VEPM versus RSD Comparisons

NAQWG Meeting – Transport Session
28 November 2013

Gerda Kuschel – Senior Air Quality Specialist*
Emission Impossible Ltd

Jeff Bluett – Team Leader - Air Quality
Golder Associates Ltd
Outline

- **Trends** – validate trends predicted by VEPM with real-world (RSD) measurements
- **Emission factors** – verify the factors used in emission inventories for light duty vehicles
Trends Report

Are the trends in on-road (RSD) vehicle emissions measurements between 2003 and 2011 comparable to trends in the light duty vehicle factors from VEPM?
Good agreement between trends in fleet average
- Mean RSD CO (%) and
- VEPM CO (g/km)

Assuming same fleet profile
Good agreement between **trends** in fleet average

- Mean RSD HC (ppm) and
- VEPM HC (g/km)

Assuming *same* fleet profile
Good agreement between trends in fleet average

- Mean RSD NO (ppm)
- VEPM NOx (g/km)

Note not the same species
**uvSmoke/PM**

**OK agreement** between trends in fleet average

- Mean RSD uvSmoke (index)
- VEPM PM (g/km)

*Note not the same species*
For the *overall light fleet*, the RSD results validate the rate of change in emissions predicted by VEPM.

The good level of agreement generally retained for *specific sectors* of the light fleet, except for:

- The trend in RSD NO (increasing) is *contrary* to the trend in VEPM NOx (reducing) from diesel vehicles.
- The rate of reduction for RSD uvSmoke is *less than* the rate of reduction in VEPM PM$_{10}$, especially for diesel vehicles.
Effect of local fleet profile

### overall light duty fleet profile

<table>
<thead>
<tr>
<th>Fuel type</th>
<th>Cars</th>
<th>Other light duty</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VEPM default</td>
<td>Auckland RSD fleet</td>
</tr>
<tr>
<td>petrol</td>
<td>75.3%</td>
<td>78.6%</td>
</tr>
<tr>
<td>diesel</td>
<td>8.1%</td>
<td>7.0%</td>
</tr>
<tr>
<td>hybrid</td>
<td>0.3%</td>
<td>0.0%</td>
</tr>
<tr>
<td>petrol</td>
<td>3.9%</td>
<td>5.1%</td>
</tr>
<tr>
<td>diesel</td>
<td>12.3%</td>
<td>9.3%</td>
</tr>
<tr>
<td>hybrid</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

### 2011 light duty fleet average emission factors

<table>
<thead>
<tr>
<th>unit</th>
<th>species</th>
<th>VEPM default light duty fleet</th>
<th>Auckland RSD fleet</th>
<th>difference vs. VEPM default</th>
<th>Rodney RSD fleet</th>
<th>difference vs. VEPM default</th>
</tr>
</thead>
<tbody>
<tr>
<td>g/km</td>
<td>CO</td>
<td>5.0</td>
<td>4.6</td>
<td>-10%</td>
<td>4.6</td>
<td>-8%</td>
</tr>
<tr>
<td>g/km</td>
<td>CO\textsubscript{2}</td>
<td>208.1</td>
<td>205.8</td>
<td>-1%</td>
<td>204.3</td>
<td>-2%</td>
</tr>
<tr>
<td>g/km</td>
<td>VOC</td>
<td>0.3</td>
<td>0.3</td>
<td>-1%</td>
<td>0.3</td>
<td>-2%</td>
</tr>
<tr>
<td>g/km</td>
<td>NO\textsubscript{x}</td>
<td>0.5</td>
<td>0.5</td>
<td>-4%</td>
<td>0.5</td>
<td>1%</td>
</tr>
<tr>
<td>g/km</td>
<td>PM\textsubscript{2.5} exhaust</td>
<td>0.03</td>
<td>0.03</td>
<td>-7%</td>
<td>0.03</td>
<td>7%</td>
</tr>
<tr>
<td>l/100km</td>
<td>FC</td>
<td>9.1</td>
<td>9.0</td>
<td>-1%</td>
<td>8.9</td>
<td>-2%</td>
</tr>
</tbody>
</table>

VEPM factors \textit{not particularly sensitive to local variations} in light duty fleet composition but needs further checking.
Emission Factor Report

To verify that the VEPM is providing useful and realistic estimates of light duty vehicle emissions and
To increase stakeholder confidence in the emission data produced by VEPM
VEPM vs RSD emission factors

**VEPM** (AC 2005 inventory)

versus

**RSD emission factors** (2006 monitoring campaign)

- Petrol cars
- Petrol light commercial vehicles
- Hybrid and Electric vehicles (none in 2005 RSD)
- Diesel car vehicles
- Diesel light commercial vehicles
RSD emission factors - petrol car example

- VEPM emission factor
- Mean
- 5 to 95%
- 25 to 75%
- Median
CO by vehicle type

Comparison of RSD and VEPM CO emission factor by vehicle type
## Traffic light criteria

<table>
<thead>
<tr>
<th>Ratio VEPM/RSD</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.50 or &gt;2.0 (more than 100% diff)</td>
<td>Red</td>
</tr>
<tr>
<td>0.50-0.67 or 1.5-2.0 (between 50 and 100% diff)</td>
<td>Orange</td>
</tr>
<tr>
<td>0.67-1.5 (less than 50% diff)</td>
<td>Green</td>
</tr>
</tbody>
</table>
### Summary of results – VEPM/RSD

<table>
<thead>
<tr>
<th></th>
<th>Petrol Car</th>
<th>Petrol LCV</th>
<th>Diesel Car</th>
<th>Diesel LCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>1.7</td>
<td>1.6</td>
<td>1.5</td>
<td>2.4</td>
</tr>
<tr>
<td>HC</td>
<td>0.7</td>
<td>1.1</td>
<td>0.3</td>
<td>0.2</td>
</tr>
<tr>
<td>NO$_x$</td>
<td>1.0</td>
<td>1.4</td>
<td>0.6</td>
<td>0.5</td>
</tr>
<tr>
<td>PM$_{10}$</td>
<td>8.2</td>
<td>21.0</td>
<td>0.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Acknowledgements

• Jayne Metcalfe (EIL) – co-author on trends report
• Martin Unwin (NIWA) - data analysis
• Auckland Council and NZTA for funding
  • Various 2003 to 2011 RSD campaigns
  • On-going development of VEPM
  • Trends and emission factors investigations
• Rob Hannaby (NZTA), Shanju Xie (AC), Iain McGlinchy (MoT) & Janet Petersen (AC) for invaluable review comments
When reports available & where from

- **Trends report** – to be uploaded to [air.nzta.govt.nz](http://air.nzta.govt.nz) website (due December 2013)

- **Emission factors report** – to be uploaded to [air.nzta.govt.nz](http://air.nzta.govt.nz) website (due December 2013) and possibly also on Auckland Council website
Thank You and Any Questions?

Gerda Kuschel
Senior Air Quality Specialist
Emission Impossible Ltd

or

Jeff Bluett
Team Leader – Air Quality
Golder Associates Ltd