



Waka Kotahi research summary

February 2022

Improving our understanding of New Zealand's vehicle fleet greenhouse gas and harmful emissions – Stage 1

How much vehicle fuel do we use in New Zealand, how much pollution do our vehicles emit, and how accurate are our estimates?

This research project aims to enhance our understanding of the magnitude of, and uncertainty in, estimated vehicle fuel use and pollutant emissions, using currently available real-world data. The researchers also provide a method to improve the measurement and understanding of New Zealand-specific light- and heavy-vehicle emissions.

Research project key tasks

- Develop a method of effectively estimating the emissions (and their uncertainty) of light- and heavy-duty vehicles in the New Zealand fleet. Consider New Zealand-specific fleet vehicle types, driving speeds and route characteristics, and their impacts on real-world fuel consumption and emissions.
- Use this method to identify and prioritise knowledge gaps in our understanding of real-world vehicle fuel use and pollutant emissions.

- Make recommendations regarding the vehicle types that should be prioritised for real-world emission measurement, to address the gaps in knowledge.
- Recommend a monitoring method that will fill the knowledge gaps.

The key pollutants considered in the study include nitrogen dioxide, particulate matter with an aerodynamic diameter of less than 2.5 microns (health impacts) and carbon dioxide (greenhouse gas) emissions.

Method

- Identify, collate and analyse real-world measurement data, to understand the uncertainty contained in real-world emission factors.
- Identify and collect New Zealand vehicle activity and road gradient data to combine with emission factors.
- Run the Vehicle Emissions Prediction Model (VEPM) at a national scale.
- Integrate the emission factor uncertainty and VEPM outputs into a database/emissions model, the 'Uncertainty Estimation Tool' (UET).
- Use the UET to do an uncertainty and sensitivity analysis to identify and prioritise the knowledge gaps.

The UET is one of the key outcomes of the project. It collates and summarises the relevant vehicle emission and performance data that were investigated in the project and provides quantitative information to address the first three research objectives.

For each of the pollutants, the UET allowed the researchers to:

- identify the vehicle classes that had the highest impact on fleet emissions and contained the highest level of uncertainty
- attribute the total uncertainty into a small subset of model inputs
- subdivide the high-impact vehicle classes into vehicle types (fuel type and emission technology)
- undertake a sensitivity analysis on the results to ensure the findings were robust
- identify target vehicle types which, if monitored, would provide data to fill the identified knowledge gaps.

Results

The study finds that light-duty petrol and diesel vehicles have the highest impact on fleet emissions and the highest associated level of uncertainty. However, heavy-duty articulated trucks feature as having high impact and high uncertainty for both the target particulate matter and nitrogen dioxide.

The researchers propose a follow-up vehicle emissions monitoring programme. This would allow improvement in the measurement and understanding of New Zealand-specific light- and heavy-vehicle emissions. It would be a cost-effective way for Waka Kotahi to target resources to improve the VEPM and the Vehicle Fleet Emissions Model 'where it matters'.

The recommended monitoring programme includes a:

- portable emission monitoring system
- roadside remote sensing device
- tunnel study.

Waka Kotahi could analyse these data sets to differentiate the emissions of specific vehicle types and sizes, and their emission control technology.

Recommendations for further research

The researchers recommend further work to extend and enhance the findings of this project. This includes a review of new emission-monitoring methods and suggests useful VEPM updates.



RR 687 – *Improving our understanding of New Zealand's vehicle fleet greenhouse gas and harmful emissions – Stage 1*, Waka Kotahi NZ Transport Agency research report.
Available at www.nzta.govt.nz/resources/research/reports/687