Australian Government

Department of the Environment, Water, Heritage and the Arts

September 2009

THE SECOND NATIONAL IN-SERVICE EMISSIONS STUDY:

Community Summary

Introduction

The quality of the air we breathe affects our health and even small improvements in air quality can achieve benefits for human health and wellbeing. High concentrations of the major air pollutants are associated with respiratory problems such as coughs, bronchitis, asthma and, in severe cases, developmental problems during pregnancy, and even death. In addition to improvements in health, the economic benefits from reducing air pollution include savings in health expenditure and reductions in sick leave.

In 1998 the Australian, State and Territory governments agreed to national air quality standards for six common and widespread air pollutants.[1] These are: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb) and fine particulate matter of 10 microns or less in diameter (PM_{10}—particles smaller than the diameter of a human hair).

Motor vehicles are a major source of the common air pollutants, including hydrocarbons (HC), volatile organic compounds (VOCs) and oxides of nitrogen (NOx). In Sydney, for example, motor vehicle exhausts contribute over 71 per cent of NOx and over 38 per cent of VOCs, excluding emissions associated with refuelling.[2] NOx and VOCs are the major contributors to ozone formation.

The key measures aimed at controlling motor vehicle pollution are national vehicle emission standards (see below) and national fuel quality standards[3] (e.g. removing lead prior to 1 January 2002 and lowering benzene and sulphur in fuel).

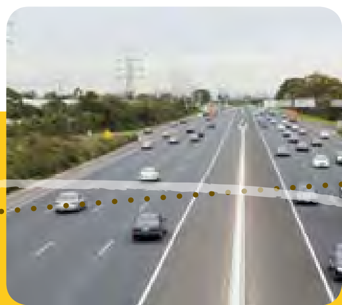
The national vehicle emission standards are set out in the Australian Design Rules[4] (ADRs). The ADRs are design standards for new vehicles. In the emissions context, they limit a vehicle's exhaust emissions of CO, HC, NOx, particulates for diesel vehicles and also set a maximum limit for evaporative emissions of HC from petrol vehicles. In attempting to improve air quality in our major cities, a key response has been to improve the emissions performance of new vehicles through progressive tightening of ADR emission limits.

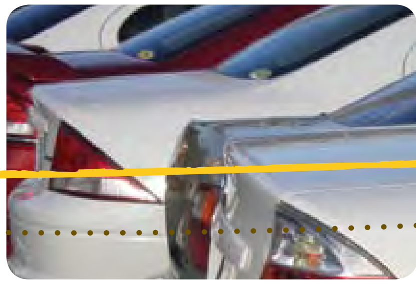
1 This agreement was made through the *National Environment Protection Measure for Ambient Air Quality,* administered through the National Environment Protection Council, see http://www.ephc.gov.au/taxonomy/term/23, accessed 20/07/09

2 Department of Environment and Climate Change NSW et al, 2007, *Air Emissions Inventory for the Greater Metropolitan Region in New South Wales: Criteria Pollutant Emissions for all Sectors: Results (Technical Report No. 1),* (Table 3.104), Department of Environment and Climate Change NSW, Sydney, http://www.environment.nsw.gov.au/resources/air/tr1aei0712.pdf, accessed 20/07/09

3 Fuel quality standards and the *Fuel Quality Standards Act 2000* are administered by the Department of Environment, Water, Heritage and the Arts. See http://www.environment.gov.au/atmosphere/fuelquality/standards/act/index.html, accessed 20/07/09

4 Australian Design Rules are administered by Department of Infrastructure, Transport, Regional Development and Local Government under the *Motor Vehicle Standards Act 1989,* see http://www.infrastructure.gov.au/roads/motor/design/index.aspx



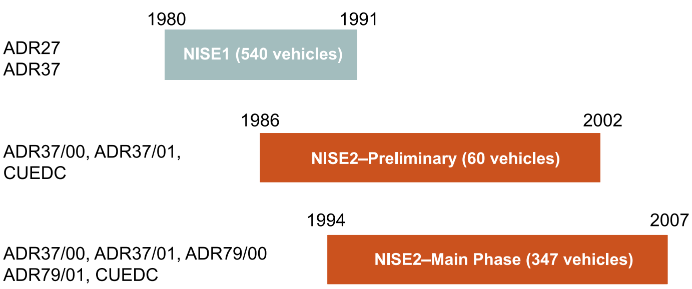


Understanding our urban emissions

This fact sheet is about a major study periodically commissioned by the Australian Government, which aims to measure the emissions being released by motor vehicles on our roads and to estimate how well these vehicles are complying with the ADR limits. These studies test and analyse the emissions that are emitted from a motor vehicle's tail pipe and from its fuel system under controlled laboratory conditions.

The first of these studies was called the National In-Service Emission Study[5] (NISE1). It was undertaken by the then Federal Office of Road Safety in 1996. NISE1 reported on the emissions and fuel consumption of 613 petrol fuelled passenger vehicles manufactured between 1971 and 1993. The recently completed Second National In-Service Emission Study[6] (NISE2)—the topic of this fact sheet—adds to this knowledge base by testing more recent vehicle models manufactured between 1986 and 2007 (see Figure 1). The study takes into account the changing profile of the Australian petrol vehicle fleet which has recently seen increases in the number of imported vehicles and a shift in the vehicle mix.

Figure 1: ADR regulations and years of manufacture used in the NISE1 and NISE2 studies. NISE2 testing used ADR37/00 (1986–98), ADR37/01 (1999–2003), ADR79/00 (2004–05) and ADR79/01 (2006–07) and a petrol Composite Urban Emissions Drive Cycle (CUEDC).



5 Federal Office of Road Safety, 1996, *Motor Vehicle Pollution in Australia: Report on the National In-Service Vehicle Emissions Study,* Canberra, see http://www.infrastructure.gov.au/roads/environment/emission/str_national-in-service.aspx, accessed 20/07/09

6 Orbital Australia Pty Ltd, *Second National In-Service Emissions Study (NISE2) Light Duty Petrol Vehicle Emissions Testing,* Commonwealth of Australia, Canberra, available from http://www.environment.gov.au/atmosphere/airquality/, accessed 20/07/09

NISE2 processes and methodology

NISE2 was broken up into two parts. The principal focus of the first (preliminary) part was to develop a test drive cycle, representative of an every day trip to work by an average car, and to test a sample of 60 vehicles against this new cycle. The drive cycle has segments which represent residential, urban, freeway and congested driving. Earlier testing in programs such as NISE1 relied on the standardised tests used for certifying vehicles to the ADRs.

The second (main) phase of NISE2 included:

- Measuring the exhaust emissions and fuel consumption of a representative sample (347 vehicles) of light duty petrol engine vehicles manufactured between 1994 and 2007. The exhaust emissions were measured using chassis dynamometers (see Figure 2) located at Orbital Australia's facilities in Perth, WA.

Figure 2: Measuring exhaust emissions—vehicle testing in an emissions chassis dynamometer (ECD) lab.

The pollutants measured included HC, CO, NOx, $PM_{2.5}$ (i.e. particles of sizes 2.5 microns or less) and the greenhouse gases carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Particle size and number distributions were also measured, allowing for data on PM_{10} and PM_1 (i.e. particles of sizes 10 microns or less and 1 micron or less) to be derived.

- Measuring the evaporative emissions of a subset of the vehicles (72) using the ADR79/01 test method, which includes a 24 hour diurnal phase and a one hour hot soak test. The 24 hour diurnal phase test measures loss of fuel vapour from parked vehicles as a result of the daily ambient temperature increases. The vehicles are subjected to a controlled ambient temperature profile over 24 hours inside a Variable Temperature Shed (see Figure 3). The one hour hot soak test measures any fuel vapour released for one hour immediately after the vehicle has been switched off.

Figure 3: Measuring evaporative emissions—ADR79/01 Variable Temperature Shed.

NISE2 results

The results from NISE2 build on to those from NISE1. Whereas the NISE1 fleet included a significant number of older pre-catalyst vehicles, most vehicles tested under NISE2 were equipped with active emission systems with catalysts for exhaust after-treatment.

Key findings from NISE2 include:

- The average level of emissions from vehicles manufactured during the 1994 to 2007 period has reduced significantly, clearly a result of progressively more stringent ADR emission standards.
- The majority of the vehicles tested were compliant with the applicable legislated emission limits as described in the ADRs. This study has shown fewer passenger vehicle ‘gross polluters’ (see inset) than NISE1.
- Many larger sports utility vehicles and light commercial vehicles were higher emitters of emissions than comparable age passenger vehicles, reflecting lower standards to which these vehicles were built.

What is a gross polluter?

A gross polluter is a vehicle that fails to meet an ADR specified emission standard by a large (unspecified) margin. These vehicles can pollute many times more than a vehicle that complies with ADR specified emissions standards. Gross polluters can potentially be responsible for over 50 per cent of the vehicle-sourced air pollution in an urban area.

An older vehicle may produce higher pollutant levels than its modern equivalent, but this does not necessarily make it a gross polluter if its emissions are comparable to the levels it was designed to achieve.

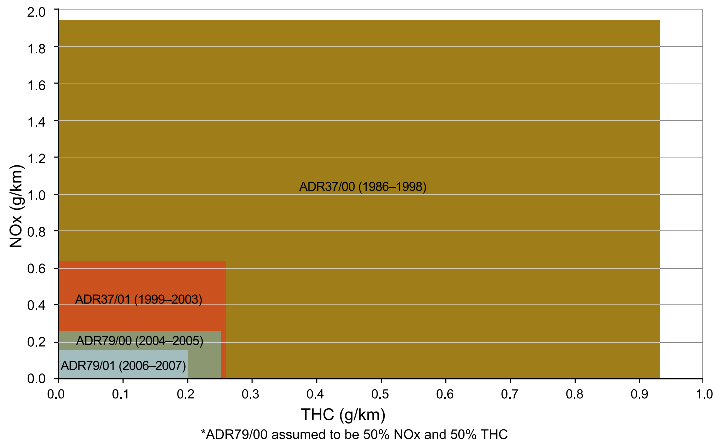
- The NISE2 project has highlighted potential concerns about 'real world' levels of evaporative emissions. The results indicate that when vehicles are parked in warm conditions for an extended period (more than a day), the evaporative emission control systems may not be able to effectively control the build up of evaporative hydrocarbons, as even the latest systems are only designed to provide effective control for a continuous 24 hour period.
- On average, passenger vehicle fuel consumption and greenhouse gas emissions have not shown significant change over the period this study has examined. The data suggests that, in itself, replacing older vehicles with newer vehicles, without significant changes in the mix of vehicle sizes, engine capacities or fuel types, would not result in significant greenhouse gas emissions benefits.

Where to from here?

The vehicle emissions data produced from the two NISE studies, as well as other Australian studies that have tested the different vehicle and fuel types that make up Australia's transport fleet, provide an increased capacity to utilise local emissions data in state-based emission inventories, instead of relying on factors derived from overseas data.

With a growing fleet of diesel and LPG vehicles contributing to transport emissions and the variable nature of aftermarket LPG conversions, consideration of a separate testing project for these fuels may be warranted. Governments are also currently assessing the value of regulating CO_2 emissions from motor vehicles and the merits of a further tightening of light vehicle emission standards to reflect recent changes to the international standards on which the ADRs are based. As shown by the graph below (Figure 4), air polluting emissions from new motor vehicles have been significantly reduced since 1986, and NISE2 has shown that this has led to a major reduction of in-service emissions from the Australian petrol passenger vehicle fleet. It demonstrates the success of the Australian Government's actions to reduce vehicle emissions through progressively more stringent Australian Design Rules, supported by better fuel quality standards, leading to improved air quality outcomes for all Australians.

Figure 4: ADR emission limits (and year of manufacture) for NOx and THC.



As well as seeking continuous improvement in the air quality performance of new vehicles, Australian governments are now also looking at options to reduce air pollution from a range of sources including wood heaters and marine engines.

Further information

For access to the full NISE2 report and NISE2 study data, go to:
http://www.environment.gov.au/atmosphere/airquality/index.html

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