18 December 2018

Dear [Redacted]

I refer to your request received 23 November 2018, pursuant to the Official Information Act 1982 (the Act):

"...I would be obliged if you would provide me with the following:

1. Any Policy Documents, in draft or otherwise pertaining to Daytime Running Lights for Motor Vehicles in New Zealand.

2. Any research data or articles that you are in receipt of.

3. Any legislative documentation or policy papers pertaining to the same.

4. Any documents, memos, advisory papers that the Ministry has compiled or is in receipt of pertaining to the possible implementation of legislation pertaining to Running Lights.

5. Any cost benefit, social versus economic analysis documents pertaining to the same."

The table below lists the documents which fall within the scope of your request, with comments indicating where information was withheld, and why.

In the interests of providing you with a prompt reply, please note that the Ministry has only considered material produced since 2003, as older material refers to incandescent bulbs which is no longer relevant, or the material is included in the 2006 paper or the two reports from 2003 noted below. This older material is not being formally withheld and if you are interested in these additional papers, the Ministry can compile a list of these documents.
<table>
<thead>
<tr>
<th>Date</th>
<th>Name</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2003</td>
<td>A review of daytime running lights. National Roads and Motorists' Association Limited report</td>
<td>Refused under section 18(d) as the information is publically available.</td>
</tr>
<tr>
<td>October 2003</td>
<td>Daytime Running Lights Deliverable 3: Final Report European Commission report</td>
<td>Refused under section 18(d) as the information is publically available.</td>
</tr>
<tr>
<td>22 November 2006</td>
<td>Daytime Running Lights/Headlights-On Policy (briefing) [WGTA8106 refers]</td>
<td>Names of Ministry officials withheld under section 9(2)(a) to protect the privacy of natural persons.</td>
</tr>
<tr>
<td>22 November 2006</td>
<td>Appendix 1: Benefit Cost Analysis of a range of options</td>
<td>Names withheld under section 9(2)(a) to protect the privacy of natural persons.</td>
</tr>
<tr>
<td>Min's concerns with</td>
<td></td>
<td>This is an informal note to the Minister produced in response to a request for further advice.</td>
</tr>
<tr>
<td>WGTA8106</td>
<td>22 November 2006</td>
<td>Released in full.</td>
</tr>
<tr>
<td>Daytime running lights</td>
<td></td>
<td>This is an informal note to the Minister produced to aid discussions for an agenda item at a scheduled meeting.</td>
</tr>
<tr>
<td>feedback</td>
<td>22 November 2006</td>
<td>Some information out of scope.</td>
</tr>
<tr>
<td>Vehicle Standards</td>
<td></td>
<td>Refused under section 18(d) as the information is publically available.</td>
</tr>
</tbody>
</table>
The Ministry has not advanced any recent work on daytime running lights since concluding, as outlined in the 2006 paper attached, that the potential safety benefits of regulating daytime running lights did not outweigh the potential costs.

However, the Ministry is aware that the replacement of older headlamps with LEDs has made daytime running lamps both more effective and more efficient. It is for that reason that the Ministry included daytime running lights in both the Vehicle Standards Map and the Vehicle Technologies and Standards Inventory. The Ministry has also noted that investigating the safety benefits of this technology could be advanced as part of the new road safety strategy.

In regard to the information that has been withheld under the Act, I am of the opinion that there are no countervailing considerations that make it desirable, in the public interest, to make the information available.

As part of the Ministry’s policy of proactively releasing information, the documents released under this request for official information will be uploaded to the Ministry’s website within ten working days.
You have the right under section 28(3) of the Act to make a complaint about the withholding of information to the Ombudsman, whose address for contact purposes is:

The Ombudsman  
Office of the Ombudsmen  
P O Box 10-152  
WELLINGTON

Email: info@ombudsman.parliament.nz

Yours sincerely

[Signature]

Brent Johnston  
Manager, Mobility and Safety  
For CHIEF EXECUTIVE
Daytime Running Lights/Headlights-On Policy

Purpose
1. To update you on the topic of daytime running lights (DRL) as per your meeting with Bruce Johnson on 17 October 2006.
2. To inform you that there are very few vehicles coming into New Zealand with DRL as standard equipment, and that to require the mandatory retrofit of DRL on all vehicles would be problematic and could not be justified.
3. To inform you of what a headlights-on policy, whether mandatory or advisory, entails, and to discuss the benefits and costs associated with such an approach.

Background
4. Both DRL and headlights-on policies are designed to increase the visual contrast between the vehicle and its background, thereby making the vehicle more visible to other road users.
5. There has not been significant change in the technology, literature or international legislative moves on DRL over the past few years.
6. Options with regard to DRL/Headlights-on include:
   - The status quo;
   - Voluntary and/or compulsory use of DRL; or
   - Voluntary and/or compulsory use of headlights during the day.
7. Many of the countries that require compulsory use of DRL are located in higher latitudes (they are located closer to the poles) and consequently have fewer hours of sunlight than other countries.

Safety benefits of DRL/Headlights-on
8. Studies have shown that the greater the contrast between an object and its background, the greater the probability of the object being detected. Further, the lower the background lighting, the greater the contrast between object and background needs to be if detection of the object is to occur.
9. Using the combination of a formulae developed by Dutch researchers and 2004 New Zealand accident rates, when all vehicles are using DRL all of the time, the intervention might save a
maximum of approximately 1100 injuries (approximately 929 of these minor) and 28 deaths. These figures would be similar if a headlights-on policy was instigated as a mandatory driving requirement.

10. Research has shown that DRL are effective in reducing daytime multi-vehicle crashes when introduced for all vehicles. The reduction in multi-vehicle crashes ranged from two to 12 percent, and the reduction of rear-end crashes ranged from three to 20 percent. These figures would be similar if a headlights-on policy was instigated as a mandatory driving requirement.

11. DRL require substantially less fuel, and are associated with lower costs, than requiring drivers to turn on their headlights during the day.

Costs associated with DRL

12. There are substantial costs involved in retrofitting vehicles with DRL or light sensors. A retrofit would cost about $500 per vehicle (that is $200 for each bulb plus $100 for installation), and the total cost to retrofit the fleet would be approximately $1.25 billion.

13. DRL may be less effective than the formula calculation indicates as New Zealand has a lower latitude (longer daylight hours) than countries that have been analysed in the research.

Costs associated with a headlights-on policy

14. Requiring the compulsory use of headlights would result in adverse environmental effects that run counter to the Kyoto Protocol, and would increase New Zealand’s liabilities with respect to it. Requiring drivers to turn their headlights-on during the day increases the amount of fuel used, which in turn increases emissions of carbon dioxide (CO₂) and other noxious gases. Preliminary calculations show that a headlights-on policy would increase transport emissions of CO₂ by approximately 1.5 percent per annum.

15. Road user costs would be increased as the electrical load of operating headlights results in higher fuel consumption. A mandatory headlights-on policy would be expected to add approximately $45 annually to operating costs for a vehicle. The total annual cost to motorists of increased fuel consumption would be approximately $112.5 million. However, this cost will vary depending on the fuel prices, the wattage of the bulbs and the efficiency of the fuel to electricity conversion.

16. The cost associated with having to replace the front and rear light bulbs would be increased, as these would need to be replaced more frequently with increased use. Furthermore, there would be significant inconvenience associated with having to replace the bulbs more regularly (most drivers would have to bring their vehicle into a garage).

17. The frequency and costs associated with people forgetting to turn off their lights, resulting in flat batteries, would increase massively.

18. If it were mandatory for drivers to turn on their headlights during the day, there would be a number of people who would forget to do this. Consequently, it would be difficult to balance the enforcement of this action as average law abiding people are likely to unintentionally break the law and thus be subject to enforcement actions.

19. If a headlights-on policy was voluntary compliance numbers may be low.

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1 The evidence concerning the effect of DRL on fatal accidents is weak and inconsistent, and the positive benefits of such a policy approach may therefore be overstated.
20. There would also be the issue known as masking. This can occur if only some road users turn on their headlights. It is possible that drivers may not notice a vehicle without its lights on due to the presence of a vehicle with its lights on. With patchy compliance – as would be the case during a transition period and voluntary compliance with a headlights-on policy - issues of masking of unlit vehicles by lit vehicles may arise. However, the Ministry of Transport (the Ministry) understands there are reputable overseas researchers who acknowledge the issue of masking but do not consider it to be of great significance.

Options

The status quo

21. The options for instigating DRL/headlights-on policy in New Zealand have uncertain safety benefits, and substantial installation costs or adverse environmental and ongoing costs for motorists.

Educate and require drivers to turn on their existing lights during the daytime (mandatory headlights-on policy)

22. A behavioural option meaning drivers are required to manually turn on their headlights during the daytime or at designated times of low ambient light. As noted above, this would add approximately $45 annually to operating costs for a vehicle. The total annual cost to motorists would be approximately $112.5 million.

Educate and encourage drivers to turn on their existing lights during the daytime (voluntary headlights-on policy).

23. A behavioural option – see 22.

Retrofit controls to make existing lights turn on when the vehicle is started.

24. In all vehicles a system is installed to automatically turn existing vehicle headlights on high beam and low intensity during the daytime. This retrofit could disturb newer vehicles electronic and computer set-up and could involve (at a very high cost) extensive modification to some vehicles.

Retrofit special purpose DRL on all vehicles.

25. These would be a pair of auxiliary lights mounted to the front bumper or spoiler of a vehicle, electronically connected so when the DRL are switched on (manually or automatically with the ignition), the vehicle’s tail lamps come on at the same time. When the vehicles headlamps are switched on, the DRL switch off at the same time (while the tail lights remain on). As noted above, a retrofit would cost about $500 per vehicle (that is $200 for each bulb plus $100 for installation), and the total cost to retrofit the fleet would be approximately $1.25 billion. These bulbs could last the life time of the car, use a lot less electricity than normal headlights and consequently have less impact on the environment and vehicle running costs.

Encourage vehicle owners to retrofit special purpose DRL.

26. The costs associated with retro-fitting DRL and the uncertain safety benefits would likely limit the number of vehicle owners willing to voluntarily fit DRL.

The Ministry’s capabilities

27. No work has been completed on this matter due to other work priorities, as DRL/Headlights-on is not on the Ministry’s work programme.
Recommendation

28. We recommend that you:

(a) **Note** the contents of this memo titled “Daytime Running Lights/Headlights-on Policy”.

Withheld under section 9(2)(a)

Advisor

Alan Thompson
Secretary for Transport

Noted

Hon Harry Duynhoven
Minister for Transport Safety

Dated: ____/____/____

Released under the Official Information Act
Information for the peer review by Lionel Rowe

Summary

1) Costs associated with DRL

*Retrofit special purpose DRL on all vehicles.*

1. These would be a pair of auxiliary lights mounted to the front bumper or spoiler of a vehicle, electronically connected so when the DRL are switched on (manually or automatically with the ignition), the vehicle’s tail lamps come on at the same time. When the vehicles headlamps are switched on, the DRL switch off at the same time (while the tail lights remain on). As noted above, a retrofit would cost about $500 per vehicle (that is $200 for each bulb plus $100 for installation), and the total cost to retrofit the fleet would be approximately $1.25 billion. These bulbs could last the life time of the car, use a lot less electricity than normal headlights and consequently have less impact on the environment and vehicle running costs.

2) Costs associated with a headlights-on policy

*Retrofit controls to make existing headlights turn on when the vehicle is started.*

2. In all vehicles a system would be installed to automatically turn existing vehicle headlights on high beam and low intensity during the daytime. This retrofit could disturb newer vehicles electronic and computer set-up and could involve (at a very high cost) extensive modification to some vehicles.

3. Requiring the compulsory use of headlights would result in adverse environmental effects that run counter to the Kyoto Protocol, and would increase New Zealand’s liabilities with respect to it. Requiring drivers to turn their headlights-on during the day increases the amount of fuel used, which in turn increases emissions of carbon dioxide (CO₂) and other noxious gases. Preliminary calculations show that a headlights-on policy would increase transport emissions of CO₂ by approximately 1.5 percent per annum.

4. Road user costs would be increased as the electrical load of operating headlights results in higher fuel consumption. A mandatory headlights-on policy would be expected to add approximately $45 annually to operating costs for a vehicle. The total annual cost to motorists of increased fuel consumption would be approximately $112.5 million. However, this cost will vary depending on the fuel prices, the wattage of the bulbs and the efficiency of the fuel to electricity conversion.

5. The cost associated with having to replace the front and rear light bulbs would be increased, as these would need to be replaced more frequently with increased used. Furthermore, there would be significant inconvenience associated with having to replace the bulbs more regularly (most drivers would have to bring their vehicle into a garage).

6. The frequency and costs associated with people forgetting to turn off their lights, resulting in flat batteries, would increase massively.
Appendix 1:

Benefit Cost Analysis of a range of options

Option 1: Using Existing Headlights during the Daytime
Option 2: Automatic Existing Headlights
Option 3: Special Purpose DRL
Option 3a: Special Purpose DRL on New Vehicles
Option 1: Using Existing Headlights during the Daytime

Within this option there are two options:
   a) Encourage, educate and mandate the use of DRL
   b) Encourage and educate about the use of DRL

Below the costs are estimated for option a). It is assumed that current light usage during the daytime is low, and when daytime running lights are mandated usage increases to almost 100%. The costs for option a) will be displayed in the units of amount per vehicle. Thus if it is known how many vehicles are likely to use DRL after an “encourage and educate” campaign then the costs for option b) can also be calculated.

The costs associated with requiring drivers to turn on their existing headlights during the daytime are fuel costs, bulb replacement costs and environmental costs.

**Fuel Costs**

The following formulae, from Lawson (1986), were used to calculate the increased fuel costs per year when all vehicles are required to use their existing headlights during the daytime.

Increase in fuel use per watt of increased electrical load

\[
= \frac{\text{(no. hours/100km)} \times \text{(watt-hrs/litre of gasoline)} \times \text{(conversion efficiency)}}{100}
\]

Whereby the following is used to calculate each factor:

**Number of hours/100 km**

- Average daytime speed in New Zealand = 36.9 km/hour (New Zealand travel survey, 1997/98)
- Therefore the average time taken to drive 100 km = 2.71 hours

**Watt-hrs/litre of Gasoline**

- Heat content of gasoline = 32 joules/litre, or 32 \times 277.78 = 8888.96 watt-hrs/L

**Conversion efficiency**

- Thermal efficiency of engine = 22%
  Alternator efficiency = 55%
  Overall efficiency of conversion of gasoline to electricity = 12.1%

- However fuel efficiency has improved since Lawson’s 1986 paper. Estimates by Hella\(^1\) indicate that the thermal efficiency of the engine has probably increased by

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\(^1\) Personal communication, 2003.
approximately 25% to be at 27% while alternator efficiency has remained the same at 55%. These higher estimates given an overall efficiency of conversion of gasoline to electricity of approximately 15%.

Therefore the increase in fuel use per watt of increased electrical load:

\[
\frac{2.69}{(8888.96)(0.15)} = 2.03 \times 10^{-3} \text{ Litre/100 km Watt}
\]

A car generally has a total light (front, side and rear) electrical load of 140 watts (two front lights at 55W each and six 5W lights for tail lights, park lights and number plate). Since it is unknown how much of the travel during daylight is done by vehicles with different lighting electrical loads, it will be assumed for the following analysis that all vehicles have an electrical load of 140 watts. Therefore assuming 140 watts, the fuel usage per vehicle using lights  

\[
= 140 \times (2.03 \times 10^{-3}) = 0.28 \text{ L/100 km.}
\]

The estimated distance travelled by all motorised vehicles except motorcycles during daytime in the year 2004 was 32.3 billion kilometres (New Zealand travel survey 1997/98 scaled by the estimated VKT for the year 2004). Therefore the increased fuel usage from travelling with head lights on during daytime will be \(0.28/100\) \times 32.3 billion, or 91.9 million litres.

The cost of 91.9 million litres of fuel will vary depending on the petrol prices at the time of the introduction of DRL. Furthermore it is unknown how much travel is done by vehicles using the different fuel types: ultra, premium and diesel. Therefore an estimate of the fuel cost was obtained for three different fuel prices, 120 cents, 130 cents and 140 cents. Table 1 displays the total cost at each price and the cost excluding GST (12.5%) and petrol taxes. Petrol taxes go to the consolidated fund at 18.475 cents/litre, ACC at 5.08 cents/litre, Local Authority Petroleum Tax at 0.66 cents/litre and the National Land Transport Fund (NLTTF) at 22.725 cents/litre. In total petrol taxes are fixed at 46.94 cents per litre. Therefore an increase in fuel of 91.9 million litres will increase the amount paid in petrol taxes to $43.1 million.

Table 1. Estimated cost of an extra 91.9 million litres of fuel.

<table>
<thead>
<tr>
<th>Fuel price (cents/litre)</th>
<th>Total (million $)</th>
<th>Total excluding GST (million $)</th>
<th>Petrol taxes (million $)</th>
<th>Total excluding petrol taxes &amp; GST (million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>110.3</td>
<td>98.0</td>
<td>43.1</td>
<td>54.9</td>
</tr>
<tr>
<td>130</td>
<td>119.4</td>
<td>106.2</td>
<td>43.1</td>
<td>63.0</td>
</tr>
<tr>
<td>140</td>
<td>128.6</td>
<td>114.3</td>
<td>43.1</td>
<td>71.2</td>
</tr>
</tbody>
</table>
**Bulb Replacement Costs**

Requiring drivers to turn on their headlights during daytime will increase the amount of time front and rear light bulbs are used. The following is an estimate of the price associated with replacing the bulbs due to the increased usage. All prices and hours of use are from Hella\(^2\).

For front lights the following cost calculations will assume that all vehicles use standard halogen headlights (H4 globes). This assumption is conservative as a small percentage of the car fleet use the more expensive sealed beam headlights and heavy vehicles do not use the standard halogen car headlights. However it is unknown how much of the travel during daylight is done by each type of headlight. Therefore to be conservative the costs will be calculated on the basis that vehicles use two standard 55 watt H4 globes that last approximately 600 hours.

For tail lights it will be assumed that all vehicles use two 5 watt tail lights that last 500 hours.

The amount of time travelled by all motorised vehicles except motorcycles during daytime in the year 2004 was estimated as 875.1 million hours (New Zealand travel survey 1997/98, scaled by the estimated VKT for the year 2004). Table 2 displays the number of bulb replacements and cost associated with requiring drivers to turn their headlights on during the daytime.

Table 2. Number of bulb replacements per year and associated cost for requiring drivers to turn their headlights on during the daytime.

<table>
<thead>
<tr>
<th>Headlight type</th>
<th>Average bulb life (hours)</th>
<th>Hours per year (million)</th>
<th>Number replaced per year (million)</th>
<th>Cost per bulb (exc. GST) ($)</th>
<th>Total Cost (2 bulbs) (million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front</td>
<td>600</td>
<td>875.1</td>
<td>2.9</td>
<td>12.87</td>
<td>37.5</td>
</tr>
<tr>
<td>Tail lamps</td>
<td>500</td>
<td>875.1</td>
<td>3.5</td>
<td>2.44</td>
<td>8.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46.1</td>
</tr>
</tbody>
</table>

**Environmental Costs**

Requiring drivers to turn their headlights on during the day increases the amount of fuel used, which in turn increases emission of carbon dioxide (CO\(_2\)). Transfund (2004) uses a value for CO\(_2\) in 2004 dollars of $40/tonne, which equates to 12 cents/litre. The additional fuel usage for turning existing headlights on during the daytime was calculated above to be 91.9 million litres. Therefore at 12 cents/litre, the total cost of carbon dioxide emissions from turning on existing headlights during the daytime is $11.0 million.

**Total Costs**

The total cost of requiring drivers to turn on their existing headlights during the daytime is calculated in Table 6 for the three different fuel prices.

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\(^2\) Personal communication, 2004.
Table 3. Total cost of turning on existing headlights during the daytime.

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Fuel price (cents/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Fuel (million $)</td>
<td>54.9</td>
</tr>
<tr>
<td>Light bulbs (million $)</td>
<td>46.1</td>
</tr>
<tr>
<td>Environment (million $)</td>
<td>11.0</td>
</tr>
<tr>
<td>Total (million $)</td>
<td>112.0</td>
</tr>
<tr>
<td>Cost per vehicle ($)</td>
<td>41.48</td>
</tr>
</tbody>
</table>

**Benefit-Cost Analysis**

Table 4 displays the benefit cost ratios for the three different fuel prices with the benefits as calculated above. For each price the benefit cost ratio is greater than one.

Table 4. Benefit cost ratio of turning on existing headlights during the daytime

<table>
<thead>
<tr>
<th>Fuel price (cents/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
</tr>
<tr>
<td>Benefits ($ per vehicle)</td>
</tr>
<tr>
<td>Cost ($ per vehicle)</td>
</tr>
<tr>
<td>Benefit cost ratio</td>
</tr>
</tbody>
</table>

The benefits calculated using the formulae by Koornstra et al (1997) may underestimate or overestimate the effect of DRL, particularly since the formulae were developed from DRL studies predominately in countries with much higher latitudes than New Zealand and assume DRL usage will change from 0 to 100%. The benefits may also be overestimated if current road safety programs result in reductions in the number of multi-vehicle crashes. Therefore Table 5 displays the benefit cost ratio if there was a 10%, 20% and 50% reduction and increase in the current benefits.

Table 5. Benefit cost ratios of using existing headlights during the daytime where the benefits are increased or decreased by 10, 20 or 50%.

<table>
<thead>
<tr>
<th>% change in benefits</th>
<th>Fuel price (cents/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>130</td>
</tr>
<tr>
<td>-50</td>
<td>0.92</td>
</tr>
<tr>
<td>-20</td>
<td>1.47</td>
</tr>
<tr>
<td>-10</td>
<td>1.65</td>
</tr>
<tr>
<td>+10</td>
<td>2.02</td>
</tr>
<tr>
<td>+20</td>
<td>2.20</td>
</tr>
<tr>
<td>+50</td>
<td>2.75</td>
</tr>
</tbody>
</table>

Table 5 demonstrates that when the benefits are reduced by 50% the benefit cost ratio is less than one for petrol prices between 120 and 140 cents/litre.
Option 2: Automatic Existing Headlights

Vehicles can be retro-fitted so that existing headlights turn on when the ignition is started. There are two types of costs associated with this option:

- set-up costs
- running costs

Set Up Costs
For this option vehicles must be retro-fitted so that the headlights turn on when the ignition is started. Auto electricians around Wellington estimate that the work would cost around $100. Assuming it is the same cost for each vehicle type on the road the total cost for the vehicle population of approximately 2.7 million vehicles, would be $270 million.

The following benefit cost analysis examines the costs and benefits over a year of special purpose DRL use. It is assumed the installation of special purpose DRL will only be required once during a vehicle’s lifetime. Therefore the cost of the installation can be spread over the lifetime of the vehicle fleet to give an annualised cost for the benefit cost analysis.

If the average life of the vehicle fleet is 10 years, then at a 10% discount rate the present value of the $270 million over the fleet’s lifetime is $43.9 million per year.

Running Costs
Since this option utilises the existing headlights the running costs will be the same as the costs for running existing headlights.

Total Costs

Table 6. Total Costs per Vehicle when automatically turning on Existing Headlights

<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Fuel price (cents/litre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Running (million $)</td>
<td>112.0</td>
</tr>
<tr>
<td>Set-Up (million $)</td>
<td>43.9</td>
</tr>
<tr>
<td>Total (million $)</td>
<td>155.9</td>
</tr>
<tr>
<td>Cost per vehicle ($)</td>
<td>57.75</td>
</tr>
</tbody>
</table>
**Benefit Cost Analysis**

Table 7. Benefit Cost Ratio when automatically turning on Existing Headlights.

<table>
<thead>
<tr>
<th>Fuel price (cents/litre)</th>
<th>120</th>
<th>130</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit</td>
<td>76.11</td>
<td>76.11</td>
<td>76.11</td>
</tr>
<tr>
<td>Cost</td>
<td>57.75</td>
<td>60.78</td>
<td>63.80</td>
</tr>
<tr>
<td><strong>Benefit Cost Ratio</strong></td>
<td>1.32</td>
<td>1.25</td>
<td>1.19</td>
</tr>
</tbody>
</table>

Table 7 shows that the benefits slightly outweigh the costs if existing headlights were automatically turned on when the ignition started. However, it is important to note that this option does not incorporate any costs associated with retro-fitting, such as retro-fitting failures or Warrant of Fitness testing.
Option 3: Special Purpose DRL

Special purpose DRL are a pair of auxiliary lights mounted to the front bumper or spoiler of a vehicle. According to UN/ECE requirements they are mounted to the front of the vehicle, no more than 250 mm and no less than 150 mm above the ground. The DRL must be electrically connected so that when the DRL are switched on, the vehicle’s tail lamps come on at the same time and when the vehicle’s headlamps are switched on the DRL extinguish at the same time (while the tail lamps remain on).

There are two types of costs associated with requiring drivers to use special purpose DRL: set up costs and running costs. The set up costs consist of installing the special purpose DRL and purchasing the special purpose DRL bulbs. The running costs consist of fuel, light bulb replacement and environmental costs.

Set up Costs

Installation costs
Special purpose DRL must be installed to the front bumper or spoiler of the vehicle and appropriate wiring connected so that when switched on the tail lamps come on and when the vehicle’s headlamps are switched on the DRL are extinguished however the tail lamps remain on. Auto electricians around Wellington estimate that the work would cost around $100. Assuming it is the same cost for each vehicle type on the road the total cost for the vehicle population of approximately 2.7 million vehicles, would be $270 million.

The following benefit cost analysis examines the costs and benefits over a year of special purpose DRL use. It is assumed the installation of special purpose DRL will only be required once during a vehicle’s lifetime. Therefore the cost of the installation can be spread over the lifetime of the vehicle fleet to give an annualised cost for the benefit cost analysis.

If the average life of the vehicle fleet is 10 years, then at a 10% discount rate the present value of the $270 million over the fleet’s lifetime is $43.9 million per year.

DRL bulbs
If special purpose DRL are required then two DRL bulbs per vehicle need to be purchased. Each bulb costs $200. Thus the total cost for the vehicle population of approximately 2.7 million vehicles, would be $1.1 billion

The DRL bulbs have a lifetime of 10,000 hours and will generally not need to be replaced during the lifetime of the vehicle. Therefore the cost of the bulbs can be spread over the lifetime of the vehicle fleet to give an annualised cost for the benefit cost analysis.
If the average life of the vehicle fleet is 10 years, then at a 10% discount rate the present value of the $1.04 billion over the fleet’s lifetime is $175.8 million per year.

**Running Costs**

**Fuel Costs**

The above calculations from Lawson (1986) for turning existing headlights on during the daytime were used to calculate the increased fuel costs of special purpose DRL. That is the increase in fuel use per watt of increased electrical load = $2.03 \times 10^{-3}$ Litre/100 km Watt

The total electrical load when special purpose DRL are used will consist of two 5 watt special purpose DRL bulbs and six 5 watt lights for tail lights, park lights and number plate. Therefore assuming an average of 40 watts, the fuel usage per vehicle using lights = $40 \times (2.03 \times 10^{-3}) = 0.08$ L/100 km.

The distance travelled by all motorised vehicles except motorcycles during daytime in the year 2004 was 32.3 billion kilometres (New Zealand travel survey 1997/98, scaled by the estimated VKT for the year 2004).

Therefore the increased fuel usage from travelling with head lights on during daytime will be $(0.08/100) \times 32.3$ billion, or 26.3 million litres.

The cost of 26.3 million litres of fuel will vary depending on the petrol prices at the time of the introduction of DRL. Furthermore it is unknown how much travel is done by vehicles using the different fuel types: ultra, premium and diesel. Therefore an estimate of the fuel cost was obtained for three different fuel prices, 120 cents, 130 cents and 140 cents. Table 8 displays the total cost at each price and the cost excluding GST (12.5%) and petrol taxes (46.94 cents/litre).

Table 8. Estimated cost of an extra 26.3 million litres of fuel.

<table>
<thead>
<tr>
<th>Fuel price (cents/litre)</th>
<th>Total (million $)</th>
<th>Total excluding GST (million $)</th>
<th>Petrol taxes (million $)</th>
<th>Total excluding petrol taxes &amp; GST (million $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>31.5</td>
<td>28.0</td>
<td>12.3</td>
<td>15.7</td>
</tr>
<tr>
<td>130</td>
<td>34.1</td>
<td>30.3</td>
<td>12.3</td>
<td>18.0</td>
</tr>
<tr>
<td>140</td>
<td>36.8</td>
<td>32.7</td>
<td>12.3</td>
<td>20.3</td>
</tr>
</tbody>
</table>
**Bulb Replacement Costs**

Using special purpose DRL will increase the amount of time the tail lights are on. Therefore there will be bulb costs for the tail lights. The following is an estimate of the price associated with this increased usage. All prices and hours of use are from Hella\(^3\). It will be assumed that all vehicles use the 5 watt tail light that last 500 hours.

The amount of time travelled by all motorised vehicles except motorcycles during daytime in the year 2004 was 875.1 million hours (New Zealand travel survey 1997/98, scaled by the estimated VKT for the year 2004). Thus there will be approximately 3.5 million tail light bulb replacements each year. With a cost per bulb of $2.44, the annual cost of bulb replacements will be $8.5 million.

**Environmental Costs**

As discussed above Transfund (2004) uses a value for CO\(_2\) in 2004 dollars of $40/tonne, which equates to 12 cents/litre. The additional fuel usage for running special purpose DRL was calculated above to be 26.3 million litres. Therefore at 12 cents/litre, the total cost of carbon dioxide emissions from running special purpose DRL is $3.2 million.

**Total Costs**

The total cost of using special purpose DRL during the daytime is calculated in Table 11 for the three different fuel prices.

Table 9. Total cost of using special purpose DRL during the daytime.

---

\(^3\) Personal communication, 2004.
<table>
<thead>
<tr>
<th>Cost Type</th>
<th>Fuel price (cents/litre)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
<td>130</td>
<td>140</td>
</tr>
<tr>
<td>Running (million $)</td>
<td>Fuel</td>
<td>15.7</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>Tail light bulbs</td>
<td>8.5</td>
<td>8.5</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td></td>
<td>Total (million $)</td>
<td>27.4</td>
<td>29.7</td>
</tr>
<tr>
<td></td>
<td>Cost per vehicle ($)</td>
<td>10.5</td>
<td>11.4</td>
</tr>
<tr>
<td>Fixed (million $)</td>
<td>Installation</td>
<td>43.9</td>
<td>43.9</td>
</tr>
<tr>
<td></td>
<td>Special purpose DRL</td>
<td>175.8</td>
<td>175.8</td>
</tr>
<tr>
<td></td>
<td>Total (million $)</td>
<td>219.7</td>
<td>219.7</td>
</tr>
<tr>
<td></td>
<td>Cost per vehicle ($)</td>
<td>84.5</td>
<td>84.5</td>
</tr>
<tr>
<td>Overall Total</td>
<td></td>
<td>247.1</td>
<td>249.4</td>
</tr>
<tr>
<td>Overall cost per vehicle($)</td>
<td></td>
<td>95.0</td>
<td>95.9</td>
</tr>
</tbody>
</table>

**Benefit-Cost Analysis**

Table 10 displays the benefit cost ratios for the three different fuel prices with the benefits as calculated above. For each petrol price the benefits are not outweighed by the costs of installing and running special purpose DRL.

Table 10. Benefit cost ratio of using special purpose DRL.

<table>
<thead>
<tr>
<th></th>
<th>Fuel price (cents/litre)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120</td>
<td>130</td>
<td>140</td>
</tr>
<tr>
<td>Benefits ($ per vehicle)</td>
<td></td>
<td>76.11</td>
<td>76.11</td>
</tr>
<tr>
<td>Cost ($ per vehicle)</td>
<td></td>
<td>95.0</td>
<td>95.9</td>
</tr>
<tr>
<td>Benefit cost ratio</td>
<td></td>
<td>0.80</td>
<td>0.79</td>
</tr>
</tbody>
</table>

The benefits calculated using the formulae by Koornstra et al (1997) may underestimate or overestimate the effect of DRL. Alternative Table 13 displays the benefit cost ratio if there was a 10%, 20% and 50% reduction and increase in the current benefits.
Table 11. Benefit cost ratios of using special purpose DRL where the benefits are increased by 10, 20 and 50%.

<table>
<thead>
<tr>
<th>% change in benefits</th>
<th>Fuel price (cents/litre)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>-50</td>
<td>0.40</td>
<td>0.40</td>
<td>0.39</td>
<td></td>
</tr>
<tr>
<td>-20</td>
<td>0.64</td>
<td>0.63</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td>-10</td>
<td>0.72</td>
<td>0.71</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td>+10</td>
<td>0.88</td>
<td>0.87</td>
<td>0.86</td>
<td></td>
</tr>
<tr>
<td>+20</td>
<td>0.96</td>
<td>0.95</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>+50</td>
<td>1.20</td>
<td>1.19</td>
<td>1.18</td>
<td></td>
</tr>
</tbody>
</table>

Table 11 indicates that the benefits only outweigh the costs if there was a 50% or above increase in the benefits.
Option 3a: Special Purpose DRL on New Vehicles

Rather than requiring all vehicles to use special purpose DRL or all vehicles to use their existing lights during the daytime, there could be a requirement that some vehicles use special purpose DRL and other vehicles use their existing lights. For example, new vehicles could be required to use special purpose DRL and old vehicles use their existing lights during the daytime.

For there to be a requirement that all new vehicles be equipped with special purpose DRL the benefits over the lifetime of the vehicle would need to exceed the costs over the lifetime of the vehicle. The above benefit cost analysis examined the benefits and costs over one year. It assumed the average life of the vehicle fleet was 10 years, to give an annualised figure for the one-off set up costs. However for new vehicles it could be assumed the average life is 15 years. Therefore a benefit cost analysis of special purpose DRL was conducted over 15 years. That is the present value of the benefits accumulated over the lifetime of the vehicle for using special purpose DRL was compared to the present value of the costs accumulated over the lifetime of the vehicle. The costs accumulated over the lifetime consist of the one off costs of installation and special purpose DRL bulbs and the on-going yearly running costs.

Table 12 displays the present value of the accumulated costs and benefits for a vehicle over 15 years. An annual discount rate of 10% was used, and it was assumed the costs and benefits were paid at the beginning of a period.

Table 12. Present value of accumulated benefits and costs for a vehicle equipped with special purpose DRL for 15 years and associated benefit cost ratio.

<table>
<thead>
<tr>
<th>Petrol Prices</th>
<th>Benefits</th>
<th>Costs</th>
<th>Benefit Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present value of accumulated benefits</td>
<td>580.09</td>
<td>586.86</td>
</tr>
<tr>
<td></td>
<td>One-off fixed cost</td>
<td>500.00</td>
<td>500.00</td>
</tr>
<tr>
<td></td>
<td>Running</td>
<td>10.22</td>
<td>11.12</td>
</tr>
<tr>
<td></td>
<td>Present value of accumulated costs</td>
<td>577.77</td>
<td>584.59</td>
</tr>
<tr>
<td></td>
<td>Benefit Cost Ratio</td>
<td>1.00</td>
<td>0.99</td>
</tr>
</tbody>
</table>

If a new vehicle was equipped now with special purpose DRL then the present value of the benefits accumulated over its lifetime would not outweigh the present value of the costs.
Appendix 2 (parts 1 and 2)

Part 1:
Email correspondence from Hella NZ confirming DRL prices (2 April 2007)

Hi [name],

I have a lot of files on daytime lamps and hopefully your system will allow 5Mb of attachments. Here is the brochures and adverts we have at the moment.

Our bulb lamps versions are around $175 list price and the LED kits are $499.00.


Here is a website as well.

http://www.tagfahrlicht.de/EN/index.html

With best regards,

[Name]
Product Manager

Hella New Zealand Limited
81-83 Ben Lomond Crescent
Pakuranga
Manukau 2010
New Zealand

DDI: + [number] Mob: + [number] Tel: + [number] Fax: + [number]

Visit us on the Internet at: http://www.hella.co.nz
Part 2:

Information supporting additional fuel cost estimates

(Excerpt from Osram website)

http://www.osram.com/osram_com/Consumer/Automotive_Lighting/See_and_be_seen/LIGHTDAY/Frequently_asked_questions.html

Does driving with dipped beam at day mean additional costs?

Answer: Costs do rise slightly: on the one hand, this is caused by higher fuel consumption (approx. 1-2% respectively 0.1-0.2 litres of fuel per 100 km). On the other hand, this is a result of higher lamp use and, therefore, a higher rhythm of lamp replacements.

But there is something to bear in mind: This increase in consumption can easily be compensated for by stepping on the accelerator with some more restraint from time to time.

And what about the more frequent lamp replacements?
For daytime running light, OSRAM offers a special range of lamps, LIGHT@DAY, which guarantees - with an increased lamp life - the usual replacement intervals.

And the higher price of a LIGHT@DAY?
Even a minor accident costs easily more than 50 or 100 car lamps. To sum up: LIGHT@DAY lamps are an investment which will always pay.
Min’s concerns with WGTA8106

1) Benefits understated

a) “28 lives maybe – and no one's interested”

The prospect of saving up to 32 lives, and 175 serious injuries has given us good reason to carefully analyse the implementation issues associated with DRL or similar systems.

For the Minister’s information, the attached report Appdx 2 “Benefit Cost Analysis of Daytime Running Lights” by Tui Patterson provides full details.

2) Costs overstated

a) The Minister notes the retrofitting cost of $500 is overstated and suggests $150 would be more realistic (refer para 12)

The $100 installation estimate was provided by surveying auto electricians in Wellington. The $200 estimate was provided by Hella and assumed the fitting of 2 special 5 watt DRL bulbs. These are additional to the headlamps and conventional parklights.

Note, the price of DRL bulbs comprises 70% of the total costs therefore a reduction in price would substantially change the benefit cost ratio.

The Ministry will undertake some more work to see if the costs of DRL bulbs have changed substantially.

b) The Minister notes the claimed increase of transport emissions of CO$_2$ by 1.5% per annum and asks to see the calculations. (refer para 14)

The calculation is preliminary and attached as Appendix 2.

c) The Minister has questioned why costs associated with the running of tail lights are included (refer para 25).

The analysis assumed tail light would operate simultaneously with the option of using headlights because that is how lighting systems are conventionally wired. Separating them would require modification and this cost would not offset the energy(fuel) savings and reduction in CO$_2$ from not operating the tail lights given 2 tail lights are typically 12 watts compared to 110 watts for dipped headlights.
DAYTIME RUNNING LIGHTS FEEDBACK ON WGTA8106

- Para 12.: $500 per retrofitted vehicle is confirmed by Hella New Zealand Bulbs $175. LED kits $499

- Para 14: Preliminary calculations show CO₂ would increase by 1.5%. Calculation attached as Appdx 2. Also confirmed by Osram info which refers to 1% increase in fuel consumption, which has a linear relationship with CO₂

- Para 24: Retrofitting systems to automatically turn on lights can involve interrupting the wiring loom this can create issues with vehicle warranty unless completed by the manufacturers representative (Ex towbar fitting)

  High beam and low intensity is the pattern and luminance most similar to approved DRL. Conventional low beam is significantly poorer than DRL. Also bear in mind DRL is achieving a different task to what headlights were traditionally designed for, that is, to illuminate the road whereas DRL is to indicate presence to an oncoming vehicle

- Para 25: It appears the inclusion of tails lamps was to simplify the switching, although some systems use this, refer Osram information

**Issue**

Trade-off between adverse impact on fuel consumption and CO₂ output vs safety benefits

LTNZ maintaining a watching brief on availability of low power bulbs and can review policy accordingly

Out of scope of request
Minimum standards for vehicle safety

Ensuring our transport system helps New Zealand thrive

Ministry of Transport

Released under the Official Information Act

Oct 2018
Examples of technologies that are here now

The **Vehicle Standards Map** is a document that describes the vehicle technologies and performance standards the Ministry of Transport believes have the greatest potential to improve the safety and resource efficiency of vehicles in New Zealand.

The **Vehicle Standards Inventory** is a 47 page list of the significant vehicle technologies and performance standards relating to safety and resource efficiency that government transport officials are aware of.
## The Vehicle Standards Map 2016

<table>
<thead>
<tr>
<th>Light passenger and commercial vehicles</th>
<th>Motorcycles and mopeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic vehicle alerting systems</td>
<td>Anti-lock braking system</td>
</tr>
<tr>
<td>Autonomous emergency braking</td>
<td>Frontal lighting</td>
</tr>
<tr>
<td>Autonomous emergency contact systems (eCall)</td>
<td>Helmet rating systems</td>
</tr>
<tr>
<td>Daytime running lamps</td>
<td>Heavy vehicles</td>
</tr>
<tr>
<td>Emergency stop signal</td>
<td>Autonomous emergency braking</td>
</tr>
<tr>
<td>Fatigue warning system</td>
<td>Blind spot warning system</td>
</tr>
<tr>
<td>Intelligent speed adaptation</td>
<td>Electronic brake force distribution</td>
</tr>
<tr>
<td>Intersection collision warning system</td>
<td>Electronic stability control</td>
</tr>
<tr>
<td>Lane departure warning system</td>
<td>Lane departure warning system</td>
</tr>
<tr>
<td>Lane keep assist</td>
<td>Lane keep assist</td>
</tr>
<tr>
<td>Pedestrian impact standards</td>
<td>Under-run protection system</td>
</tr>
<tr>
<td>Pole side impact standards</td>
<td>Efficiency</td>
</tr>
<tr>
<td>Reverse backup camera</td>
<td>Vehicle exhaust emissions standards</td>
</tr>
<tr>
<td>Seatbelt reminder</td>
<td>Vehicle fuel economy standards</td>
</tr>
<tr>
<td>Side curtain airbags</td>
<td>Fleet management systems standards</td>
</tr>
<tr>
<td>Three point centre seatbelts</td>
<td>Predictive power train control</td>
</tr>
<tr>
<td>Tyre pressure warning system</td>
<td></td>
</tr>
</tbody>
</table>
Slides 16 – 17 out of scope
Europe – standards already adopted

Light vehicles

Daytime running lights (DRLs)
- These come on automatically whenever a vehicle’s engine is started. They substantially increase the visibility of cars and other vehicles. Since 2011, DLRs are mandatory for all new cars and small delivery vans in the EU. Trucks and buses followed in August 2012. Vehicles produced before don’t have to be retrofitted.

eCall
- eCall is an automatic emergency call system for motor vehicles. It dramatically shortens the time it takes for emergency services to arrive. Carmakers will have to install the technology in all new car and van models from 31 March 2018 onwards. The system could help save hundreds of lives every year and so improve road safety in Europe.
Released under the Official Information Act

Slides 19 – 31 out of scope

19

282

203
Slides 2 - 12 out of scope
Would retrofitting vehicle technologies or safety features to in-service vehicles to help reduce DSI?

Should we mandate the retrofit of safety technologies? Why?
What would be the consequences for individuals and organisations?
What would the costs and benefits be, and how could you address any negative consequences including cost?

Technologies for retrofit could include:
• additional mirrors or cameras
• underrun barriers
• fatigue detection equipment
• tyre pressure monitoring
• daytime running lights
• telematics
• speed governors
• intelligent speed advisories
• protective clothing for motorcycles
• any other examples as appropriate

Note these are presented solely to support discussion and debate. This should not be considered Government policy or to illustrate direction of travel.
Slides 14 - 16 out of scope