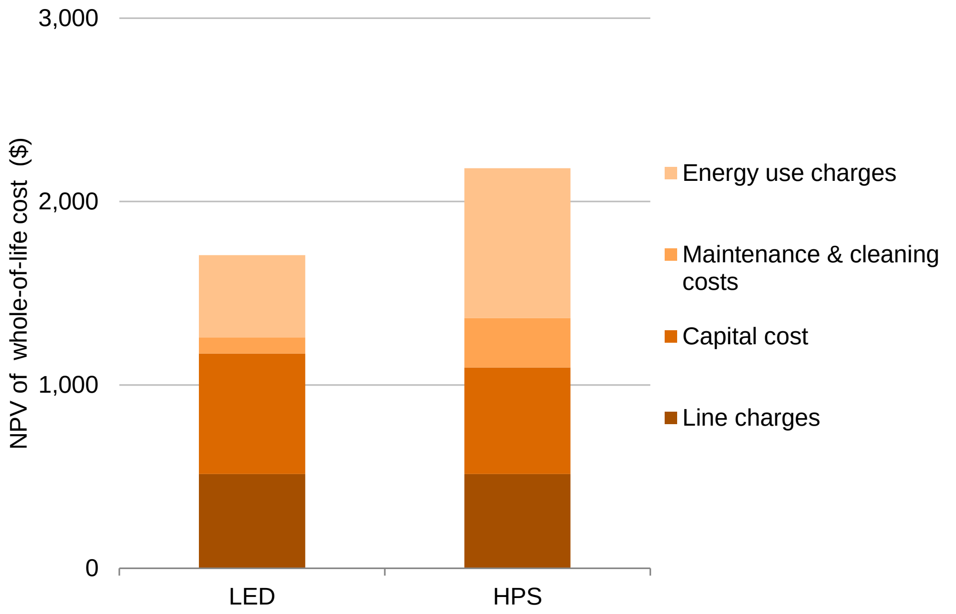
We have estimated these costs as the weighted average of the operating and capital cost of four types of light bulbs. We used their current estimated use in New Zealand roads as weighting factors. The figures are the discounted cashflow of operating and capital costs over 20 years.

The illustration shows that the whole-of-life cost of LED road lights is around 20% lower than that of HPS technology. This difference is made up of

- almost 50% lower energy use charges by the LED light (ie the combination of wholesale electricity prices and retail prices)

- almost 70% lower maintenance and cleaning costs for the LED light[2]
- a capital cost advantage of around 10% for a HPS luminaire. This may reflect actual cost differences (which may change over time given that the technology is relatively new) or reflect the particular assumptions we have chosen in our modelling.

Figure 3.1 Net present value of the whole-of-life-cost of a LED and HPS luminaire, representative of New Zealand roads



Notes: The time period for the NPV calculation is 20 years.
Source: PwC calculations based on inputs from various sources.

We assumed that line charges (ie the charges levied by electricity distributors and the national transmission grid operator Transpower for transporting electricity from the power plant to the road lights) are the same for both representative road lights. [3]

The actual whole-of-life cost savings will depend on the factors listed above, including road types, charges for electricity use (which depend on the Council's/RCA's contract with electricity retailers, and the line charges set by both the local electricity distributor (which vary nationally) and the national transmission operator Transpower.

LED road lights are expected to provide additional benefits

In addition to cost savings, LED road lighting is also expected to provide additional benefits, including increased safety, reduced crime and better environmental outcomes.

Research is underway in New Zealand and around the world to quantify the size of these benefits but conclusive evidence is not yet available. We have therefore agreed with EECA and NZTA to exclude these effects from the analysis in chapter 6. What this means is that an analysis focusing exclusively on savings from lower whole-of-life costs resulting from a government intervention may under-estimate the actual net benefit from road lighting to New Zealanders.

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2 Maintenance costs are the total cost of all maintenance carried out at the service interval including any replacement parts and consumables and labour. Cleaning costs are the costs associated with cleaning the LEDS to keep the light providing consistent light output over its useful life of around 20 years.

3 The line charge seeks to recover the cost of providing capacity for transporting electricity to road lights. As discussed in a separate report by PwC for EECA, the most likely response from distribution companies is to move towards a charging structure that recovers a greater proportion of charges through fixed charges (ie those charges that do not vary with the amount of electricity delivered). This means that lines companies recover a similar amount of cost irrespective of the basis for charging for them.

Below we discuss briefly some of the additional benefits discussed in the literature. The discussion is not meant to be a comprehensive overview of benefits. It is also worth noting that what is perceived by some as a benefit may be perceived as a disadvantage by others.

Enhancing road safety

LED lighting promotes road safety and reduces accidents. LEDs produce high quality white light, which appears to improve driver reaction times to hazards and thereby averts accidents. A study of LED lights that mainly focuses on the Australian market shows that only a quarter of the energy is used to achieve the same driver reaction time as with HPS lighting.[4]

Reducing road crime and improving safety

Studies also show that LED road lights reduce road crime and improve actual and perceived safety. The white light produced by LEDs improves visibility and allows pedestrians to recognise objects, facial expressions and possible intentions earlier. This allows pedestrians to better identify and avoid threats, while also increasing perceived night time security.

For example, research by the U.S Department of Energy shows that improvements to the Los Angeles lighting system (involving the retrofitting of 150,000 road lights to LED throughout the city) contributed to a 10.5% reduction in reported incidents of road crime and vandalism compared to before the LED roll-out started in 2008/2009.[5]

Community social benefits

Social benefits such as an increase in the city's liveliness, increased urban desirability and enhanced civic pride are intangible and therefore difficult to measure.

LED technology allows better control of road lights which can reduce unwanted spill light and the abatement of neighbourhood light nuisance. The reduction of light pollution can affect people's mood, navigation in birds and insects, animals' lifecycles and flowering in plants.[6] It may also contribute to healthier sleep due to less light interference with sleep patterns.

Environmental benefits

LEDs consume less electricity than HPS based light systems. Assuming that at least part of the energy is produced from non-renewable sources, lower energy consumption decreases the emission of greenhouse gases.

For example, energy efficient road lights used by Australian utilities (both LEDs and other energy efficient lighting with electric power supplies) are estimated to reduce Australian road lighting energy consumption and greenhouse gas emissions by at least 47%.[7]

Unlike HPS lights, LEDs do not contain any mercury. Bulbs that contain mercury require recycling to avoid any substances contaminating the ecosystem.

However, depending on the type of LED used, some can have some negative environmental impacts. For example, some may contain high levels of lead, iron, copper and nickel.[8] These substances are harmful to the environment and human health and therefore may require effective recycling.

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4 Towards More Sustainable Road Lighting (July 2014). Practice Note prepared by Next Energy and Strategic Lighting Partners for the Institute of Public Works Engineering Australasia Limited (IPWEA) and the Australian Centre of Excellence for Local Government (ACELG) at the University of Technology, Sydney (UTS). www.ipwea.org/practicenotes

5 US Dept. of Energy, "The City of Los Angeles LED Roadlight Program" http://www1.eere.energy.gov/buildings/ssl/text-alt_consortium-la_video.html

6 Road lighting in Wellington City: Making a case for adopting LED lighting, p. 16. http://wellington.govt.nz/~/media/your-council/meetings/Committees/Transport-and-Urban-Development-Committee/2014/08/Report8Attachment1.pdf

7 Towards More Sustainable Road Lighting (July 2014). Practice Note prepared by Next Energy and Strategic Lighting Partners for the Institute of Public Works Engineering Australasia Limited (IPWEA) and the Australian Centre of Excellence for Local Government (ACELG) at the University of Technology, Sydney (UTS). www.ipwea.org/practicenotes

8 European Commission: Science for Environment Policy (2011). http://ec.europa.eu/environment/integration/research/newsalert/pdf/229na2.pdf

4. Road Controlling Authorities' intentions to roll out LED road lights

Findings

Over the next decade most road lights in New Zealand are expected to be replaced by road lights using LED technology.

In this section we summarise our assessment of RCAs' intentions to roll out LED road lights.

Why we need information on roll-out intentions

EECA estimates that there are 376,671 road lights in New Zealand. An important part of the analysis in this report is to assess:

- the extent to which road lights owners have plans for rolling out LED road lights to the lights they maintain and operate
- the speed at which existing HPS lights are expected to be replaced and what factors may affect roll-out intentions.

Based on the analysis in this section we have developed an assumption of the number of road lights that may benefit from a government intervention aimed at bringing costs savings in the roll-out of LED road lights.

We discuss the strategic reasons for a government intervention to promote the LED roll-out in chapter 5, and the results from our economic assessment of the scope for savings of an intervention in chapter 6.

Data sources for our estimates of roll-out intentions

We have relied on two types of information for assessing LED roll-out intentions:

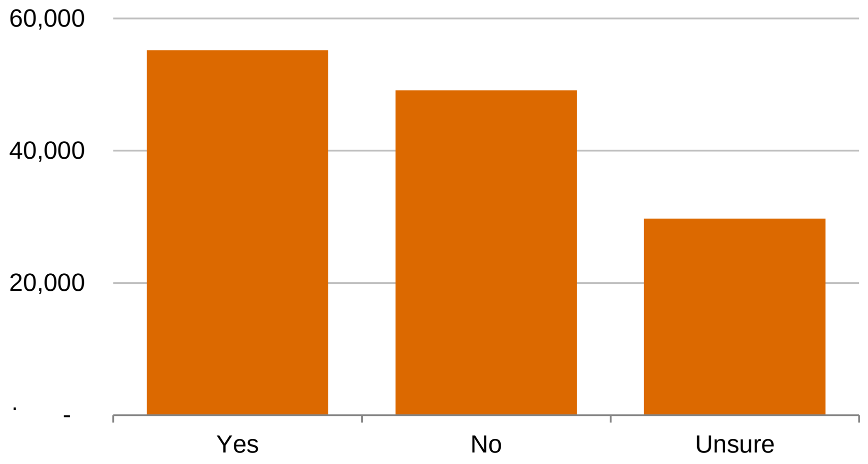
- A road lighting survey conducted in July 2014 by the New Zealand Society of Local Government Managers (the SOLGM survey) covering around half (38 out of 67) of RCAs.
- Information on LED roll-out intentions published by cities with populations of more than 100,000.[9]

The figure below shows the responses to the question "Does your Council have plans to undertake an accelerated road lights renewal programme, converting to LED?"

Around half of the 150,000 road lights covered by the survey are owned by RCAs that stated they had plans for an accelerated roll-out. The remaining lights are owned by councils that do not have plans for acceleration, or have not yet decided whether they will develop a plan for accelerating the roll-out.

9 We chose to focus on cities with more than 100,000 to limit the amount of overlap between responses in the SOLGM survey. These cities are Auckland, Christchurch, Dunedin, Hamilton, Napier, Tauranga, and Wellington.

Figure 4.1 Number of road lights managed by RCAs (accelerated roll-out question in SOLGM survey, grouped by response)



Source: PwC based on SOLGM survey (2014).

In Appendix B we discuss some additional characteristics of survey respondents.

One of the main shortcomings of the SOLGM survey for assessing roll-out intentions is that the questions aim to reveal councils intentions for *accelerated* roll-out of LED road lights. This means that we do not have direct information on:

- councils' 'un-accelerated' roll-out of road lights (expected to be part of their business-as-usual maintenance cycle); or
- the period over which LED road lights are expected to be installed under business-as-usual scenarios.

We discuss other limitations of our assessment of intentions based on this survey at the end of this chapter.

Many RCAs intend to roll out LED technology over the next 10 years to a majority of their road lights

Our assessment of published plans and a survey commissioned by EECA shows that many RCAs intend to roll out LED technology over the next 10 years.

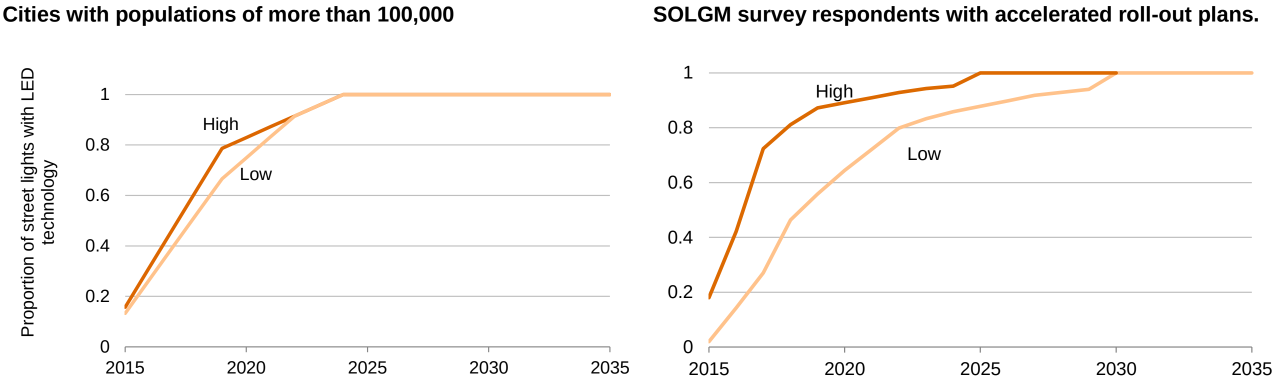
The left panel in figure 4.2 shows that in cities with populations of more than 100,000, 80% of road lights are planned to be replaced with LED lights in the next five to six years. All lights are expected to be replaced with LED technology within 10 years.[10]

The right panel shows that SOLGM survey respondents with acceleration plans in place intend to roll out LED lights to 80% of their road lights within three to seven years.[11] The remaining lights are planned to be rolled out over a longer period. In the chart we assume that all road lights are rolled out by 2025 and 2030 in the high and low speed scenarios respectively (we have cut off a residual of road lights which our modelling of survey data suggested would take a long time).

[10] Some cities do not have a published roll-out timeline and we have estimated their roll-out speed based on cities for which we have information. We assumed that under a high roll-out speed they would install LEDs in all road lights within five years. Under low roll out speed we assumed that they would install LEDs in all road lights within eight years.

[11] The high and low speed estimates are based on roll-out ranges provided by respondents.

Figure 4.2 Stated LED road light roll-out intentions



Source: PwC based on RCAs published information and SOLGM survey (2014).

Larger New Zealand cities intend to roll out lights

Based on our assessment of council's stated intentions of cities with populations of more than 100,000, we found that:

- most intend to roll out LEDs fairly quickly
- most have reflected their plans to roll out LEDs as part of their long-term plans
- of the larger cities most have recently started replacing their road lights with LED lights already, however, the uptake is in the early stages.

RCAs in the survey

Based on our assessment of survey responses, we found that among RCAs with plans to undertake an accelerated roll-out of LED lights:

- most would like to roll out LEDs fairly quickly
- most consider including a LED roll-out as part of their long-term plans, but have a decision to commit often depends on various factors (see table 4.1 below)
- relative to larger cities, their views on the roll-out speed and volume of road lights to be installed are less fully formed.

Factors affecting decisions for accelerated roll-out

Table 4.1 summarises the factors survey respondents listed in relation to a decision to accelerate renewal of roads light with LEDs.

Most of the RCAs appear to be considering accelerated roll-out. This suggests that they know about the benefits from LED lights.

Table 4.1 Issues listed by survey respondents in relation to a decision to put in place a plan to accelerate LED roll-out (figures are number of times a factor was listed)

Decision	Issue	Yes	Unsure	No
Start time	Accelerated roll-out is under consideration	6	5	
	Depends on NZTA incentives			1
	Updating existing strategy	1		
	Depends on funding	2	1	
	Depends on Council decision	1	1	
	Part of long term plan	3	1	1
	Depends on NZTA involvement		1	
Number of replacements	Depends on budget/replacement cost	1	3	

Source: PwC based on SOLGM survey.
Note: More than one reason possible per respondent.

Where we have some data on roll-out speed and amount, the roll-out speed and replacement rates vary. More than half of the planned roll-outs speeds were similar to or faster than in larger cities.[12]

For respondents with plans for accelerated funding, budget and planning related questions seems to be an important factor in their decision to accelerate roll-out. There are possible interpretations for this, including that:

- councils need to do further work to understand the cost of LED road light roll-out, assess their budget constraints and plan for efficient investment in the long term
- councils face funding constraints.

Three of the respondents had comparably slow roll-out profiles and:

- appear to replace their existing HPS road lights with LEDs as part of their business-as-usual road lighting programme. This means that the roll-out speed is determined by the council's business-as usual light bulb replacement rather than being implemented faster.
- are considering acceleration and a decision to do so depends on their long-term plan being accepted.

Limitations of our assessment of survey responses

As discussed above, one of the main shortcomings of the survey for assessing *overall* roll-out intentions is that the questions aim to reveal councils intentions for *accelerated* roll-out of LED road lights. This means that we do not have direct information on councils that may plan to replace the road lights as part of their business-as-usual maintenance cycle. Other limitations which affect the accuracy of our roll-out profiles include:

- Councils may suffer from optimism bias, ie their desired replacement rates may be higher than is practical.
- In particular respondents without plans in place may have been answering tactically if they expected that their answer may have financial implications.

12 Some of the roll-out plans appear to be at the early stages.

5. Strategic reasons for intervening in the roll-out of LED road lights

Findings

There is not a strong case for using crown funding to accelerate the roll-out of LED road lights.

However, there is likely to be a valuable role for EECA and NZTA for targeted interventions such as providing advice to RCAs to ensure the roll-out occurs at the lowest cost to rate payers.

In this section we set out potential strategic reasons for intervening in the roll-out of LED road lights.

There does not appear to be a case for a nationwide intervention

In a ministerial briefing from 6 June 2014, EECA contemplated a package of financial and non-financial interventions aimed at accelerating the uptake of LED road lighting in New Zealand. The aim of the package of interventions was to create whole-of-life cost savings, reducing the cost of road lighting for New Zealanders. As part of this package EECA considered that a co-ordinated roll-out over seven years would be feasible.

We do not consider that there is a case for a nation-wide intervention. Based on our assessment of roll-out intentions in chapter 4, larger cities and many of the smaller RCAs already have plans to roll out LED technology to a majority of road lights over a similar time frame to that envisaged by EECA in its ministerial briefing. It is therefore likely that for many road lights, while an intervention would create whole-of-life savings, these would not be additional to those realised under business-as-usual.

Given the lower whole-of-life cost of LED lights compared to HPS lights (illustrated in chapter 2 and shown in many other studies) there appears to be a strong financial incentive for councils to invest in LED lights. In addition, since half of councils' transport related expenditure is funded by NZTA, it has a strong financial incentive to ensure councils make efficient asset management decisions (for example, so that funds are freed up for other transport related initiatives).

There may be benefits from targeted interventions

The roll-out of LED lights involves replacing a proven and well known technology (HPS) with a new technology. Given the relatively limited experience many RCAs are likely to have with this technology, in the short term councils may have to commit resources over and above those they normally require to manage road lights. They also may require more access to capabilities they normally need less off.

RCAs may benefit from targeted interventions in the roll-out of road lighting. For example, some of the survey responses implied they would benefit from better understanding the assumptions for estimating the cost of a roll-out (for example, to use as part of their annual and longer term planning).

Further work would be required to recommend specific type of interventions (which may vary across councils as their individual circumstances may vary). At a generic level, ranging from less to more interventionist, interventions may include:

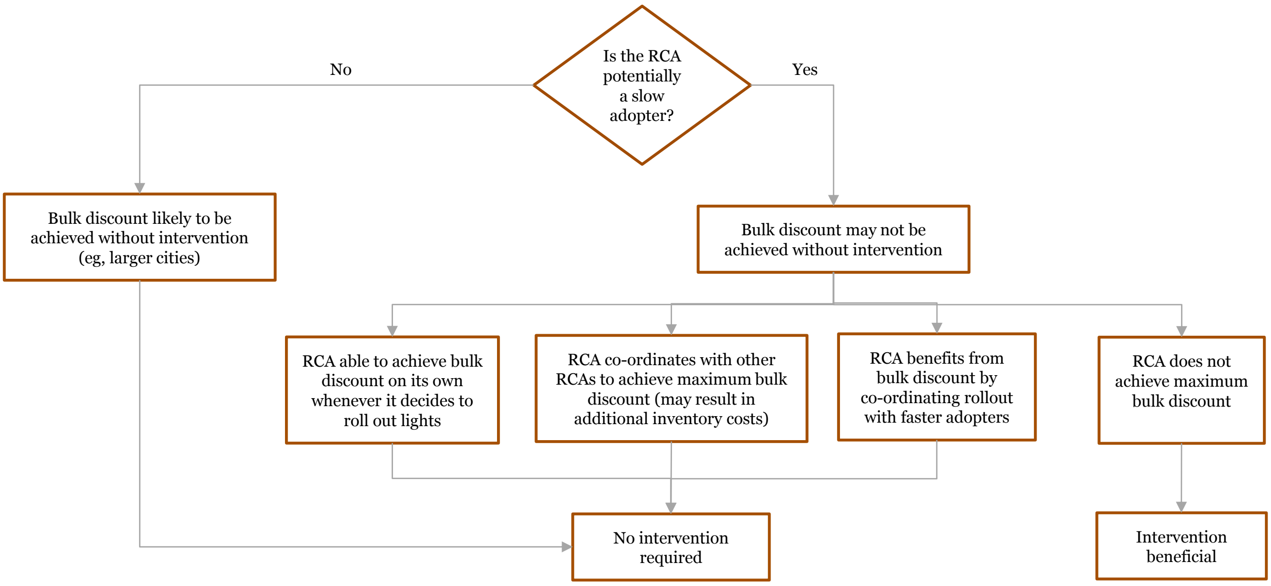
- advice to RCAs, for example helping with business planning
- establishing a platform for sharing experience among road lighting asset managers and engineers
- assisting RCAs at relevant stages of the LED procurement process so that RCAs have access to the best prices (including through bulk discounts)
- assist RCAs at relevant stages of the LED installation process so that RCAs have access to the best installation prices (including through installation bulk discounts)

- assisting with financial planning
- providing financial assistance to those councils that cannot afford road lights.

Illustration of when it may be appropriate to intervene

Figure 5.1 sets out circumstances under which RCAs may benefit from an intervention to achieve bulk discounts and circumstances in which they may achieve bulk discounts without intervention.

Figure 5.1 Under which circumstances may an intervention result in cost savings that would not be achieved under business-as-usual?



6. Assessing potential cost savings from a targeted intervention

Findings

A comparison of the cash flows under business-as-usual and an EECA intervention scenario shows that an intervention (involving 97,000 road lights) may deliver cost savings of up to net present value $7.5 million over 20 years. This estimate assumes that these savings

- are the result of a 15% bulk discount on the purchase price of LED luminaires, and installation cost savings of 5%
- would not be achieved without intervention.

In this section we assess the potential cost savings from a targeted intervention in the roll-out of LED road lights. This report does not focus on specific interventions for different road classifications.

Modelled intervention

For the purpose of the economic assessment in this report we have modelled two interventions:

- a 15% bulk discount on the capital cost of road lights [13]
- a 5% discount on installation costs.[14]

Up to 100,000 lights may benefit from an intervention

We assume that approximately 97,000 of the c.370,000 road lights belong to RCAs which might not have the size and/or capacity to secure a bulk discount of 15% or achieve a 5% discount per unit from more rapid installation.

We agreed to focus our assessment on 96,688 road with EECA based on a discussion of the roll-out intentions which we have summarised in chapter 4.

To arrive at this number we took into account the following:

- EECA's estimate of the number road lights in New Zealand
- the number of road light in cities with populations of more than 100,000; we assumed that all of these are able to achieve the maximum amount of savings
- the number of road lights owned by NZTA; we assume that NZTA does not require assistance to achieve the maximum amount of savings
- the rest of the road lights are assumed to have the properties of the sample in the SOLGM survey
- a discussion with EECA, which suggested that half of the yes survey respondents may not be in a position to fully secure the benefits resulting from a LED roll-out.[15]

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13 Evidence from the UK suggests that bulk discounts of 15% can be achieved on orders of 10,000 or more LED road lights.

14 Based on discussions with EECA. This figure requires further testing, for example with a road lighting engineering firm.

15 In the meeting with EECA and NZTA on Thursday, 9 October 2014, we agreed to assume that 50% of the survey respondents that stated they had plans to accelerate the roll-out would benefit from the intervention.

The table below shows the steps we followed to get from the estimated number of road lights in New Zealand (376,671) to an estimate of the number of road lights that are assumed to require intervention to benefit from bulk discounts and installation cost discounts (96,688).

Table 6.1 Steps to estimate the number of road lights assumed to benefit from an intervention

	Number of road lights
A. Estimate of total number of road lights (source: SOLGM survey)	376,671
of which	
B. Number of lights in cities with populations of more than100,000 (source: PWC calculations based on RCA plans and EECA information)	234,217
C. Estimate of number of road lights owned by NZTA (source: NZTA)	20,700
D. Number of road lights assumed to have characteristics of survey sample (D = A – B – C)	121,754
E. Number of roads lights owned by RCAs assumed to have plans to accelerate LED roll-out (source: PWC estimate based on EECA survey)	50,132
F. Estimated number of road lights assumed to require intervention to benefit from bulk discount (F= D – 0.5x E)	**96,688**

Source: PwC based on EECA, published information by larger cities and SOLGM survey (2014).
Note: We assume all growth in road lighting is in LED road lights. New lights are therefore excluded from our analysis.

Assumed roll-out profiles

To develop a business-as-usual roll-out profile we assumed that: [16]

- Road lights owned by RCAs with yes and unsure responses follow the roll-out profile of major cities (shown in figure 4.2).
- Road lights owned by no-respondents follow the low roll-out speed profile of the yes survey respondents (also shown in figure 4.2).

The figure shows the resulting roll-out profile. Most road lights are rolled out within the first 10 years of the roll-out, with a full replacement after 15 years.

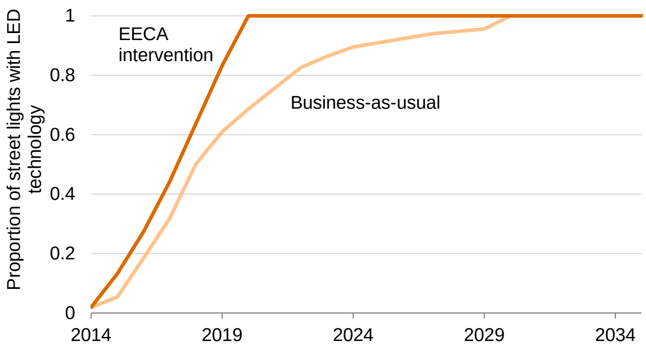
For the EECA intervention we assumed the roll-out would occur over seven years.[17]

As explained further below the roll-out speed is not a major driver of savings from an intervention (compared to business-as-usual).

16 Note, the data underpinning the profile is based on the survey undertaken with the different RCAs. As PWC was not involved in the survey design and execution, the roll-out profile might lack robustness (depending on the objectivity, reliability and validity of the survey).

17 Source: EECA.

Figure 6.1 Assumed roll-out profile under business-as-usual and under an EECA intervention



Source: PwC based on EECA, information published by larger cities and SOLGM survey (2014).

Cost savings modelled in this report

In the chart below we set out our approach to estimating the net benefit to New Zealanders affected by the intervention.

We assume that there are no changes in outputs from the intervention (ie the lighting services provided under business-as-usual and the EECA intervention are the same. We also exclude from the calculation any additional benefits that LED road lighting may provide over and above the whole-of life- savings (refer to discussion in chapter 3).Given that there is no change in benefit, we focus on differences in the net present value of cash flows under the business-as-usual and the EECA intervention.[18]

Figure 6.2 Approach to estimating net benefits from the EECA intervention

Cost savings from EECA intervention that achieves a 15% bulk discount on LED luminaires, a 5% discount on installation costs, and a faster roll-out

=

Cost of street lighting under business-as-usual
RCAs are assumed to install 96,668 LED street lights
as per roll-out profile in figure 6.1. RCAs pay the full capital and installation costs.

−

Cost of street lighting under EECA intervention
RCAs are assumed to install 96,668 LED street lights as per roll-out profile in figure 6.1. A 15% bulk discount on capital costs and a 5% installation cost discount applies.

Source: PwC.

Our modelling assumes that the lifecycle of an LED luminaire is 20 years (at the end of which it would need to be replaced). All modelling below is over 20 years, except for the sensitivity analysis in figure 6.4. (We explain the reasons for this below.)

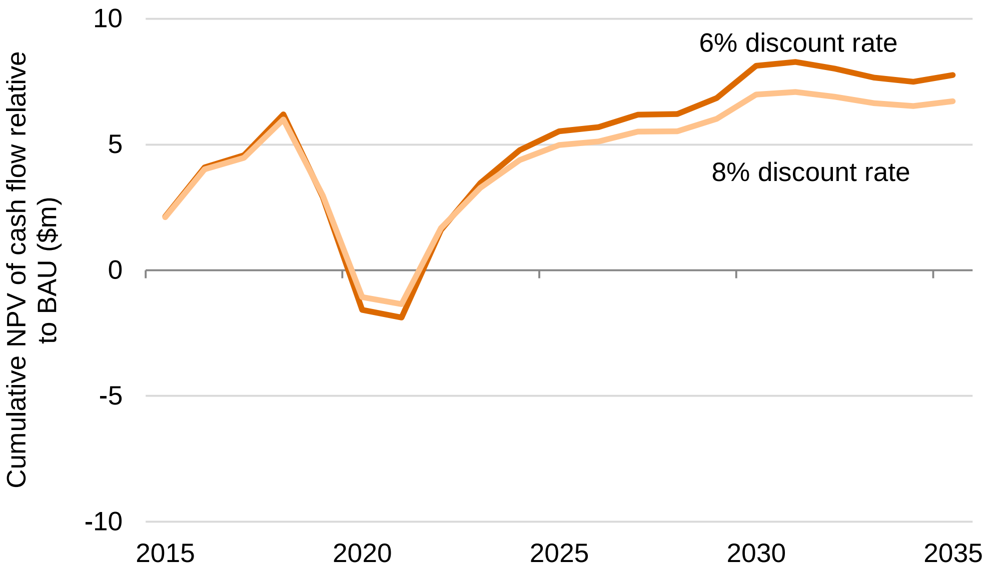
[18] A fuller cost-benefit analysis would also consider the net change in administration cost. For example, if bulk discounts are achieved through centralised purchasing, this would result in cost savings within RCAs. However, at least some of this cost would be shifted to the organisation that coordinates the centralised purchasing.

Estimated savings from the intervention

Figure 6.3 shows the cumulative net present value of the EECA intervention. After 20 years the savings relative to business as usual are around $7.5million.As a default discount rate we used 6%, and show a sensitivity of 8%.

As shown in figure 6.1, up to 2019 the volume of roll-out is similar. After that the roll-out volume increases relative to the business as usual. The higher early capital cost of the EECA intervention roll-out leads to the dip in relative cash flows around 2020 shown in figure 6.3

Figure 6.3 Cumulative net-cash flow of EECA intervention relative to business-as-usual



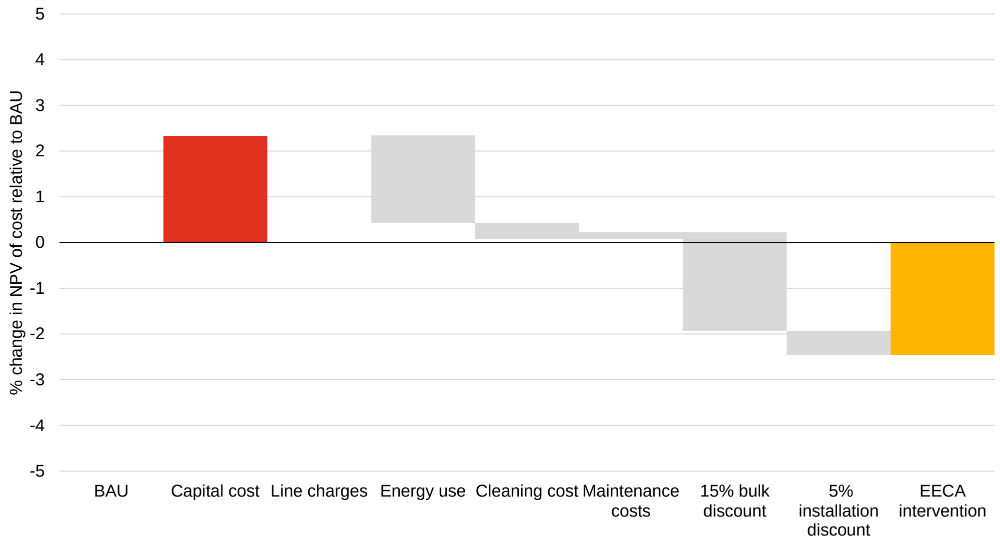
Source: PwC modelling
Note: All values are in real 2014 dollars.

Composition of cost differences

Having assessed that the net present value of cash flow savings is around $7.5million after 20 years, figure 6.4 sets out the main components of cost differences between business as usual and the EECA intervention.

Overall, costs are around 2.5% lower under the EECA intervention. The figure shows that accelerating capital costs earlier leads to an increase in (the net present value of) costs of almost 2.5% compared to business-as-usual. This cost increase is more than offset by cost savings in other cost components. The main sources of saving are the bulk discount on luminaire capital costs and reduced energy use, each of which are estimated to reduce the NPV of costs by around 2%.

Figure 6.4 Components of cost savings from EECA intervention compared to business-as-usual

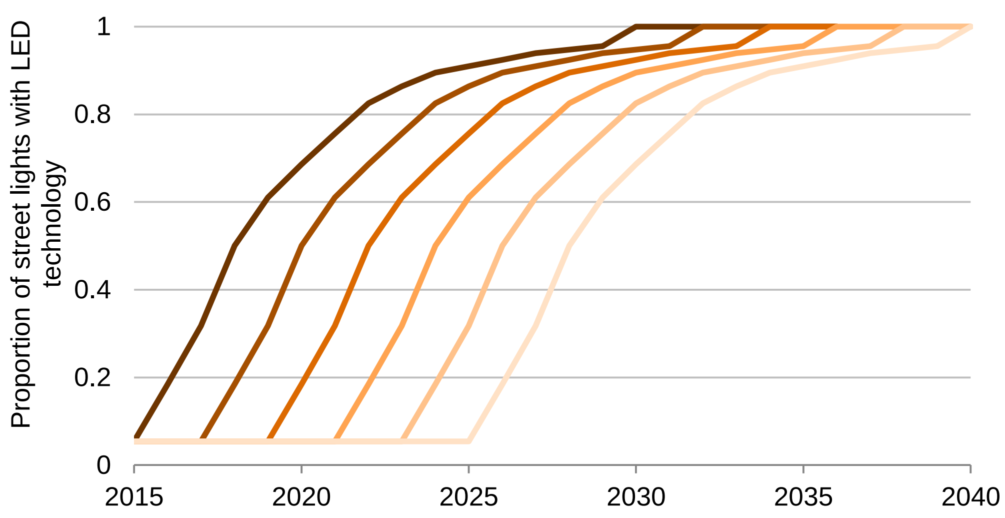


Source: PwC modelling.
Note: All calculations are expressed in percentage terms relative to BAU, which is represented by the black horizontal line through zero. Line charges are assumed to be the same under BAU and the EECA intervention, and therefore do not contribute to cost savings.

The effect of delays in the BAU roll-out increase

It is possible that while the councils overall may plan to follow a roll-out profile under BAU as that described in figure 6.1, the start of the roll-out may be delayed. Without the momentum in the first year, the roll-out may be pushed forward, resulting in the s-shaped rollout profiles like those in figure 6.5.

Figure 6.5 Assumed roll-out profiles for BAU and s-shaped sensitivities



Source: PwC based on EECA, information published by larger cities and SOLGM survey (2014).

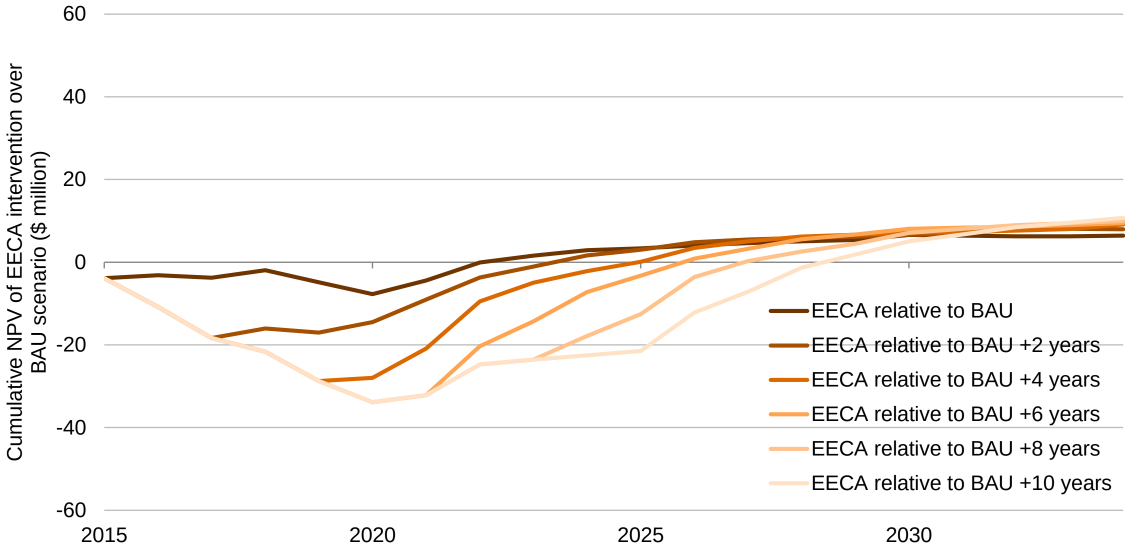
To assess the effect of such delays on the present value of savings, we have compared the cumulative cash flows under the EECA intervention with the business-as-usual cash flows being successively rolled forward by two year intervals (ie using the roll-out schedules in the figure above).

We have assumed that it is feasible to delay the roll-out under the BAU without affecting services levels and that there are no consequences for the cash flows in later years (for example, higher expenditure due to need to catch up with deferred maintenance and replacement).

It is very unlikely that a longer deferral (eg, 10 years) would be without consequence. However, we expect the consequences of a deferral to be not materially significant for services and whole-of-life costs in a long-run. The chart in figure 6.6 below needs to be interpreted accordingly. In particular, in practice the difference between BAU and the EECA intervention would be less than that suggested by delaying the BAU roll-out because councils could not delay spending under BAU without consequences.

Under the assumptions made, the chart illustrates that delays in BAU roll-out delays the break even. This is the result of capital costs being deferred (without any assumed consequence for costs and service outputs). However after 20 years the cumulative cash flows are similar, which suggests there is little need for targeted intervention.

Figure 6.6 NPV of successively delaying the roll-out start under business-as-usual.



Source: PwC modelling.

Appendix A Important notice

This report has been prepared solely for the purposes stated herein and should not be relied upon for any other purpose. We accept no liability to any party should it be used for any purpose other than that for which it was prepared.

This report is strictly confidential and (save to the extent required by applicable law and/or regulation) must not be released to any third party without our express written consent which is at our sole discretion.

To the fullest extent permitted by law, PwC accepts no duty of care to any third party in connection with the provision of this report and/or any related information or explanation (together, the "Information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation, negligence) or otherwise, and to the extent permitted by applicable law, PwC accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the Information.

We have not independently verified the accuracy of information provided to us by EECA, NZTA and other sources. Accordingly, we express no opinion on the reliability, accuracy, or completeness of the information provided to us and on which we have relied in our analysis.

The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this report are based on information available as at the date of the report.

We reserve the right, but will be under no obligation, to review or amend our report, if any additional information, which was in existence on the date of this report was not brought to our attention, or subsequently comes to light.

We have relied on assumptions (including forecasts) prepared by others which, by their nature, are not able to be independently verified. Inevitably, some assumptions may not materialise and unanticipated events and circumstances are likely to occur. Therefore, actual results in the future will vary from the forecasts upon which we have relied. These variations may be material.

This report is issued pursuant to the terms and conditions set out in our contract dated 10 October 2014.

Appendix B Characteristics of survey respondents

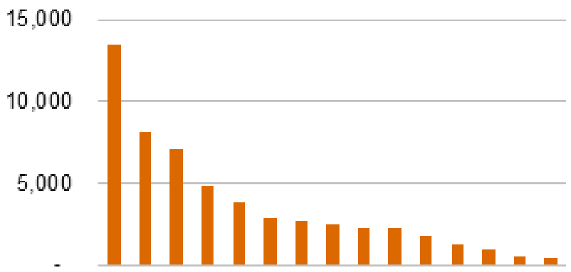
RCAs that intend to accelerate the roll-out of LED road lights differ in the number of road lights they manage and their planned roll-out speed. The number of road lights per RCA ranges from more than 10,000 to fewer than 1,000.

In figure B1 we show the number road lights by response, ordered by size. Most of the yes and no responses were from RCAs with fewer than 5,000 road lights. In assessing the qualitative responses, we found that RCAs with fewer than 5,000 roads were diverse in their survey response profile.

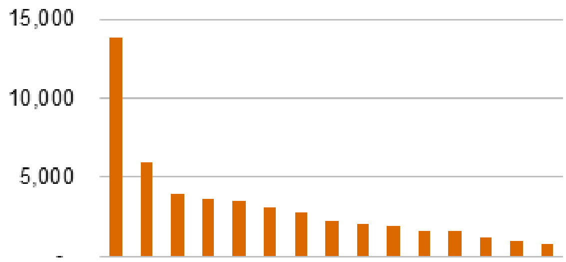
Half of the respondents who did not seem to have clear roll-out intentions (and which we classified as unsure') own more than 5,000 road lights. In assessing the qualitative responses, we found that almost all of the unsure respondents considered accelerating the LED roll-out, but may face barriers that may prevent them from currently committing to an accelerated road light renewal programme (see table 4.1).

Figure B1 Number of road lights managed type of RCA response

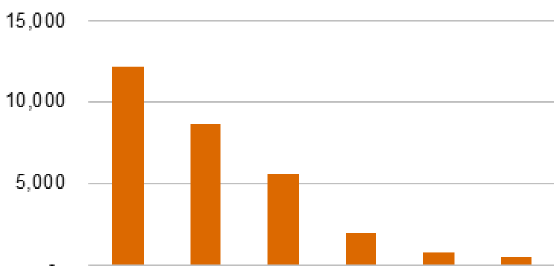
Yes responses



No-responses



Unsure responses



Source: PwC based on SOLGM survey.