

AIR QUALITY

On-road remote sensing identifies the worst vehicle polluters



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A campaign to measure vehicle emissions using a remote-sensing technique has yielded significant information about pollution from vehicles under normal driving conditions.

Every major city in the world faces problems associated with emissions of air pollutants from motor vehicles. In some cases these are severe and growing, with few prospects for short-term improvements. One cost-effective approach may be to target the worst offenders: often, the total emissions are dominated by a small number of vehicles with very high emissions.

In New Zealand’s urban areas, particularly in Auckland, vehicle emissions are responsible for much of the air pollution. However, there is a dearth of information on the emissions of New Zealand’s vehicle fleet. This has made it difficult to develop targeted policies to reduce emissions and to monitor the effectiveness of any policy that is implemented. To provide some baseline information on vehicle emissions in Auckland, NIWA monitored emissions using a remote-sensing technique. The work was undertaken for Auckland Regional Council.

Emissions: caught by a light beam

Vehicles contaminate the atmosphere by emitting by-products of the fuel combustion process. By-products include carbon monoxide, hydrocarbons, nitric oxide, and particulates. Remote sensing is one of the most efficient methods of measuring emissions from

a large number of vehicles as they are being driven. Exhaust emissions are measured as vehicles pass by a sensor. A light beam passes through the exhaust plume of the vehicle to a detector. The pollutants discharged from the vehicle’s exhaust absorb some of the light beam; the amount of the light remaining is measured at the detector and is used to determine the amounts of pollutants discharged by the vehicle. Emissions of carbon monoxide, hydrocarbons, and nitric oxide can be detected because they absorb light from different parts of the spectrum.

NIWA carried out remote-sensing measurements of exhaust emissions from over 40,000 vehicles at 16 sites throughout the Auckland region during April 2003. We used a remote-sensing system from the University of Denver, USA, which not only measured exhaust emissions, but also videoed the number plate of the vehicle, and put up a real-time display to give drivers an immediate message on whether their vehicles had “good”, “fair”, or “poor” emissions. In general, poor

The remote-sensing system in operation at a sampling site in the Auckland region. The exhaust emissions of a pass-by car were measured and the display showed a “good” emissions result. The number plate of the car was also videoed.

Teachers’ resource for NCEA AS: Science 2.2, 2.6; Chemistry 1.2. See www.niwa.co.nz/edu/resources



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emissions indicate a badly tuned and inefficiently run vehicle, which is also costing the motorist extra money to run.

Vehicle maintenance important

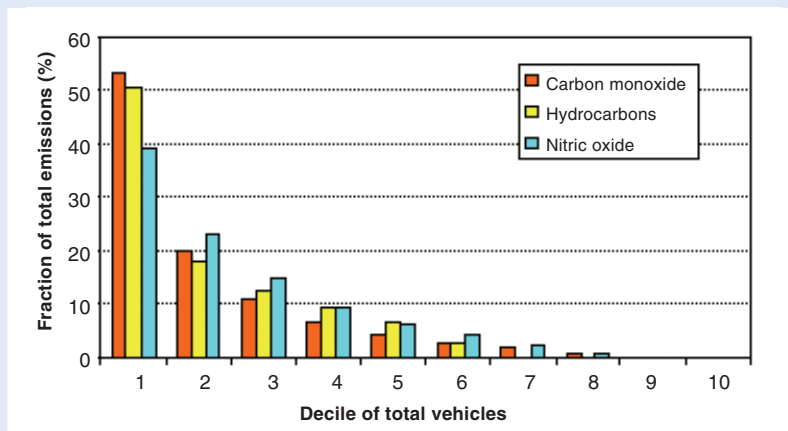
Our study found that the dirtiest 10% of vehicles were responsible for over 50% of the total carbon monoxide and unburned hydrocarbon emissions, and almost 40% of the total nitric oxide emissions. On the other hand, the cleanest 50% of the fleet contributed to less than 10% of the total emissions.

Analysis of the emissions trends with vehicle age showed that, on average, older vehicles are more polluting than newer ones. However, the best 20% of old vehicles emit less pollution than the worst 20% of new vehicles. Clearly, well-maintained and well-operated old vehicles emit fewer contaminants than poorly maintained and operated new vehicles. This highlights the importance of vehicle maintenance in reducing emissions.

The New Zealand vehicle fleet consists of approximately 50% NZ-new vehicles (vehicles first registered and only driven in New Zealand) and 50% imported used vehicles. Most used vehicles (97%) are imported from Japan. We found that NZ-new vehicles are generally more polluting than Japanese-imported used vehicles. This unexpected result is probably because vehicles driven in Japan require a higher level of technology (such as fuel injection and catalysts) in order to meet Japanese emissions regulations. As New Zealand has few emission regulations, NZ-new vehicles consequently incorporate less sophisticated exhaust emission control technology, or even none in some cases. (New Zealand Traffic Regulations (1976) prohibit excessively smoky emissions; see the Ministry of Transport's website for information about the "10 second rule": www.mot.govt.nz/downloads/03-pamphlet.pdf) The results from similar studies in the United States demonstrate that vehicles in Auckland emit three times the amount of hydrocarbons, and twice the amount of carbon monoxide and nitric oxide, than their US counterparts.

Relevance to policy setting

These results indicate that there is scope and opportunity to clean up the Auckland vehicle fleet. In particular, resource-efficient reductions can be achieved by targeting particular portions of the fleet – the gross emitters. The



Contributions by deciles (10% of the vehicles measured, from the dirtiest to the cleanest emissions) to total emissions of carbon monoxide, hydrocarbons and nitric oxide.

study showed clearly that these gross emitters are not necessarily the older portion of vehicles, but can include new model vehicles as well. Other results from the study have also provided valuable information, such as data on the types of vehicles that might be gross emitters.

The potential benefit of emissions reduction is significant. The New Zealand government has introduced a number of new policy initiatives to improve air quality through reductions in emissions from vehicles. One of these, promulgated in 2003, has been the introduction of fuel standards that will see sulphur contents progressively reduced so that by 2007 New Zealand standards will come into line with those in the EU. Another initiative being considered in 2004 is the introduction of vehicle emissions standards.

Our remote sensing campaign has provided information relevant to such policies. The study has clearly demonstrated the value of remote-sensing information for effective emissions-reduction policy development, and further studies are planned to assess the effectiveness of new policies once they are enacted. ■

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Further reading

Fisher, G.W.; Bluett, J.G.; Xie, S.; Kuschel, G.I. (2003). On-road remote sensing of vehicle emissions in the Auckland Region. *Auckland Regional Council Technical Publication No.198*, available from www.arc.govt.nz under Air Quality Publications and Documents.