Updating and extending Vehicle Fleet Emission Model

December 2018 | By Haobo Wang, Tim Denne¹, Adolf Stroombergen², Iain McGlinchy, Ralph Samuelson, Sina Mashinchi, and Stuart Badger

¹ Resource Economics
² Infometrics
What is VFEM?

- MoT’s Vehicle Fleet Emission Model can project vehicle fleet composition, energy (fuel and electricity) use, and greenhouse gas emissions
- VFEM has been used extensively for low carbon policy developments and related CBAs, as well as international reporting

Base Case

Base Case: projected vehicle fleet emissions by fuel type

- Petrol
- Diesel
- Other
- Petrol plug-in
- Diesel plug-in
- Electric
How does VFEM work?

Vehicle numbers/VKT model

Projections of Vehicle numbers/VKT

MVR database

Vehicle scrappage pattern

EV uptake model

Vehicle mix of registrations

VFEM

Fuel factors of ICE vehicles

Electricity factors of EVs

➢ Fleet mix
➢ Energy use
➢ GHG emissions
Why does VFEM need to be updated and extended?

- Currently it can only project up to 2040
  - Need to support low carbon policy for net zero emissions by 2050
- An EV uptake model was developed in 2015, mainly for light passenger vehicles
  - EV technology/market has developed fast
  - Light commercial vehicles
  - Heavy vehicles
- A study for real-world fuel efficiency was carried out in 2014
  - A large body of more recent data is available
What are we doing for VFEM?

Four work streams are underway to extend VFEM to 2055

- Updating and extending EV uptake model
  - *Detailed economic/market analysis*
  - *LPVs, LCVs, and HCVs*
- Updating real-world fuel efficiency study
  - *A large amount of data has been obtained from three sources*
- Updating and extending the vehicle numbers and VKT model
- Revising VFEM model structure, and testing and optimising VFEM
### What are the timelines?

<table>
<thead>
<tr>
<th>Work stream</th>
<th>Team</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updating &amp; extending EV uptake model</td>
<td>Resource Economics &amp; Infometrics</td>
<td>By 30 October 2018</td>
<td>Draft model and report completed</td>
</tr>
<tr>
<td>Updating real-world fuel efficiency study</td>
<td>Haobo Wang &amp; Iain McGlinchy</td>
<td>By 20 December 2018</td>
<td>Analysis of Eroad data completed</td>
</tr>
<tr>
<td>Updating &amp; extending vehicle numbers and VKT model</td>
<td>Ralph Samuelson &amp; Sina Mashinchi</td>
<td>By 30 November 2018</td>
<td>Completed</td>
</tr>
<tr>
<td>Revising VFEM model structure and optimising the model</td>
<td>Haobo Wang &amp; Stuart Badger</td>
<td>By 29 March 2018</td>
<td>Revision of model structure completed</td>
</tr>
</tbody>
</table>
A Model for Projecting the Demand for Electric Vehicles

Tim Denne, Resource Economics
Adolf Stroombergen, Infometrics

Presentation to
Transport Knowledge Conference
Wellington, November 2018
Model Structure

The model has different worksheets for:

- Inputs (yellow tabs)
- Results (green tabs)
- Scenarios (grey tabs)
- Data (red tabs)
- Workings (blue tabs).

Structure of Fleet – vehicle classes, types, sizes, travel distances, ages of entry (new & used)

Input Assumptions and background data
- Vehicle prices
- Fuel prices
- Vehicle efficiencies
- EV uptake barriers

Total Cost of Ownership (TCO) Analysis

Import Shares Analysis
- Multinomial logit
- Minimum cost
Selected Outputs:
EV% of New Registrations

(a) MNL Model: New Vehicles
(b) MC Model: New Vehicles
(c) MNL Model: Used Vehicles
(d) MC Model: Used Vehicles
Summary

The model projects a long way into the future. There is considerable uncertainty. For example:

- Oil prices
- Electricity prices
- Carbon price
- Rate of change in EV battery storage capacity
- Rate of price decline of EV batteries
- Battery depreciation (physical and economic)
- Future policy settings (e.g., excise taxes)

We don’t have a crystal ball so:

- Many inputs may be changed by the user
- But there is a risk of silly results
- Users should be careful!
Updating real-world fuel efficiency study
Real-world fuel use data from EROAD
Real-world fuel use data from EROAD – Cont’d

Diedel HCVs - Median fuel economy (L/100km) and median GVM (km) change with YoM

- Variation in FE is likely caused by GVM changes
- Further confirm that FE seems not to change with YOM for heavy diesel trucks
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Thank you