



NZTA research summary

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The demographics of private motor vehicle kilometres travelled (VKT) in New Zealand

To impact transport users' behaviour and provide an efficient transport system, we need evidence on travel patterns and the role of household features, fleet composition and network characteristics.

To date, our understanding of these factors is partial and based on a few data points. This report provides a comprehensive understanding of the vehicle kilometres travelled (VKT) of households across New Zealand, focusing on their demographic and spatial characteristics.

What we did

We investigated:

- the demographic factors influencing VKT, the role of fleet composition and contextual factors
- variations in VKT across regions and by the features of roads and the public transport (PT) network
- the impact of VKT demographics on private vehicle ownership and battery electric vehicle uptake.

VKT profiles will help to improve the effectiveness of pricing (and mode shift) policies, which has been identified as critical for estimating the generalised costs between modes. This makes the findings of the current report critical for any assessment of the effectiveness of pricing policies and the other drivers of VKT. Technically, we identified a crucial role in VKT demographics and various modelling frameworks used for informing policy decisions. We also developed a publicly available VKT database that will be available for future research.

We used frontier methodologies to gather various datasets together

We explored the available literature and identified that the current studies are not based on a comprehensive dataset. We used the best available methods to address the complexities of constructing the dataset using various sources, including the Motor Vehicle Register, Statistics NZ's administrative population census, NZ Transport Agency Waka Kotahi (NZTA)'s Rightcar safety ratings, environmental ratings and others. The report explores the technical complexities of gathering this data and describes our solutions. The dataset covers odometer readings between April 2018 and June 2024.

The literature shows significant variation in the impacts of VKT determinants

Our review of the available literature identified a long list of VKT determinants (demographic, vehicle, economic and spatial features) with varying estimated impacts from one study to another. This highlights the importance of establishing an evidence base and local data for studies of VKT patterns across New Zealand regions and communities.

What we found

Consistent with common knowledge, our **descriptive statistics** (not controlling for other factors) show that VKT positively correlates with the number of dependent children and household and individual income. Other observations are as follows:

- The least-deprived groups have higher VKT per household, but deprivation group 10 (most-deprived group) also has higher VKT per household than average.
- The households with one or two people have a lower VKT than the mean.
- VKT is negatively correlated with the age of the oldest member of the household.
- Spatial patterns of VKT indicate a close negative correlation with PT coverage.
- While the most-deprived areas indicate high emissions, there are variations in the emissions observed for the least-deprived areas across the regions.
- Auckland has a relatively high VKT per vehicle for low-safety star vehicles.

After **controlling for confounding factors**, a comparison between our regression results and the descriptive statistics suggests the following:

- While descriptive statistics show a positive correlation between VKT and income, this correlation changes to negative after controlling for other demographic factors. This suggests that income and VKT correlate with other confounding factors and indicate that, while income is not necessarily the cause of high and low VKT, it is a useful target/summary measure for VKT policy.
- The higher VKT of self-employed people drives the initially positive correlation with employment. The correlation with employment became negative after controlling for other demographic factors and being self-employed.
- VKT is higher for households located in the urban core and in areas outside of the metropolitan area, but this relationship changes after we control for local features, particularly PT coverage and access to amenities.
- After fixing the PT coverage (assuming the same level of PT coverage across suburbs and households), petrol vehicle VKT decreases.
- VKT has a significant negative correlation with PT coverage.

VKT is positively associated with being male, Māori and Pacific, low-income, older, having more dependent children and having higher education. More interestingly, our **regression analysis** suggests the following:

- An increase in the number of cars is associated with lower VKT. One additional car per household decreases VKT by 6%, and this relationship is decreasing – the VKT is declining below 6% for a third or more vehicles.
- Lower VKT in dense areas is driven by access to amenities and facilities.
- VKT is positively correlated with travel time to the nearest town centre using PT, walking and cycling and negatively correlated with travel time to the nearest town centre using a car.
- The highest VKT due to regional features is for Waikato, Bay of Plenty, Canterbury and Hawke's Bay.
- VKT is lower in most tier 3 urban environments (Gisborne, West Coast and Tasman).

We explored **electric vehicle (EV) patterns** and identified that decreasing the distance to EV chargers by 340m increases the likelihood of EV adoption by 0.07% – this implies an elasticity of 0.007.

- This relationship decreases with density and income.
- Being in an area with a high population density is associated with a lower likelihood of EV adoption. This is after controlling for compounding factors.
- A 1% higher population per square kilometre (equal to 19.1 people) is associated with a 0.05% decrease in the likelihood of EV adoption.

These **vehicle features** are more significantly correlated with VKT (than demographics) and after controlling for other factors:

- Newer cars travel more, and the relationship is (non-linear and) decreasing.
- Station wagons have higher VKT than other body types, and convertibles have the lowest VKT.
- Electric cars travel more than petrol cars (with the above-mentioned caveats).
- While diesel vehicles seem to travel more than petrol cars initially, the correlation becomes negative after controlling for demographic features.
- Larger cars travel more than other vehicle sizes.

While important, demographic factors do not explain **car ownership** significantly. Although we identify significant impacts on car ownership, the low goodness of fit suggests that a broader range of factors may affect the car ownership decision. This finding helps reduce car ownership policy decisions. We also tested the correlation between these factors and vehicle emissions, excluding VKT. The results suggested a very low goodness of fit (at around 4%). This finding may indicate that users do not consider vehicle emissions in their vehicle ownership decisions.

Next steps

Overall, this report improves our knowledge of VKT patterns significantly. The outcomes provide a rich dataset for exploring a wide range of policy and technical questions:

- Applying a similar approach to establish a VKT dataset for freight using Statistics NZ's Longitudinal Business Database will provide an invaluable data source for freight policy.
- Further analysis of the endogeneity of the factors of VKT. This report used a large dataset to establish the correlations between VKT and various aspects. The dataset's large size and the parameters' persistence across regression models indicate the robustness of the established correlations. Further analysis will be required to understand the impact of each identified factor. For example, an additional assessment of the correlation between proximity to EV charging stations on VKT suggested a significant role for density, household income and location features. The established dataset provides the information needed for future research on different aspects of VKT.
- A granular analysis of own and cross-VKT elasticities is unavailable in New Zealand. This would be particularly useful for understanding the impact of pricing policies such as tolling.
- Further assessment of the drivers of EV uptake. This report provides initial results to inform EV uptake policies. A future report should focus on specific hypotheses and consider various policy levers.
- Further assessment of local factors of modal share under different policies. The granular data is beneficial for understanding the impact of policies on the combination of price and quantity (revenue).
- Time-of-use pricing policies can be analysed by further disaggregating the explanatory variables and linking the established VKT dataset with other Integrated Data Infrastructure datasets.

- Improving forecasts of VKT and fleet composition by linking the established dataset with an advanced socio-economic model such as the Regional Land Transport Demand Model. This is particularly useful as an input to fleet composition forecasts.
- To inform that modelling (and forecasts of fleet composition) is helpful to improve our understanding of preference changes and social norms that have been identified as critical factors in shaping preferences and ultimately matter significantly to VKT over time.
- The dataset could be further used to investigate the impact of changes in preferences such as working from home, which are critical for VKT forecasts. Another essential factor that could be investigated is the impact of infrastructure availability such as PT coverage and the low-hanging fruit (least-costly policies) for future investment to achieve different policies such as mode shift.
- The impact of policies is often realised with delay. The frequent data available on motor vehicle registration and its linkage to address data could be used to establish an informative local dashboard of VKT that will monitor policy impacts promptly.
- The low explanatory power of demographics, built environment and regional context for vehicle ownership motivates further research into the impact of other factors such as travel demand management policies and the role of social norms on vehicle ownership.



RR 745: *The demographics of private motor vehicle kilometres travelled in New Zealand.*
 NZ Transport Agency Waka Kotahi research report.
 Available at www.nzta.govt.nz/resources/research/reports/745