Vehicle Emission Prediction Model: VEPM 6.0 update technical report

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Executive summary

The NZ Transport Agency commissioned an update of key assumptions and emission factors in the Vehicle Emission Prediction Model (VEPM), which was last updated in 2017 (Sridhar and Metcalfe, 2017). These include:

- Updating the fleet
- Extending VEPM to 2050
- Creating separate categories in VEPM for light duty hybrid, plug-in hybrid and electric vehicles
- Adding a new category for electric heavy-duty trucks and buses
- Replacing all existing Euro emission factors with emission factors from the latest version of COPERT (the EU standard vehicle emissions calculator)
- Incorporating new Euro 6 emission factors for passenger and light commercial vehicles
- Updating the method for calculation of tailpipe CO₂
- Updating brake and tyre wear emission factors

The vehicle fleet was updated based on updated vehicle kilometres travelled (VKT) data from the Vehicle Fleet Emission Model (VFEM3) provided by Ministry of Transport. Projections in VFEM are based on the assumptions described in the Transport Outlook: Future State report (MoT, 2017). Data provided for this update of VEPM are based on a recent update of VFEM which incorporates historical fleet and travel data up to 2017 and provides projections to 2050.

In general, fleet weighted average emission factors from the updated VEPM 6.0 are similar to VEPM 5.3 up to 2030. Beyond 2030, emission factors from VEPM 6.0 are generally lower than VEPM 5.3 primarily because of changes in the Ministry of Transport vehicle fleet projections. Key exceptions to these general comparisons are:

- Brake and tyre wear particulate matter (PM) emission factors were updated to be consistent with European guidance. The updated PM emission factors for brake and tyre wear are significantly higher than in previous versions of VEPM.
- Fleet weighted fuel consumption factors beyond 2030 are significantly lower in the updated version of VEPM because of the significantly higher proportion of electric vehicles in the updated MoT fleet projections.
1.0 Introduction

1.1 Background and scope

The Vehicle Emissions Prediction Model (VEPM) was developed by the NZ Transport Agency (hereafter referred to as the Transport Agency) and Auckland Council to predict emissions from vehicles in the New Zealand fleet under typical road, traffic and operating conditions. The model provides estimates suitable for air quality assessments and regional emissions inventories.

VEPM requires a detailed breakdown of kilometres travelled by the fleet. Fleet weighted emission factors are calculated by multiplying the emissions factors in g/km for each vehicle class by the proportion of kilometres travelled by that class for any given year.

The Transport Agency commissioned Emission Impossible Ltd to update key assumptions and emission factors in VEPM. These include:

- Updating the fleet
- Extending VEPM to 2050
- Creating separate categories in VEPM for light duty hybrid, plug-in hybrid and electric vehicles
- Adding a new category for electric heavy-duty trucks and buses
- Replacing all existing Euro emission factors with emission factors from the latest version of COPERT (the EU standard vehicle emissions calculator)
- Incorporating new Euro 6 emission factors for passenger and light commercial vehicles
- Updating the method for calculation of tailpipe CO₂
- Updating brake and tyre wear emission factors

1.2 Purpose and scope of this report

This technical report:

- Provides details of the vehicle fleet update, including key assumptions
- Provides details of the emission factor updates, including key assumptions
- Summarises the differences in fleet weighted emission factors between VEPM 5.3 and VEPM 6.0.
Further information and technical reports relating to development of the Vehicle Emission Prediction Model are available on the Transport Agency’s Highways Information Portal website.¹

2.0 Method

Fleet weighted emissions are calculated in VEPM by multiplying the emissions factors in g/km for each vehicle category by the proportion of vehicle kilometres travelled (VKT) by that category for a defined year. VEPM is based on emissions from the European COPERT model, which are published by the European Environment Agency in a spreadsheet (EEA 2018b).

2.1 Vehicle fleet

Vehicle kilometres travelled (VKT) data is used in VEPM to calculate the proportions of VKT travelled for each vehicle category.

2.1.1 Updated VKT data

Updated VKT data from the Vehicle Fleet Emission Model (VFEM3) was provided by Ministry of Transport (MoT).

Data provided for this update of VEPM are from a recently updated version of VFEM, which incorporates historical fleet and travel data up to 2017 and provides projections to 2050. Projections are for the Base Case scenario described in the Transport Outlook: Future State report (MoT, 2017) as follows:

- The Base Case is a relatively conservative scenario that assumes normal technological changes and a continuation of current demographic and economic trends. It is an easy-to-understand scenario as not much new and unexpected has to happen to get us there.
- In the Base Case, population growth follows the Statistics NZ medium projections, which sees New Zealand’s population rising to 5.9 million by 2042/43, compared with about 4.7 million in 2016. Population growth is heavily focused on Auckland and the ‘golden triangle’ area that also includes Waikato and the Bay of Plenty. Economic growth follows the Treasury’s long-term projections, averaging about 2.4% per year in real terms.
- Transport in 2042/43 is easier and more convenient but not much cheaper than today. Fully self-driving vehicles and vehicle-sharing services arrive later during this period. Twenty per cent of trips in private vehicles shift to vehicle-sharing by 2042/43. Electric vehicles are assumed to make up a significant share of the vehicle fleet by 2042/43.

Fleet data for other scenarios could be incorporated into future versions of VEPM to allow testing of scenarios.

Data were provided for all years from 2001 to 2050 broken down by:

- vehicle type,
- fuel type,
- engine capacity (light duty vehicles) or vehicle mass (heavy-duty vehicles)
- year of manufacture,

There are several changes in the fleet breakdown provided by Ministry of Transport for VEPM 6.0 compared with the fleet provided for VEPM 5.3. The changes in the overall fleet breakdown are summarised in Table 1.

Table 1: Changes in the fleet categories in VEPM6.0 compared with VEPM5.3.

<table>
<thead>
<tr>
<th>VEPM 5.3 fleet categories</th>
<th>VEPM 6.0 VKT fleet categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Diesel HCV weight classes in VEPM 5.3</td>
<td>7 Diesel HCV weight classes (previous 12-15t and 15-20t combined to 10-20t in VEPM 6.0) to match weight classes in VFEM.</td>
</tr>
<tr>
<td>No electric HCV’s or buses</td>
<td>Electric HCV (&lt;10 t and &gt;10t) and buses added</td>
</tr>
</tbody>
</table>

2.1.2 Overall fleet breakdown

The overall composition of the default fleets in VEPM 5.3 and the updated VEPM 6.0 are shown in Table 2 and Table 3 respectively. There are differences in the projected fleet compositions. For example, hybrid, plug-in hybrid and electric cars account for 24% of VKT by 2040 in the VEPM5.3 projection and 43% of VKT in the updated projection in VEPM 6.0.

Figure 1 and Figure 2 show the overall proportions of light duty petrol, light duty diesel, light duty hybrid & electric and heavy-duty diesel vehicles. The trends for these categories are similar from VEPM 5.3 and VEPM 6.0, except that VEPM 6.0 has a higher proportion of VKT from electric vehicles in future years.

Table 2: Default fleet (% VKT by vehicle class) in VEPM 5.3
## Table 3: Updated default fleet (% VKT by vehicle class) in VEPM 6.0

<table>
<thead>
<tr>
<th>Year</th>
<th>Light Duty Vehicles &lt;3.5tonnes</th>
<th>Diesel HCV &gt;3.5tonnes</th>
<th>Electric HCV &gt;3.5 tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Car petrol</td>
<td>Car diesel</td>
<td>Car hybrid</td>
</tr>
<tr>
<td>2001</td>
<td>72.5%</td>
<td>6.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2005</td>
<td>71.0%</td>
<td>7.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>2010</td>
<td>70.1%</td>
<td>7.6%</td>
<td>0.2%</td>
</tr>
<tr>
<td>2015</td>
<td>67.5%</td>
<td>7.8%</td>
<td>0.6%</td>
</tr>
<tr>
<td>2020</td>
<td>64.2%</td>
<td>7.8%</td>
<td>1.2%</td>
</tr>
<tr>
<td>2025</td>
<td>61.4%</td>
<td>7.6%</td>
<td>1.9%</td>
</tr>
<tr>
<td>2030</td>
<td>54.5%</td>
<td>6.5%</td>
<td>3.0%</td>
</tr>
<tr>
<td>2035</td>
<td>40.5%</td>
<td>4.5%</td>
<td>3.6%</td>
</tr>
<tr>
<td>2040</td>
<td>26.6%</td>
<td>2.8%</td>
<td>3.1%</td>
</tr>
<tr>
<td>2045</td>
<td>17.2%</td>
<td>1.7%</td>
<td>2.5%</td>
</tr>
<tr>
<td>2050</td>
<td>12.5%</td>
<td>1.1%</td>
<td>1.8%</td>
</tr>
</tbody>
</table>
Figure 1: Default fleet (% VKT by vehicle class) in VEPM 5.3

Figure 2: Updated default fleet (% VKT by vehicle class) in VEPM 6.0
2.1.3 Equivalent COPERT vehicle categories assumed for vehicles categories in VEPM

Vehicle categories in the COPERT emissions model do not match categories in the NZ fleet data from VFEM. This means that assumptions are required as summarised in Table 4.

Table 4: COPERT vehicle categories assumed in VEPM6.0

<table>
<thead>
<tr>
<th>NZ Fleet Data</th>
<th>COPERT vehicle class used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrol passenger cars</td>
<td></td>
</tr>
<tr>
<td>1350-1599cc</td>
<td>Small (1350 - 2000cc)</td>
</tr>
<tr>
<td>1600-1999cc</td>
<td>Medium (1350 - 2000cc)</td>
</tr>
<tr>
<td>2000-2999cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>3000-3999cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>&gt;=4000cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>Diesel passenger cars</td>
<td></td>
</tr>
<tr>
<td>1350-1599cc</td>
<td>Medium (1350 - 2000cc)</td>
</tr>
<tr>
<td>1600-1999cc</td>
<td>Medium (1350 - 2000cc)</td>
</tr>
<tr>
<td>2000-2999cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>3000-3999cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>&gt;=4000cc</td>
<td>Large (&gt;2000cc)</td>
</tr>
<tr>
<td>Petrol hybrid</td>
<td>Petrol hybrid medium</td>
</tr>
<tr>
<td>All engine sizes</td>
<td></td>
</tr>
<tr>
<td>Petrol plug-in hybrid</td>
<td>No emission factors available</td>
</tr>
<tr>
<td>All engine sizes</td>
<td></td>
</tr>
<tr>
<td>Light commercial vehicles</td>
<td>Light commercial vehicles N1-III class</td>
</tr>
<tr>
<td>All engine sizes</td>
<td>(reference mass &gt; 1760kg)</td>
</tr>
<tr>
<td>Heavy Commercial Vehicles</td>
<td></td>
</tr>
<tr>
<td>3.5 – 7.5 (includes buses 3.5 – 7.5t)</td>
<td>Rigid 3.5 – 7.5t (&lt;7.5)t</td>
</tr>
<tr>
<td>7.5 - 10 (includes buses 7.5 – 12)</td>
<td>Rigid 7.5 – 12t</td>
</tr>
<tr>
<td>10 – 20t (includes buses &gt; 12t)</td>
<td>Rigid 14 – 20t</td>
</tr>
<tr>
<td>20 – 25t</td>
<td>Rigid 20 – 26t</td>
</tr>
<tr>
<td>25 – 30t</td>
<td>Rigid 26 – 28t</td>
</tr>
<tr>
<td>&gt;30t</td>
<td>Rigid &gt;32t</td>
</tr>
</tbody>
</table>

2.1.4 Light commercial vehicle category

There are three categories of commercial vehicles in COPERT. These are:

- N1-I: reference mass<1305kg
- N1-II: 1305kg<reference mass<1760kg
- N1-III: 1760<reference mass

The reference mass is defined in the European regulations as the mass of the vehicle in running order less the uniform mass of the driver of 75kg and increased by a uniform mass of 100. In the New Zealand fleet data, commercial vehicles are categorised by engine size, so these are not directly comparable with the COPERT categories. The average Gross Vehicle Mass (GVM) of new LCVs in New Zealand is around 3,000kg. The GVM isn’t directly

comparable with the European reference mass. However, it is expected that a vehicle with a GVM of 3,000kg will typically have a reference mass above 1,760kg (so is equivalent to a category N1-III in Europe). For example, the Ford Ranger has a GVM of 3,200kg and a kerb mass of 2,188kg. The kerb mass is reasonably comparable with the European reference mass.

All light commercial vehicles are classified as N1-III in VEPM on the basis that the average light commercial vehicle mass in New Zealand is roughly equivalent to the COPERT N1-III category.

### 2.1.5 Availability of emission factors for additional vehicle categories (not currently included in VEPM)

The COPERT emission factor database has significantly expanded since the development of VEPM in 2008 (EFRU, 2008). There are a significant number of vehicle classes in COPERT which are not included in VEPM. The differences between COPERT and VEPM are summarised in Table 5. The addition of extra vehicle categories (for example buses) into VEPM could be considered for future updates.

**Table 5: comparison of vehicle categories included in COPERT with categories included in VEPM**

<table>
<thead>
<tr>
<th>Vehicle category</th>
<th>COPERT</th>
<th>VEPM 6.0</th>
</tr>
</thead>
</table>
| Passenger cars   | • 4 size categories (mini, small, medium, large)  
• New category for ATV’s (quad bikes) | • 3 size categories (equivalent to small, medium, large) |
| Passenger car petrol hybrid | • 4 size categories (Mini, small, medium, large)  
• 5 emission standards (Euro 4 onwards) | • 1 size category (assuming medium)  
• 1 emission factor (assuming Euro 4) |
| Passenger car diesel | • 4 size categories (mini, small, medium, large) | • 2 size categories only (equivalent to medium and large) |
| Light commercial vehicles | • 3 size categories | • 1 vehicle size category only (equivalent to largest COPERT class) |
| Buses | • Comprehensive range of factors for urban buses and coaches (diesel, CNG and biodiesel) | • Bus emission factors assumed to be the same as HCV emission factors |
| HCV’s | • Separate emission factors for articulated and rigid HCV’s.  
• Emission factors for articulated HCV’s up to 60t. | • All HCV’s assumed to be rigid.  
• Maximum size category >30t. |
2.2 Emission factors

As described in previous technical reports (EFRU, 2011., Sridhar and Metcalfe, 2017), emission factors in VEPM 5.3 were based primarily on:

- Emission factors from the UK National Atmospheric Emissions Inventory (NAEI) database for light duty vehicles up to Euro 4, and
- Emission factors from COPERT4 for heavy-duty vehicles up to Euro IV
- Emission factors from the European EMEP/EEA guidebook 2016 (which is based on COPERT) for all pollutants, for all Euro 5, Euro 6 (light duty) and Euro V and Euro VI (heavy-duty) vehicles.

The methodology for development of VEPM5.3 was peer reviewed by Pacific Environment Limited\(^3\). This review recommended that:

- In future, for general consistency and ease of updating it would be preferable to make all European emission factors consistent with the latest version of COPERT.
- If possible, adjustment factors and equivalencies for Japanese vehicles should also be recalculated to be consistent with COPERT.

These recommendations were implemented as part of this update.

In VEPM6.0, all hot emission factors for all vehicle classes are consistent with COPERT emission factors, which are published in the latest version of the EMEP/EEA guidebook (July 2018 update)\(^4\).

The methodology for estimation of emission factors from Japanese used and New Zealand manufactured vehicles is described in Development of a Vehicle Emissions Prediction Model (EFRU, 2008). This methodology has not changed. However, the emissions are calculated from the updated COPERT emission factors instead of the original NAEI emission factors.

Some assumptions were necessary to update all emission factors. These are described in the following sections.

2.2.1 New Euro 6 emission factors

Euro 6 (light duty) emission factors in VEPM5.3 were replaced with updated Euro 6 emission factors, which are separated into three categories based on date of introduction.

In VEPM5.3 it was assumed that there was a four to five year delay in the introduction of European emission factors in New Zealand (Sridhar and Metcalfe, 2017). The assumed dates of introduction for the new Euro 6 emission factors are consistent with this assumption. The assumed dates are summarised in Table 6.

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Table 6: Assumed date of introduction of Euro 6 emissions standards in VEPM 6.0 for light duty vehicles

<table>
<thead>
<tr>
<th>Passenger vehicles</th>
<th>Assumed date of introduction in VEPM for new vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro 6 up to 2016</td>
<td>20-21</td>
</tr>
<tr>
<td>Euro 6 2017-2019</td>
<td>22-24</td>
</tr>
<tr>
<td>Euro 6 2020+</td>
<td>&gt;=2025</td>
</tr>
<tr>
<td>Light commercial vehicles</td>
<td></td>
</tr>
<tr>
<td>Euro 6 up to 2017</td>
<td>20-22</td>
</tr>
<tr>
<td>Euro 6 2018 -2020</td>
<td>23-25</td>
</tr>
<tr>
<td>Euro 6 2021+</td>
<td>&gt;=2026</td>
</tr>
</tbody>
</table>

2.2.2 Hybrid, plug-in hybrid and electric vehicle emission factors

VEPM 6.0 has been updated so that emissions from hybrid, plug-in hybrid and electric vehicles are reported separately. There are no emission factors available for plug-in hybrid vehicles in the EMEP/EEA guidebook. For VEPM 6.0, it is assumed that all tail pipe emission factors are 48% of hybrid vehicle emission factors. This is based on an estimate of the typical proportion of driving in electric mode undertaken for Ministry of Transport energy use estimates (Metcalfe and Sridhar, 2016).

There are no emission factors available for hybrid or plug-in hybrid LCVs so it is assumed that these are the same as passenger car emission factors.

Electric vehicles have zero emissions except for brake and tyre wear emissions, which are assumed to be the same as conventional vehicles.

2.2.3 CO₂ emission factors

CO₂ emissions are calculated based on fuel consumption. In previous versions of VEPM, tailpipe CO₂ was estimated by subtracting the equivalent amount of carbon in tailpipe VOC, CO and PM emissions from the total carbon. For VEPM 6.0, the calculation was changed to be consistent with the methodology described in the EEA guidebook (EEA, 2018) and the New Zealand Greenhouse Gas Inventory (MfE, 2017).

In VEPM 6.0, CO₂ emissions are reported as ultimate tailpipe CO₂. This is estimated based on the assumption that all carbon contained in fuel is oxidised to CO₂. Gross CO₂ emission factors from the 2017 greenhouse gas inventory (MfE, 2017) are assumed for all years:

- Petrol 66.7 tCO₂/TJ
- Diesel 69.31 tCO₂/TJ

2.2.4 Brake and tyre wear emission factors

Brake and tyre wear emission factors in VEPM 6.0 were updated to be consistent with the EMEP/EEA guidebook (EEA, 2016). The emission factor calculation takes speed into account.
For heavy-duty vehicles, the load and vehicle size (based on the number of axles) are also taken into account.

The Transport Agency provided estimated maximum default weights by axle number for typical vehicles based on the requirements of the Vehicle Dimensions and Mass Rule as follows:

- 2 axle truck – 12t, 4 wheels
- 2 axle truck 14.2t, 6 wheels
- 3 axle truck – 21t
- 4 axle truck – 26t
- 5 axle truck – 29t
- 2 axle bus – 12t
- 3 axle bus - 18t

Truck and trailers or semi trailers depend on their first to last axle spacing, but typically can have:

- 6 axle tractor semi – 39t
- 7 axle tractor semi – 41t
- 8 axle tractor semi – 44t
- 6 axle truck trailer – 39t
- 7 axle truck trailer – 42t
- 8 axle truck trailer – 44t
- 9 axle truck trailer – 50 t (50MAX permit)

The default number of axles for heavy-duty vehicles was defined based on these maximum default weights as shown in Table 7.

Table 7: Default number of axles assumed in VEPM 6.0 for calculation of tyre wear emission factors

<table>
<thead>
<tr>
<th>Vehicle classification</th>
<th>Default number of axles</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5 – 7 t</td>
<td>2 axles</td>
</tr>
<tr>
<td>7.5 - 10 t</td>
<td>2 axles</td>
</tr>
<tr>
<td>10 – 20t</td>
<td>3 axles</td>
</tr>
<tr>
<td>20 – 25t</td>
<td>4 axles</td>
</tr>
<tr>
<td>25 – 30t</td>
<td>5 axles</td>
</tr>
<tr>
<td>&gt;30t</td>
<td>6 axles</td>
</tr>
</tbody>
</table>
3.0 VEPM 5.3 versus VEPM 6.0

This section briefly describes the differences between VEPM 5.3 and the updated VEPM 6.0.

3.1 Effect on fleet weighted emission factors

This section discusses the effect of changes in the assumptions on fleet weighted emission factors. Figures 3 to 8 show fleet weighted emission factors for carbon monoxide (CO), volatile organic compounds (VOC), nitrogen oxides (NOx), PM$_{2.5}$, brake and tyre and fuel consumption from VEPM5.3 and VEPM6.0.

![CO emission factors (50km/hr)](image)

Figure 3: Comparison of CO emission factors from VEPM 5.3 and VEPM 6.0

![VOC emission factors (50km/hr)](image)

Figure 4: Comparison of VOC emission factors from VEPM 5.3 and VEPM 6.0
Figure 5: Comparison of NOx emission factors from VEPM 5.3 and VEPM 6.0

Figure 6: Comparison of PM$_{2.5}$ emission factors from VEPM 5.3 and VEPM 6.0
3.1.1 Discussion of the fleet weighted emission factor comparison

Figures 3 to 8 show that updating the fleet and emission factors generally made little difference to fleet weighted average emissions factors up to 2030. Beyond 2030, the updated fleet weighted emission factors are generally lower than VEPM 5.3 due to the much higher proportion of electric vehicles in the VEPM 6.0 fleet compared with VEPM 5.3. Some of the significant differences between VEPM 6.0 and VEPM 5.3 are discussed briefly in the following sections.
3.1.2 NOx emission factors

Figure 5 shows that there is a (relatively small) change in the fleet weighted average trend for NOx from around 2015 to 2025. This is due to changes in the NOx emission factors for light duty diesel vehicles, which are illustrated in Figures 9 and 10. For light duty vehicles, NOx emission factors are generally higher in VEPM6.0 compared with VEPM5.3 because the emission factors have been updated to reflect recent evidence about high real world emissions. NOx emission factors for diesel cars in VEPM6.0 are lower compared with VEPM5.3 beyond 2025 due to the effect of updated Euro 6 emission factors.

Figure 9: Comparison of NOx between VEPM 5.3 and VEPM 6.0 for a diesel car

Figure 10: Comparison of NOx between VEPM 5.3 and VEPM 6.0 for diesel LCV
3.1.3 Brake and tyre wear emission factors

Brake and tyre wear PM$_{10}$ emission factors are significantly higher in VEPM6.0 compared with VEPM5.3. This is because the emission factors were updated to reflect the latest available guidance.

3.1.4 Fuel consumption

Trends in fleet weighted fuel consumption are quite different in VEPM6.0 compared with VEPM 5.3. Two key reasons for this difference are:

- Updated fuel consumption factors for cars are significantly different as shown in Figure 11 and Figure 12. Trends in updated COPERT fuel consumption factors reflect recent evidence that real world fuel consumption has not significantly reduced over time.
- As shown in Figure 12, fuel consumption for petrol cars is predicted to increase slightly over time in VEPM 6.0. This is because updated COPERT fuel consumption factors for petrol cars increase between Euro 1 and Euro 4 vehicles.
- Further work is needed to ensure that the fuel consumption factors in VEPM reflect real world fuel consumption and trends in New Zealand.
- Beyond 2030, fleet weighted average fuel consumption in VEPM 6.0 is significantly lower than VEPM5.3 due to the higher proportion of electric vehicles in the updated fleet.

![Diesel car fuel consumption](image)

Figure 11: Comparison of diesel car fuel consumption from VEPM 5.3 and VEPM 6.0
Conclusions and recommendations

VEPM is now based on recent fleet information and projections from Ministry of Transport, as well as the latest emission factors from Europe.

Improvement of VEPM is an area of ongoing research, and recommendations from previous reports are not repeated here. Specific recommendations relating to regular review and update of the model are as follows:

- The fleet projection included in VEPM 6.0 is for the Base Case described in the Transport Outlook: Future State report (MoT, 2017). Fleet data for other scenarios is available and could be incorporated into future versions of VEPM to allow testing of scenarios.
- There are a significant number of vehicle classes in COPERT which are not included in VEPM. Addition of extra vehicle categories (for example buses) into VEPM could be considered for future updates.
- Cold start and degradation factors were not reviewed as part of this current update. A previous review by Pacific Environment Limited\(^5\) recommended that the COPERT Australia approach to estimating cold start emissions could be considered. Review of cold start and degradation factors, including consideration of COPERT Australia approach is recommended for future updates.
- In general, it is recommended that VEPM should be updated whenever COPERT is updated. The detailed fleet profile should also be updated regularly.

References


