Mixed results for emissions and roadside air quality

The Kiwi penchant for diesel and older passenger vehicles may be limiting our ability to achieve cleaner air at the roadside despite advances in emission control technology and legislation, according to new research.

The Transport Agency's *Understanding trends in roadside air quality* study found mixed results for roadside measurements of vehicle emissions and roadside air quality.

Recent vehicle emissions control technology has led to general improvements in emissions of pollutants. In addition, monitoring of ambient air at roadside locations has shown that both carbon monoxide (CO) and oxides of nitrogen (NOx)[1] concentrations have decreased since 2006.

However, the study found the increased percentage of light duty diesel vehicles and the presence of older 'gross emitting' vehicles within the New Zealand fleet may be partly responsible for the slowing down in improvements to roadside ambient NOx concentrations between 2011 and 2014.

Report author, Jeff Bluett, of Golder Associates (New Zealand), notes, as a result, 'We may not be realising the anticipated benefits in roadside air quality.'

The study

This 2015 study used a roadside remote sensory device (RSD) to measure vehicle emissions from about 38,600 light-duty vehicles and 630 heavy-duty vehicles on Auckland roads. This study is a continuation of earlier RSD campaigns conducted in Auckland in 2003, 2005, 2009 and 2011.

While the RSD measures a number of parameters in vehicle exhaust emissions, the focus of the current study was on NO and CO. The study notes that the ratio of NO and NO2 in vehicle exhaust varies. Because of this there are some limitations on using NO alone to assess trends in vehicle NOx emissions, but overall it was considered a useful marker.

The RSD findings were compared to ambient air quality data from permanent roadside monitoring sites in Auckland and Christchurch to gain a better understanding of trends in roadside air quality over time in New Zealand.

Vehicle fleet trends

As part of the RSD campaign, the characteristics of the monitored vehicles were also documented. This included vehicle age, mileage, fuel type (petrol or diesel), vehicle size (heavy or light duty), emissions control standard, mileage and whether the vehicle had been imported to New Zealand new or used from Japan.

Analysis of the light-duty vehicle data showed a marked age difference between petrol and diesel vehicles, with an average age of 11.3 years for the petrol vehicles and 8.2 years for the diesel ones. New Zealand-new light-duty vehicles were an average 7.9 years old compared with the average age of 14 years of a Japanese used import. All of these figures are younger than national averages, reflecting the make-up of the Auckland vehicle fleet.

Diesel vehicles comprised 18% of the monitored light-duty vehicle fleet, compared with 12.5% in 2003. This trend is consistent with changes seen in national fleet statistics.

The heavy-duty vehicle data showed an increase in the average age of these vehicles: from 12.3 years in 2015, compared with 9.2 years in 2003.

Vehicle emissions findings

The RSD study found CO and NO emissions from light duty vehicles in New Zealand decreased significantly between 2003 and 2015, with an average vehicle in 2015 emitting about half the CO and NO levels of the vehicles monitored in the earlier 2003 study. A similar trend was observed for CO emissions from heavy-duty vehicles, with NO emissions from these vehicles remaining relatively stable.

The study found that most of the drop in measured NO vehicle emissions occurred before 2009. Emissions then stabilised in the 2011 and 2015 monitoring campaigns. Between 2009 and 2015 the average NO emissions from diesel light-duty vehicles actually increased.

The RSD also confirmed diesel vehicles emit disproportionately more NO, with diesel light-duty vehicles emissions approximately 60% higher than those of petrol light-duty vehicles. The opposite trend was observed for CO, where in 2015, the mean CO emissions measured from petrol light-duty vehicles were more than 10 times greater than those from the diesel light-duty vehicles.

[1] Oxides of nitrogen or NO_x is a collective term used for nitrogen dioxide (NO_2) and nitrogen monoxide (NO).

When these results are ‘considered in the context of an increasing number of diesel light-duty vehicles within the fleet profile, a significant challenge is created for managing future roadside concentrations of NOx,’ the author said.

For petrol vehicles, newer emissions control technology resulted in improvements to vehicle emissions for both CO and NO. However, increased vehicle age and mileage were associated with decreased emissions performance.

Diesel vehicles were a different story; the average NO emissions from light-duty diesel vehicles have not improved significantly with recent emissions control technology. Mileage did not appear to have a significant impact on diesel vehicle emissions. These findings are consistent with other international studies and are not unique to New Zealand.

For petrol vehicles, it was found that ‘gross emitting’ vehicles had a significant impact on average CO and NO emissions. The impact of gross emitters on average emissions has increased since the first 2003 monitoring campaign. Overall the effect of gross emitting vehicles on mean diesel emissions is less, and does not appear to be increasing.

What this means for roadside ambient air

Roadside ambient air NOx concentrations measured by regional councils in both Auckland and Christchurch decreased between 2006 and 2010, and then appeared to stabilise between 2011 and 2014.

The initial improvements may be related to significant improvements in vehicle emissions control technology implemented over that period.

The recent stabilisation in roadside ambient NOx concentrations may result from a balancing of negative and positive pressures. That is, the negative pressure of an increased proportion of diesel light-duty vehicles in the New Zealand fleet, combined with the poor emissions performance of older and gross emitting petrol light-duty vehicles, may be being more or less balanced by the generally better emission performance of newer petrol light-duty vehicles. Combined, these result in relatively stable roadside NOx concentrations in 2011 and 2014 ambient monitoring, the study concluded.

The roadside ambient CO concentrations measured in Auckland and Christchurch decreased between 2003 and 2014. This decrease is consistent with the overall reduced CO emissions from both the light- and heavy-duty portions of the vehicle fleet measured during the RSD monitoring campaigns.

Where to next?

The study recommends continuation of the RSD monitoring campaigns. Tracking this data over time provides many benefits, such as validating vehicle emission models, understanding the effect of a changing fleet profile on vehicle emissions and identifying the effect of gross emitting vehicles.

The author identified gaps in the data recorded at the roadside air quality monitoring sites and suggested that key sites be identified and ‘future proofed’ to enhance the analysis of air quality trends.

Stakeholders, such as regional councils and transport providers, should be involved to help ensure the longevity, quality and value of such record keeping.

Further research could also focus on particulate emissions, particularly from diesel vehicles, as this was an important consideration in terms of human health effects and could further enhance the understanding of vehicle emissions and their effect on air quality in New Zealand.