Effect of speed on emissions

Summary of investigations undertaken by Emission Impossible and EMM Consulting

May 2023

CONTEXT

- New Zealand's road safety strategy (Road to Zero) vision is a New Zealand where no-one is killed or seriously injured in road crashes.
- Speed is one of the determinants of whether people are killed, injured or walk away uninjured from a crash
- Speed limits changes are being implemented to improve safety outcomes
- Reduced speed can impact vehicle emissions

OVERVIEW

- This presentation is based on a report summarising evidence about effects of speed management on greenhouse gas and harmful emissions[1]
- Summarises three technical reports:
  - A review of evidence about the effect of speed limits on emissions[2]; and
  - A review of literature about the effect of traffic calming measures on emissions[3].
  - A summary of modelling undertaken to estimate the impacts of speed interventions on emissions[4].
- References are provided at the end of this presentation on page 26

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OVERVIEW

Reports prepared by

- Emission Impossible, an independent New Zealand based consultancy specialising in air quality management and vehicle emissions.

and

- EMM consulting Ltd, an Australian planning and environmental consultancy.

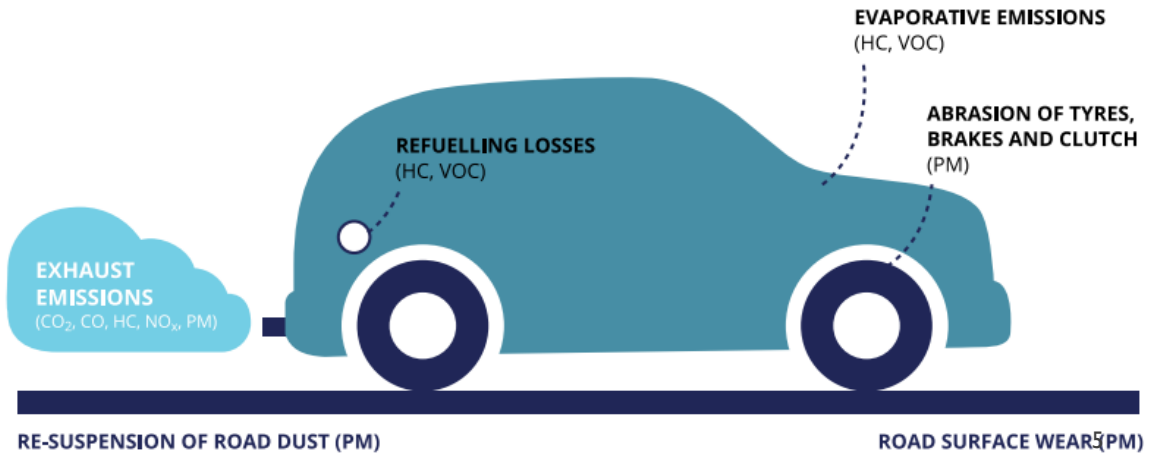
VEHICLE EMISSIONS

Greenhouse gases include:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)

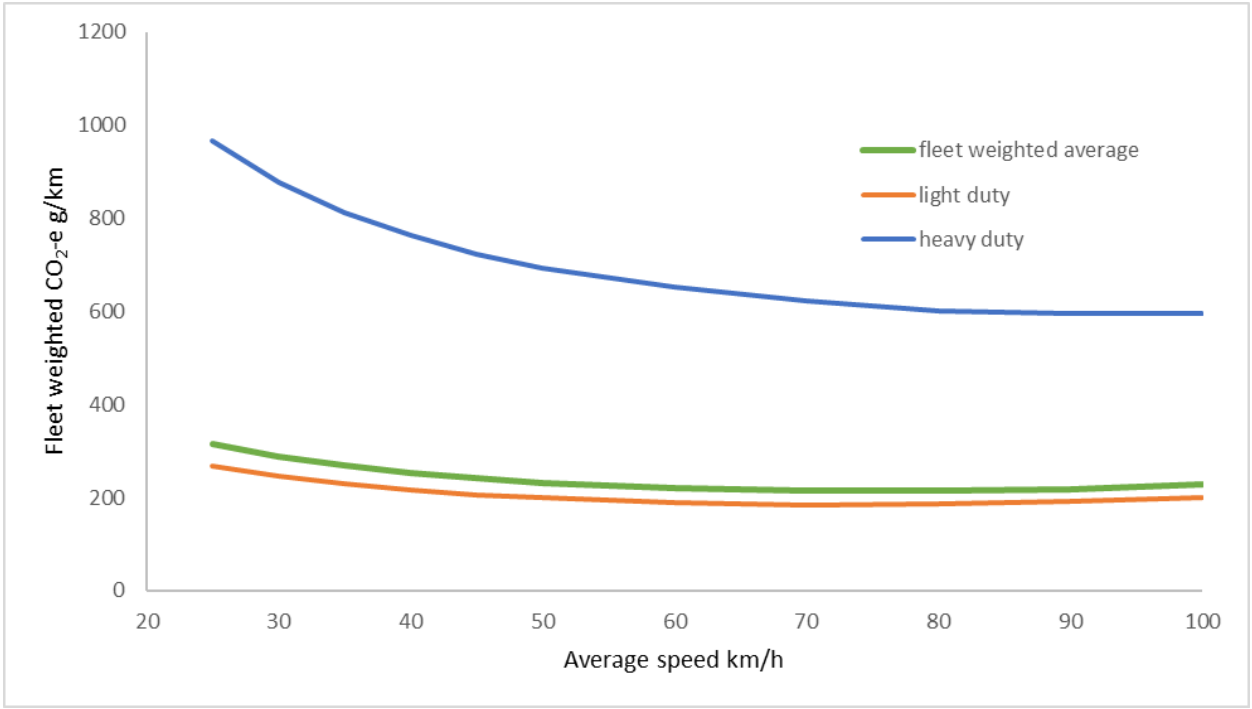
Harmful air pollutants of most concern include:

- Particulate matter smaller than 10 micrometres (PM_{10}) or smaller than 2.5 micrometre ($PM_{2.5}$).
- Nitrogen oxides (NO_X), in particular nitrogen dioxide (NO_2)



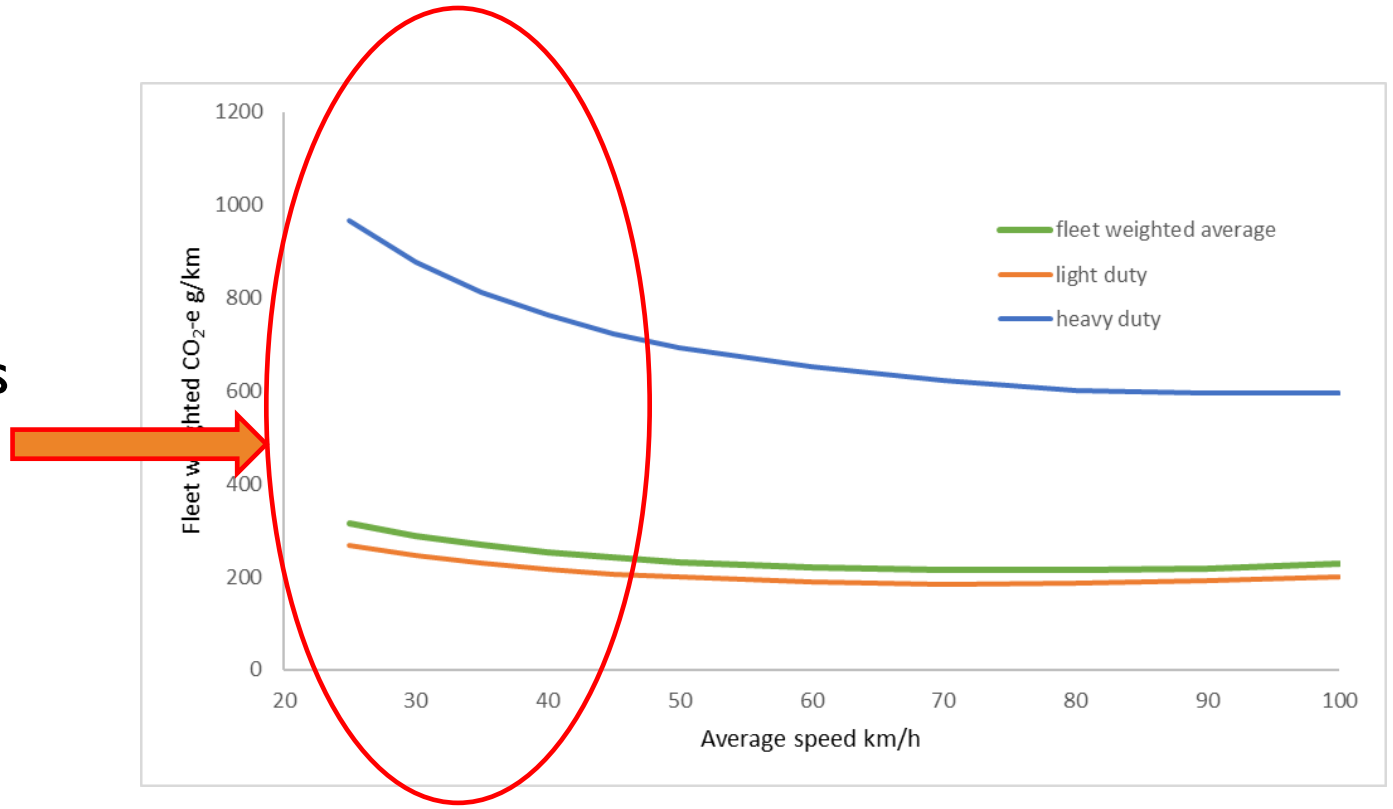
FACTORS AFFECTING VEHICLE EMISSIONS

- Speed is one factor than can affect emissions
- On average emissions tend to be higher at speeds less than about 50 km/h and more than about 80 km/h



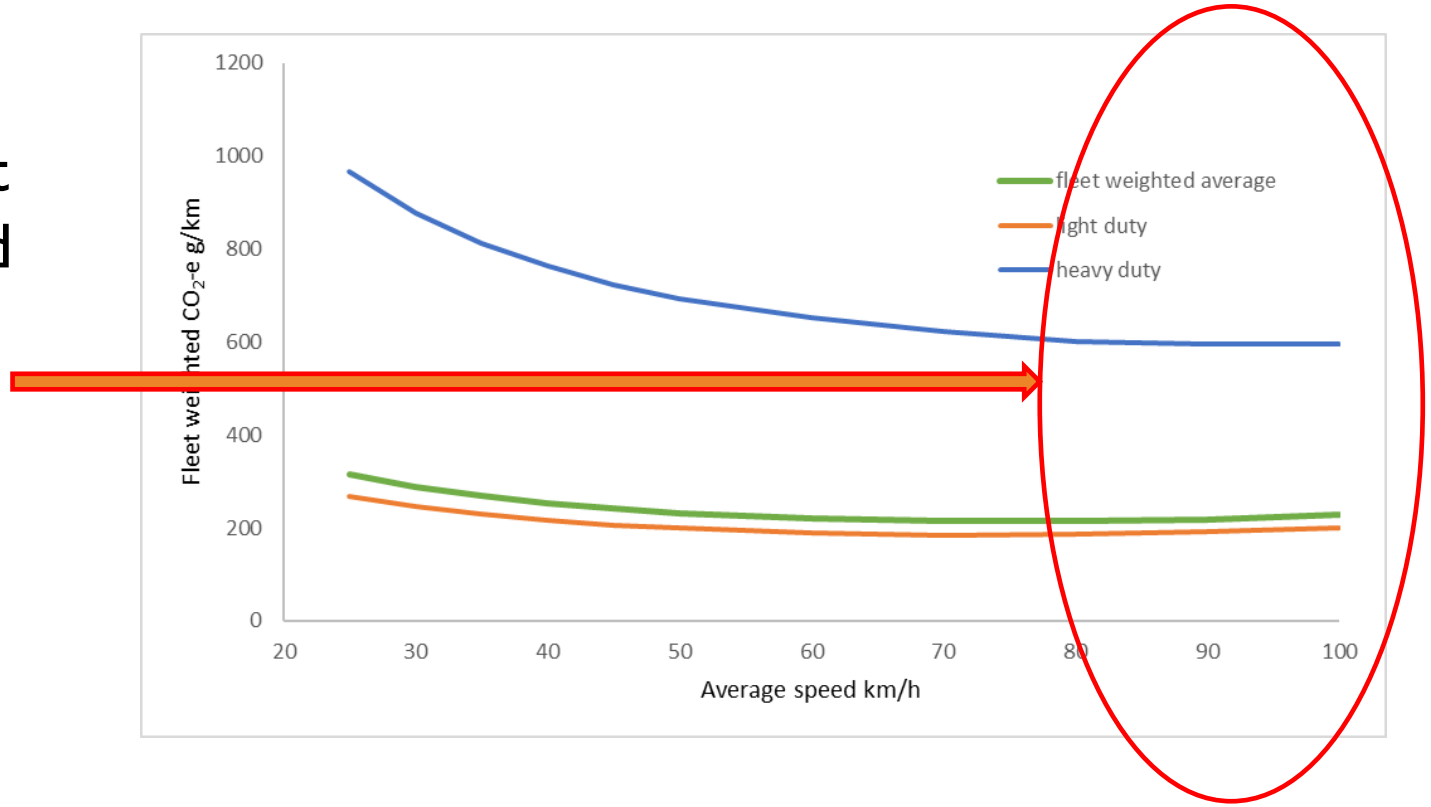
FACTORS AFFECTING VEHICLE EMISSIONS

At low average speeds (less than about 50 km/h) emissions tend to be higher because there tends to be more stop and go driving (i.e. more acceleration and deceleration)



FACTORS AFFECTING VEHICLE EMISSIONS

At high speeds (more than about 80 km/h) higher engine loads and aerodynamic resistance require more fuel and generate more emissions

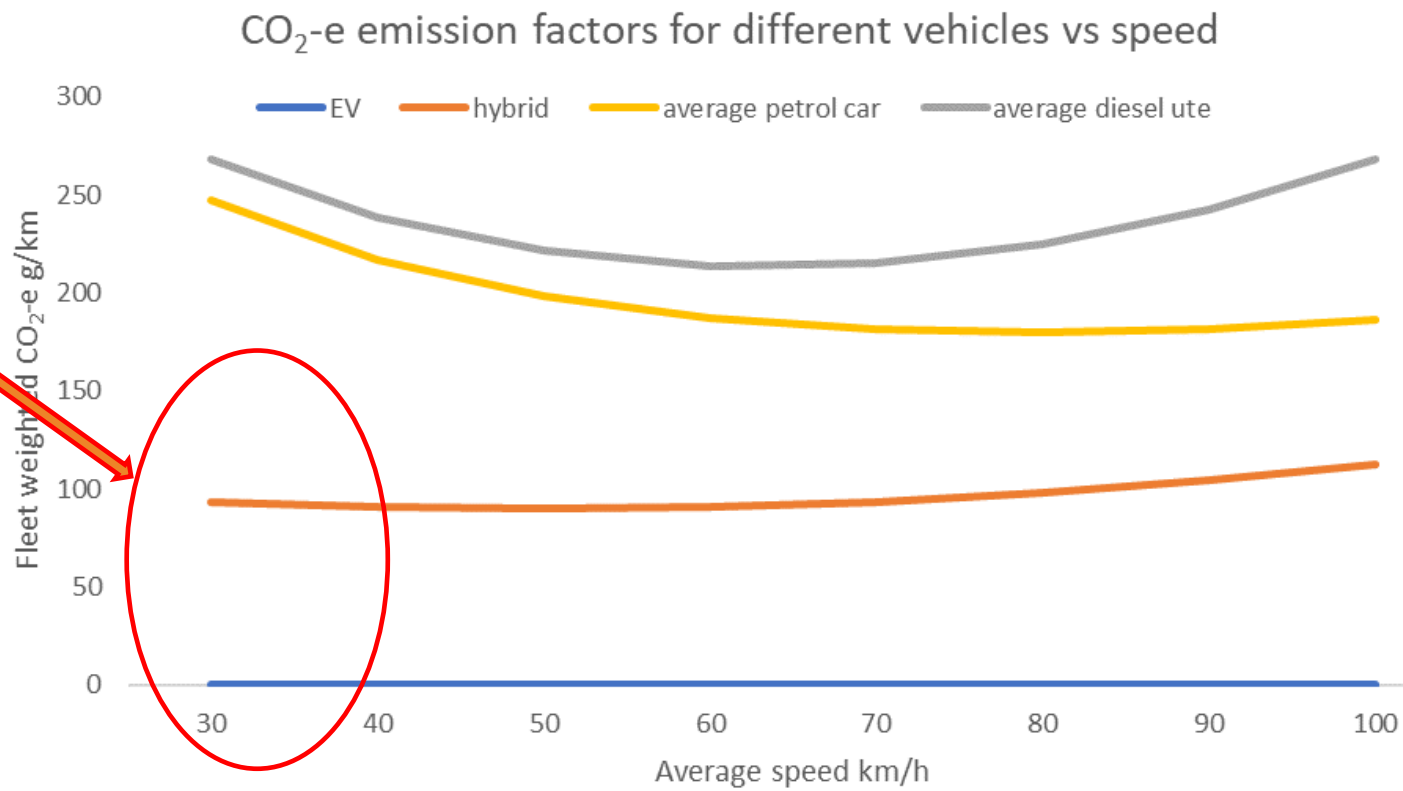


FACTORS AFFECTING VEHICLE EMISSIONS

Hybrid and electric vehicles have low emissions, and emissions aren't higher at low speeds.

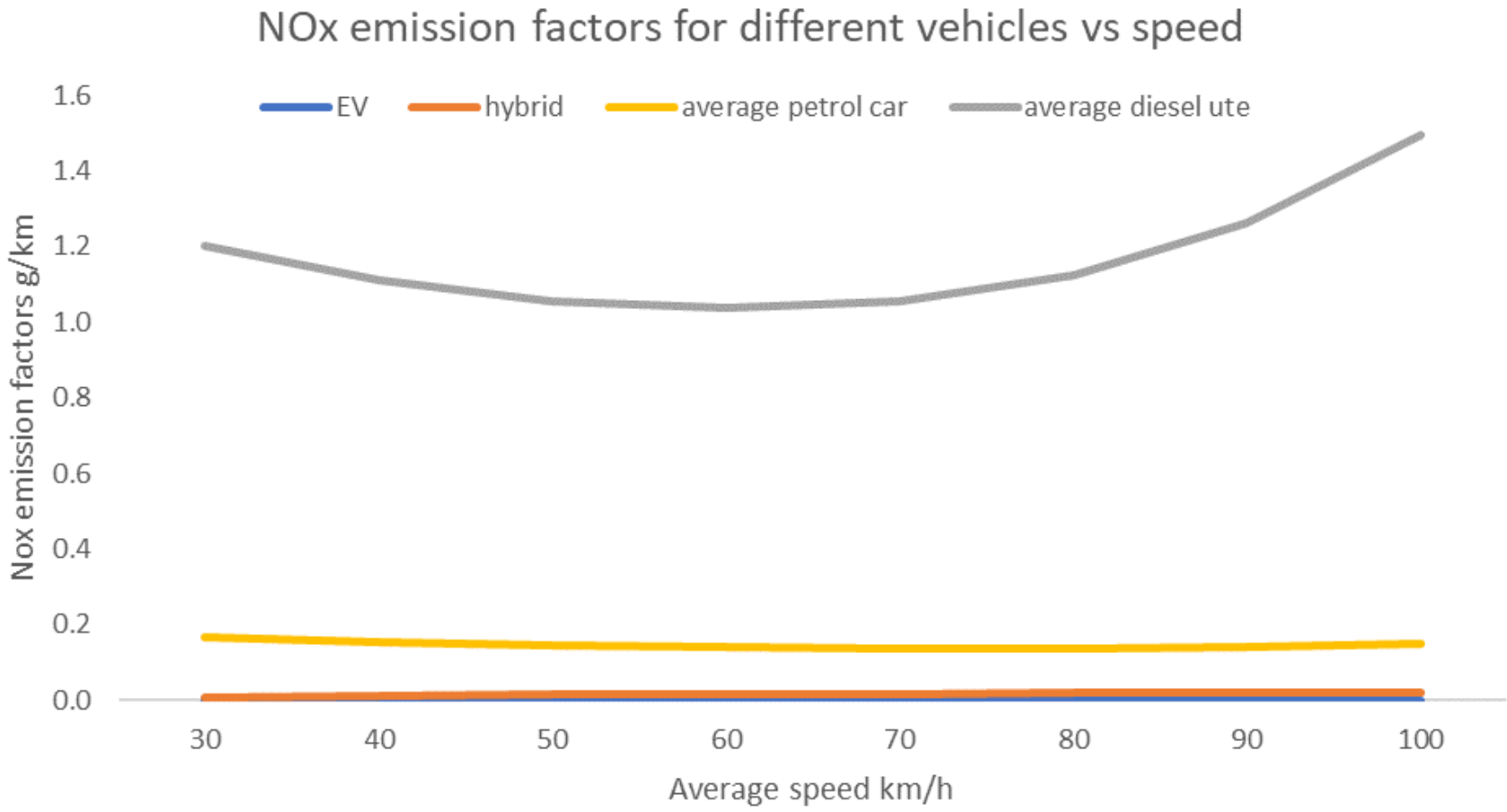
The increasing proportion of electric and hybrid vehicles in the fleet will have a big impact on fleet emissions over time.

Vehicle type is a much more important factor affecting emissions compared with speed.



FACTORS AFFECTING VEHICLE EMISSIONS

For harmful emissions, vehicle type is an even more important factor affecting emissions.



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FACTORS AFFECTING EMISSIONS

Overall conclusions:

- Speed is one of many factors that can affect emissions. However, the most significant factor is the types of vehicles in our fleet.
- Over time, the proportion of zero-emission and low-emission hybrid vehicles in our fleet will have a big impact on average fleet emissions of greenhouse gases and harmful pollutant emissions. This will be much more important than any change in emissions due to changes in speed.

EFFECT OF SPEED LIMITS ON VEHICLE EMISSIONS

- At low average speeds (less than about 50 km/h) emissions tend to be higher because there tends to be more stop and go driving (i.e. more acceleration and deceleration)

<u>but important to note that:</u>

- Vehicles travelling at lower speeds don't necessarily produce higher emissions if the vehicles are driving at **steady** speeds

EFFECT OF URBAN ROAD SPEED LIMITS ON EMISSIONS

- Three international studies have estimated the impacts of reducing speed limits from 50 km/h to 30 km/h in urban areas. The **impacts varied**, from a small increase in emissions from vehicles on the affected roads (a few percent) to a 25% overall reduction, which was attributed to the combination of traffic rerouting and smoother traffic flow at the lower speed.
- In New Zealand a real world fuel consumption study found average fuel consumption **dropped by a small amount (3% – 5%)** when reducing the speed limit from 50 km/h to 40 km/h on urban roads.

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EFFECT OF OPEN ROAD SPEED LIMITS ON EMISSIONS

- International literature typically reports that reducing the speed limit from 100 km/h to 80 km/h results in a **small decrease** in fuel consumption (less than 10%) and associated greenhouse gas emissions
- In New Zealand a real world fuel consumption study found average fuel consumption **dropped by 14-15%** when reducing the speed limit from 100 km/h to 80 km/h on the open road.

LITERATURE REVIEW: SPEED LIMITS

Overall conclusions:

- Reduction of speed limits in urban areas will not significantly impact greenhouse gas emissions from vehicles on the affected roads.
- Speed limit reductions in the 100 km/h to 80 km/h range will reduce greenhouse gas emissions from vehicles on the affected roads by a small amount (less than 10%).

LITERATURE REVIEW: TRAFFIC CALMING

- Traffic calming is the use of physical measures, such as speed bumps, to control vehicle speed and traffic volume
- Traffic calming measures can increase vehicle accelerations and decelerations, which can in turn increase emissions

PHOTO: AUCKLAND TRANSPORT

LITERATURE REVIEW: TRAFFIC CALMING

The **overall effect** of traffic calming on emissions across the whole affected area is likely to be small because:

- Traffic calming measures tend to be implemented on low-traffic residential roads, or on isolated segments of busy roads (for example in the vicinity of schools)
- Traffic calming can lead to some reduction in overall traffic volume and some diversion of traffic (onto unaffected roads)

PHOTO: AUCKLAND TRANSPORT

LITERATURE REVIEW: TRAFFIC CALMING

International studies have found no measurable effect on **ambient air quality** in areas where traffic calming has been implemented.

PHOTO: AUCKLAND TRANSPORT

LITERATURE REVIEW: TRAFFIC CALMING

Overall conclusions:

- The overall impact of traffic calming on greenhouse gas emissions, ambient air quality and air pollution health impacts of traffic calming measures across the affected area would be small (emissions are likely to increase by less than 10%).
- It is unlikely that traffic calming measures will result in poor local air quality even in the vicinity of traffic calming measures.

OVERALL IMPACTS: MODELLING

- Modelling by the Auckland Forecasting Centre predicts impact of speed limit changes on emissions is less than 1% at 2035
- As with any modelling exercise, there is some uncertainty in the results.
- However, the results provide a useful estimate of overall impacts.

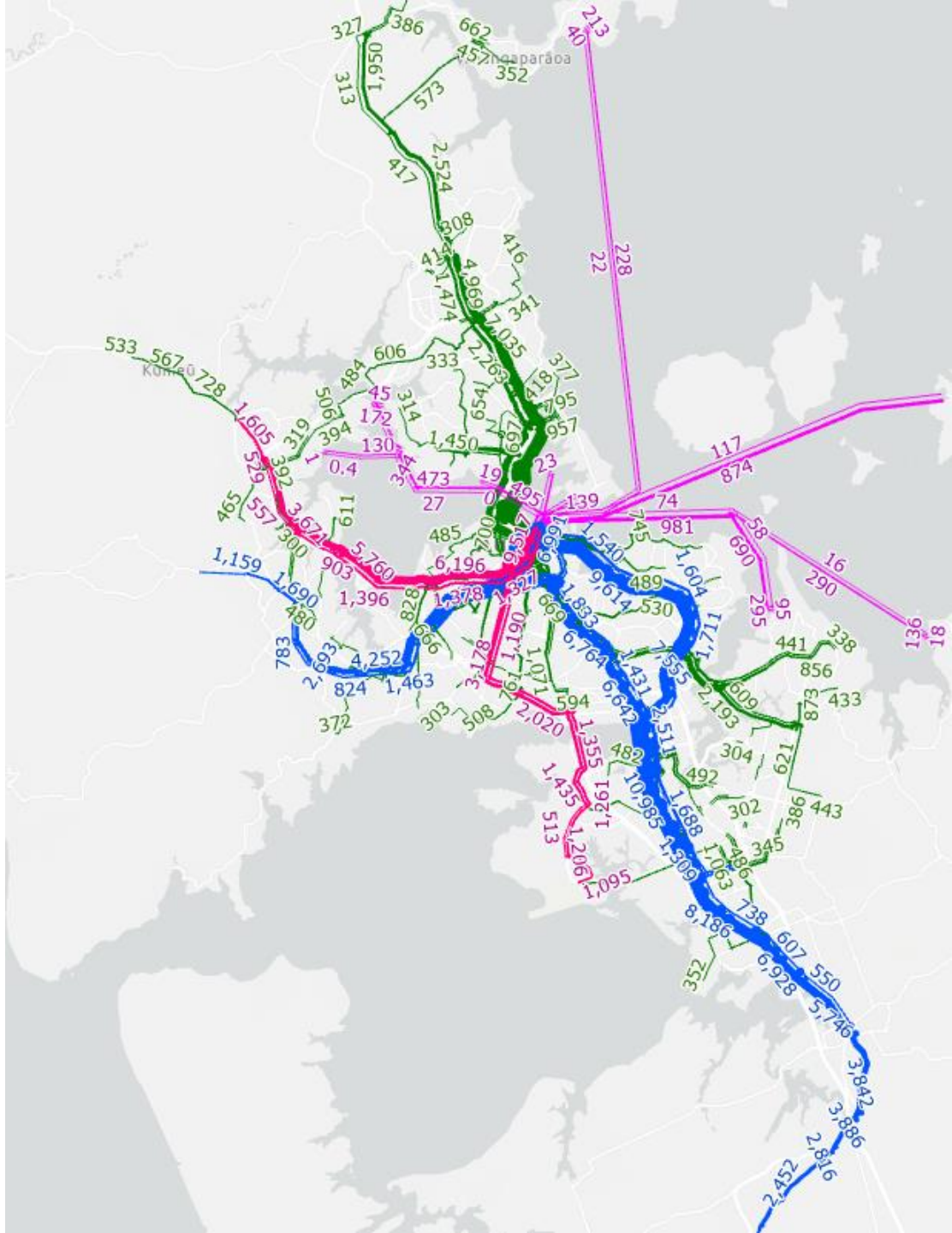

PHOTO: AUCKLAND FORECASTING CENTRE

OVERALL IMPACTS

Conclusion:

- Taking into account findings from our literature reviews, as well as the results of a detailed modelling study for Auckland, we conclude that, although speed management can affect emissions, the overall impact in Auckland is expected to be small (possibly an overall increase or decrease of around 1%).

HOW DO WE REDUCE EMISSIONS?

Modelling shows that to achieve significant reductions in vehicle emissions and air pollution health impacts we need to increase the proportion of zero emission vehicles in the fleet and reduce vehicle travel

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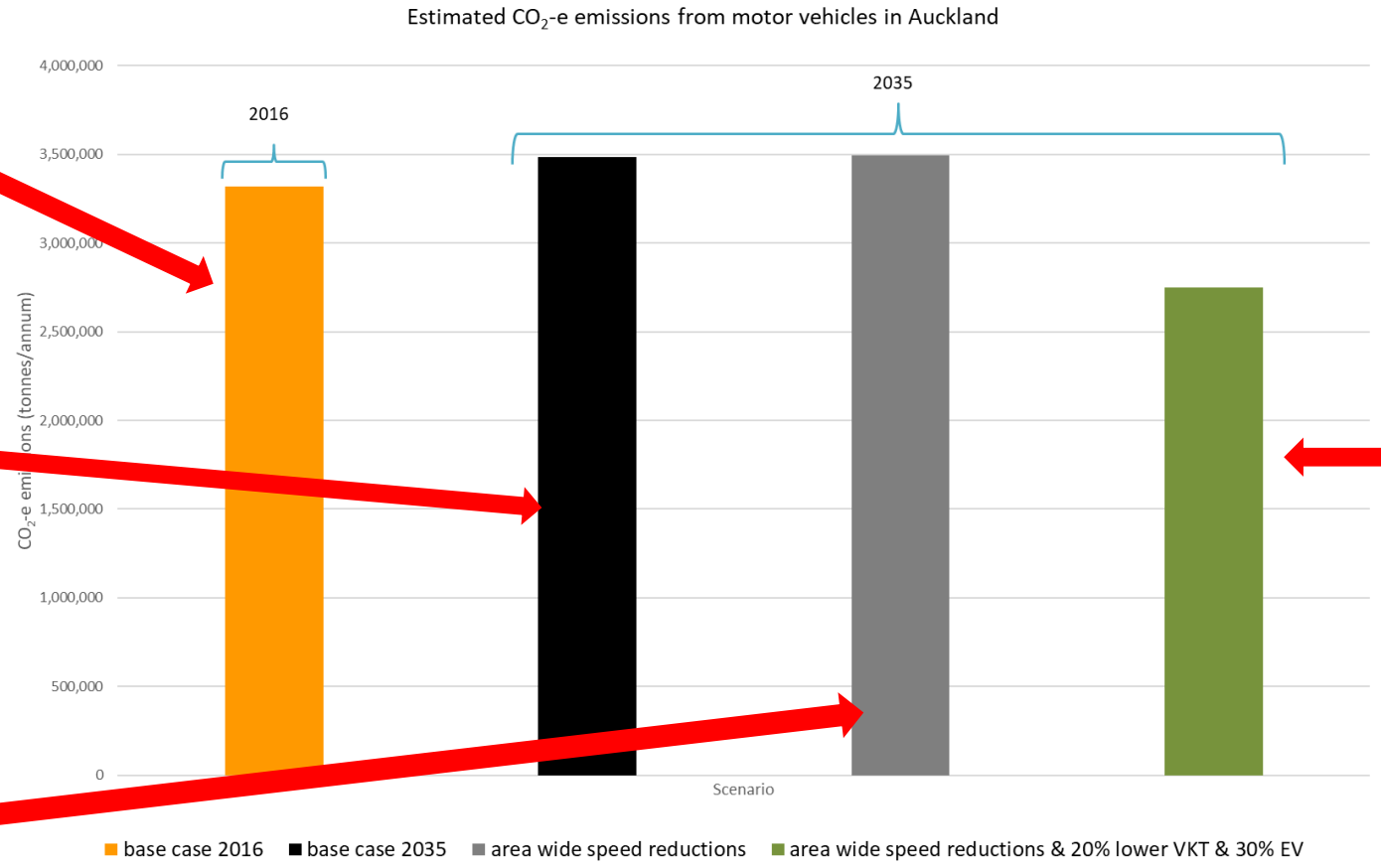
REDUCING EMISSIONS: EXAMPLE OF ESTIMATED VEHICLE GREENHOUSE GAS EMISSIONS IN AUCKLAND

CO_2-e: 2016

CO_2-e: 2035 without speed interventions

CO_2-e: 2035 with speed reductions across Auckland



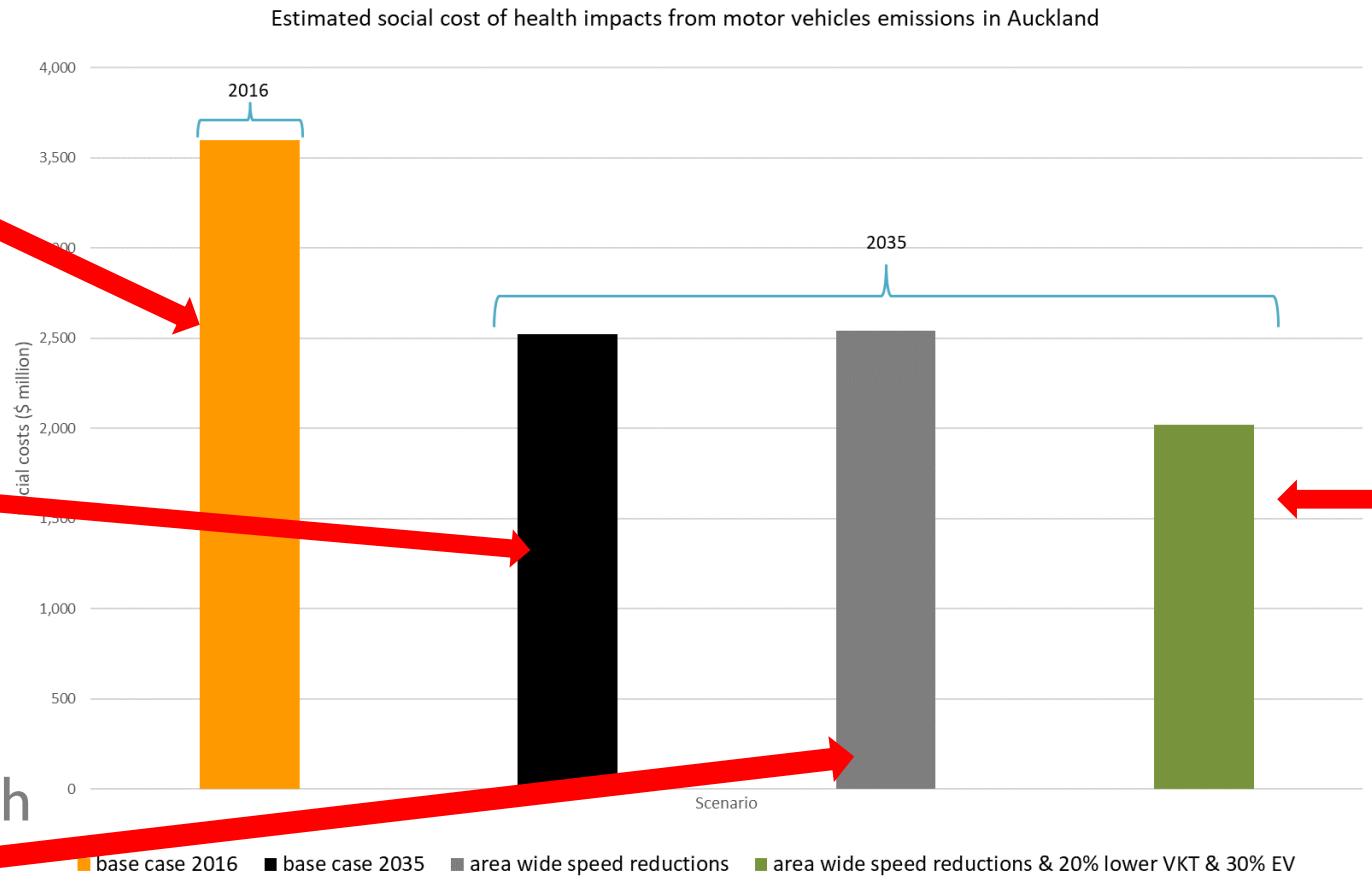
CO_2-e: 2035 with 20% reduction in light vehicle travel and 30% of light duty vehicles being electric

REDUCING EMISSIONS: EXAMPLE OF ESTIMATED SOCIAL COSTS OF VEHICLE AIR POLLUTION IN AUCKLAND

Social costs: 2016

Social costs 2035 without speed interventions

Social costs 2035 with speed reductions across Auckland



Social costs 2035 with 20% reduction in light vehicle travel and 30% of light duty vehicles being electric

CONCLUSIONS

Our review finds that, although changes in vehicle speed can affect emissions, **the overall impact of speed management interventions in Auckland is expected to be small.**

Importantly, to achieve national and regional greenhouse gas emission reduction targets, and to reduce the health impacts of poor air quality, **we need to reduce vehicle travel**.

Speed reduction, which makes it safer to walk and cycle, **is a critical component of our emission reduction pathway for Auckland and New Zealand**.

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REFERENCES

1. Metcalfe (2023) *The effect of speed on emissions: summary report.* Report prepared by Emission Impossible Ltd for Waka Kotahi and Auckland Transport. May.

2. Metcalfe and Boulter (2022) *Effect of speed on greenhouse gas emissions from road transport: a review*. Report prepared by Emission Impossible Ltd, and EMM Consulting, for Waka Kotahi, September, 2022.

3. Gilbert and Boulter (2022) *Traffic calming: effects on emissions and air quality. Literature review*. Report prepared by EMM Consulting, November 2022

4. Metcalfe (2023a) *Effect of speed and mode shift on air quality health impacts and greenhouse gas emissions from motor vehicles in Auckland.* Report prepared by Emission Impossible Ltd for Auckland Transport and Waka Kotahi, May.