7 March 2024

Hugh Marshall-Tate
Senior Analyst
He Pou a Rangi, Climate Change Commission

By email: Hugh.Marshall-Tate@climatecommission.govt.nz

Dear Hugh

Impacts of air pollution from road transport

1. Scope

Emission Impossible was commissioned by He Pou a Rangi, Climate Change Commission to review your analysis of the impacts of air pollution from road transport for the Emissions Budget 4 project.

I have reviewed:

- the overall methodology as described in your email of 22 February
- calculation of air pollution social costs for transport in the "Road" tab of the "TP_39.xlsx" workbook provided by Simon Coates (by email) on 1 March 2024
- calculation of weighted average emission factors based on VEPM outputs in the spreadsheet "non-Co2VEPM.xlsx" provided by you (by email) on 4 March, and an updated version on 5 March 2024
- calculation of annual benefits for a scenario compared with baseline in the spreadsheet "air pollution social cost.xlsx" provided on 22 February, and the updated version "air pollution social cost_6_03_2024_corrected_HMT.xlsx" provided on 6 March.

2. Corrections

I suggested a number of changes and corrections in the calculation of weighted average emission factors. These were provided to you by email on 4 March and 5 March. The changes have been implemented, and results have been updated.

3. Overall findings

The methodology is summarised as follows:

- Fleet weighted emission factors for NOx, $PM_{2.5}$, CO, and VOC (grams per km) were determined for all vehicle and fuel types, and all years in the ENZ model as follows:

    - Emission factors were obtained from VEPM 7.0[1] with speed = 50km/hr for all vehicle categories and all other settings at default 2015, 2023, 2030 and 2040 and 2050.
    - Weighted emission factors were calculated for medium trucks (3.5t to <30t, heavy trucks (>30t) and buses (>3.5t)
    - Exhaust $PM_{2.5}$ and brake and tyre wear $PM_{2.5}$ was added to give total $PM_{2.5}$ emission factors.
    - Emission factors were interpolated between 2015, 2023, 2030 and 2040 and 2050. No change in emission factors is assumed after 2050.
- Emission factors were multiplied by annual vehicle kilometres travelled for each vehicle and fuel type and each year. VKT are based on projections calculated endogenously within the ENZ model based on scenario assumptions.
- Emissions were summed to give total tonnes per annum of each pollutant from motor vehicles.
- Total annual emissions were multiplied by the damage costs provided in the Waka Kotahi MBCM (inflated from $2021 to $2023). Note that the MCBM damage costs are used in the Treasury CBAx tool.
- Social benefits due to avoided health effects were then calculated based on the difference between air pollution social costs for the baseline and a scenario.

The methodology is generally in accordance with procedures outlined in Section 3.3 of the Waka Kotahi Monetised benefits and costs manual[2].

Your estimated total air pollution social costs from motor vehicles of approximately $12.9 billion for 2016 ($2023). This is comparable with total air pollution social costs estimated from motor vehicles in 2016 in the HAPINZ study of $10.5 billion ($2019)[3] when adjusted for inflation.

Overall, based on my review, I can confirm that your methodology for calculating air pollution social costs is appropriate and robust.

Some key limitations and suggestions for future analysis are discussed in the next section.

4. Limitations and suggestions

Non-exhaust emissions

Battery electric and ICE vehicles produce non-exhaust PM emissions. These include brake and tyre wear as well as road dust (road abrasion and road dust resuspension).

VEPM includes $PM_{2.5}$ brake and tyre wear and PM_{10} brake and tyre wear factors. These emission factors are currently identical for battery electric and equivalent ICE vehicles, so brake and tyre wear factors don't need to be explicitly considered for direct replacement of ICEs with BEVs. However, I

[1] Vehicle Emissions Prediction Model V7.0 (vepm.co.nz)
[2] Monetised benefits and costs manual v1.6 April 2023 (nzta.govt.nz)
[3] Health and air pollution in New Zealand 2016 (HAPINZ 3.0): Findings and implications | Ministry for the Environment

recommend that **brake and tyre wear factors from all vehicle categories should be considered in any analysis of the air pollution impacts of mode shift**.

Emission factors for road abrasion are not currently included in VEPM, and are not considered in the Waka Kotahi MCBM. However, recent research suggests that road abrasion emissions can be significant[4]. **I would recommend inclusion of road abrasion/road dust emission factors in any analysis of the air pollution impacts of mode shift**. In the absence of factors in VEPM, European emission factors are generally used in New Zealand[5].

VEPM assumptions

A possible limitation of your analysis compared with the procedures described in the Waka Kotahi MBCM is in the selection of a single speed (50km/hour) and default user defined values for extraction of emission rates from VEPM.

For example, actual average speed and actual gradient would generally be used to extract appropriate emission factors from VEPM for assessment of emissions from a specific road. **However, it is appropriate (and necessary) to make assumptions for a national scale assessment.** Similar assumptions (selection of a single speed and default user defined values in VEPM) were made in the assessment the costs and benefits of introducing Euro 6/VI vehicle requirements for Ministry of Transport in 2022[6].

Policy design

Previous analysis has shown that air pollution social cost estimates are sensitive to policy design[7]. For example, we know that diesel vehicles contribute disproportionally to air pollution. This means that, a policy which primarily impacts petrol vehicle sales would have significantly lower air pollution benefits compared to a policy that impacts petrol and diesel vehicle sales equally. Similarly, the estimated social costs used in your analysis are based on average damage costs ($ per tonne of emissions) for New Zealand. It is likely that policy which impacts primarily in rural areas would have lower air pollution benefit, and that policy which impacts primarily in urban areas would have higher air pollution benefits compared with this average.

It is beyond the scope of this high-level national scale analysis to consider these issues in detail. However, **it should be noted that estimated air pollution social costs will depend on policy design, and that ideally, policy should be designed to maximise co-benefits.**

[4] RR683 - Determining the ecological and air quality impacts of particulate matter from brake and tyre wear and road surface dust: Stage 1 – Literature review and recommendations for developing new emission factors for New Zealand (nzta.govt.nz)
[5] 1.A.3.b.vi-vii Road tyre and brake wear 2023 — European Environment Agency (europa.eu)
[6] For this analysis we assumed a single speed of 48km/hr for all vehicles and all other settings at default to derive emissions from VEPM: MoT-Euro-6-modelling-final-report-4-July.pdf (transport.govt.nz)
[7] esr.cri.nz/digital-library/environmental-health-report-public-health-risk-associated-with-transport-emissions-in-nz-part-2-road-transport-emission-trends/

Please don't hesitate to contact me if you have any questions.

Yours sincerely

Jayne Metcalfe
Director and Senior Air Quality Specialist

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