Vehicle Emissions Working Group
The Department of Infrastructure and Regional Development
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Submission from the Centre for Air quality and health Research and evaluation (CAR)

Subject: Commonwealth of Australia Vehicle Emissions Discussion Paper

Thank you for the opportunity to comment on the Vehicle Emissions Discussion Paper.

The Centre for Air quality and health Research and evaluation (CAR) (www.car-cre.org.au/) is a Centre of Research Excellence funded by the National Health and Medical Research Council. CAR's role is to enable research on the impact of air pollution on human health and to translate that research into contributions to policy that aim to mitigate that impact. CAR offers opportunities for researchers, operating in diverse but related disciplines, to create and apply knowledge about air pollution and health of both national and international interest. CAR is a collaboration among senior researchers in the fields of epidemiology, exposure assessment, toxicology, air physics and chemistry, biostatistics and clinical respiratory medicine based at universities in Queensland, New South Wales, Victoria and Tasmania. Some CAR investigators are currently undertaking research into traffic related air pollution and associated health effects.

The discussion paper focuses on the contribution of vehicle emissions to carbon or greenhouse gas emissions. It indicates that a working group has been established under the Ministerial Forum to investigate measures to reduce noxious and carbon dioxide (CO_2) emissions from the road transport sector (pg. 2). While the focus of the discussion paper is on the reduction of greenhouse gas emissions, the paper also acknowledges the potential for impact on health and indeed notes that motor vehicle emissions can significantly impact on human health and the environment (pg. 3).

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Vehicles as a major source of air pollution

Vehicle emissions include not only CO_2 as a greenhouse gas, but also substantial concentrations of nitrogen oxides (NO_x), fine and coarse particulate matter ($PM_{2.5}$ and PM_{10}), ultrafine particles (UFPs), volatile organic compounds such as benzene, toluene and ethylbenzene amongst others. Secondary gaseous pollutants, such as nitrogen dioxide (NO_2) and ozone (O_3), are also formed from reaction among primary air pollutants.

The discussion paper (pg. 3) notes that motor vehicles are a major contributor to NO_x in Australian cities and that diesel motor vehicles produce NO_x at a higher rate than petrol vehicles (and are permitted to do so under current standards). Our recent research (unpublished) developing a land use regression model (a model used for estimating pollution exposure, combining measured pollution data and land use information) for western and south western Sydney found that, of four major predictors of NO_2, three of the predictors were traffic related (traffic load on minor roads within 50m of a location; traffic load on main roads within 500m of a location and heavy traffic on a main road within 300m of a location). It is calculated that this model can predict 87% of the change in NO_2 concentrations in Sydney. This finding is similar to a land use regression model used to predict NO_2 for the Lane Cove area before and after the opening of the Lane Cove Tunnel (Rose et al, 2011). These models demonstrate the contribution of vehicles to NO_2 levels in Sydney (and potentially other major urban areas in Australia) and support New South Wales Environment Protection Authority's estimates of an approximate 72% contribution of traffic to NO_x (DECCW, 2009).

There is ample evidence to indicate that, for many of the air pollutants, higher concentrations occur along roadsides (Karner et al, 2010; Zhou & Levy, 2007). However, the pollutants also disperse to affect the local neighbourhood. A study conducted in Sydney by CAR researchers found that levels of NO_2 and NO_x were greatest within 100m of busy roads (Cowie et al, 2012a). They also showed that reductions in traffic volumes along some roads led to reductions in NO_x and NO_2 concentrations. This demonstrates the opportunities to make improvements in air quality in local neighbourhoods and thereby reducing the exposure to hazardous air pollutants for people living close to main roads.

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Health impacts of vehicular emissions

Due to the substantial contribution of vehicle emissions to NO_x and PM concentrations in ambient air, these air pollutants (and including NO_2) are widely used as markers of traffic related air pollution in epidemiological studies. Most epidemiological studies look for associations between exposure to pollutants and health outcomes using one or two pollutants in isolation, for example, NO_2 or PM_{10} or $PM_{2.5}$. The evidence of harm from vehicle emissions is substantial and has been the subject of several reviews conducted by major organisations (HEI, 2010; WHO, 2005) and others (Brugge et al, 2007; Salam et al, 2008). These reviews illustrate the vigour and extent to which this subject has been, and continues to be, studied.

Traffic related air pollution has been associated with a wide range of adverse health outcomes including exacerbation of respiratory symptoms especially in children, adverse effects on lung function, increased risk of cardiovascular disease such as myocardial infarctions, stroke, and adverse pregnancy outcomes such as premature births. Toxicological evidence and evidence from chamber studies provide some understanding of the mechanisms of action of vehicle emissions, reporting increases in biomarkers of inflammation and other cellular changes occurring after exposure. A landmark study (Peters et al, 2004) reported an increased risk of having a myocardial infarction (heart attack) after being exposed to traffic, either by time spent in a car, on buses or while riding a bicycle or motorcycle, although travel by car was the more common route of exposure. A study conducted in Sydney (Cowie et al, 2012b) showed that short term exposures of two hours (people walking alongside a main road in Sydney (Parramatta Rd, Camperdown)) were associated with increased airway inflammation, and eye and throat symptoms, compared to two locations that were distant from main roads, demonstrating the ability to detect effects from local exposures to vehicle emissions.

Health impacts of particulate matter air pollution

As there already is an extensive literature of the adverse health effects attributable to ambient PM (both PM_{10} and $PM_{2.5}$), implementation of measures to reduce vehicle emission of PM in Australia are welcomed. A recent World Health Organization review (WHO, 2013) highlights that there is no safe level or threshold for harm for PM. This suggests that even low levels of PM, below current guidelines or standards, may be damaging to health. While the health effects of PM are largely focussed on cardiovascular and respiratory disease, there is also evidence for increases in cancer risk, diabetes, adverse birth outcomes and possible neurological impairment. CAR has recently completed a major review of the health effects associated with PM from various sources, including PM from both non-diesel vehicles and diesel vehicles (Hime et al, 2015). The individual chapters on these two vehicular related sources clearly present the health effects associated with their exposure. This report is accessible from CAR's website (http://www.car-cre.org.au/images/content/Health%20impacts%20of%20PM%20report_final%20for%20web.pdf).

Given the above, CAR recommends that the levels of PM to which the Australian population is exposed should therefore be as low as practically possible to mitigate the harmful effects of PM. As such, CAR supports any measures that lead to a reduction of ambient air pollutants, including those outlined in the discussion paper. These measures include implementation of more stringent fuel standards as well as implementation of vehicular manufacturing technology that reduces emissions from vehicles. Previous successful reduction measures include the substantial removal of lead from petrol and introduction of Euro standards.

Health impacts of ultrafine particles

At this time, there is insufficient evidence of health effects related to UFPs (particles smaller than 0.1 µm) to warrant introduction of a standard (2). However, there is an increasing body of evidence that short-term exposure to UFPs is linked to adverse health effects. Given the known ability UFPs to reach the systemic circulation through inhalation (3), together with specific toxicological actions (including cell and DNA damage) (4), it is likely that future studies will show that UFPs are associated with adverse health effects.

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Health impacts of NO_x/NO_2

NO_2 is associated with adverse health effects – increases in hospital admissions, decreases in measures of lung function and lung function growth, increases in respiratory symptoms, asthma prevalence, asthma incidence, cancer incidence, adverse birth outcomes and mortality (US EPA, 2015; WHO, 2013). There has been some debate whether the health effects are caused by NO_2 itself, or by some other traffic related air pollutant(s) with which it is correlated in the ambient air. However, the current consensus is that there is a causal relationship between NO_2 and adverse health effects, particularly for respiratory effects (Committee on the Medical Effects of Air Pollutants, 2015; WHO, 2013). It is also generally agreed that there is no threshold for NO_2 exposure and adverse health effects. The evidence base, however, for assessing the existence of a NO_2 threshold is weaker than that for fine particles (US EPA, 2015; WHO, 2013).

Changing urban settings

The discussion paper (pg. 4) highlights that Australia's increasingly urbanised and ageing population may be more susceptible to the adverse health impacts of noxious vehicular emissions. In 2012, 66% of Australians lived in capital cities. Current pressures of in-fill development and urban renewal in our cities mean that more and more homes (apartments in particular) are being built along main with high traffic loads. This practice will increase the number of people exposed to higher concentrations of vehicle emissions.

Fuel efficiency considerations

The discussion paper (pg. 10) discusses fuel efficiency and states that the preferred method of measurement of fuel efficiency is calculation of grams of CO_2 emitted per km (g/km). This ensures all fuel types are comparable and recognises the "broader environmental benefits of improved fuel efficiency". While diesel engines are considered more fuel efficient, they also produce much higher concentrations of noxious emissions (pg. 16). We believe it is important that a decrease in CO_2 emissions should not be accompanied by an increase in other harmful emissions, for example, PM (including UFPs) and NO_x. Given the likely adverse health effects associated with UFPs, as outlined above, consideration should be given to monitoring UFPs in any change to fuel make-up or manufacturing standards.

We are uncertain whether any current monitoring of UFP emissions is conducted in this respect.

Sulfur content

The discussion paper (pg. 13) discusses fuel emissions with respect to sulfur content and states that Australia meets international best practice for sulfur limits in automotive diesel. However, it also states that non-premium petrol (91 RON) is permitted to have up to 150ppm sulfur content while premium unleaded petrol (95+ RON) is permitted to have 50ppm sulfur content. The minimum standard adopted in the European Union is 95 RON. A worldwide ranking has Australian petrol quality for sulfur at 63rd in the world, close to the bottom of the Organisation for Economic Co-operation and Development countries' list for petrol quality. Therefore, there are opportunities for improvement in this area. The CAR review on the health effects of PM from different sources (Hime et al, 2015) found that sulfur related PM particles are likely to pose a greater risk to human health with an increased risk of mortality and morbidity than other types of particles. Therefore, efforts to reduce sulfur related particles in air are likely to be beneficial to health.

Other emissions standards

The discussion paper outlines that Australia has made the Euro 5 standards compulsory for all new vehicles produced from 1 November 2016, and states that Euro 5 standards reduce emission limits for NO_x in petrol vehicles by up to 30% and PM emissions in diesel vehicles by up to 80-90%, compared with the Euro 4 standard (for light vehicles). Page 16 states that these changes will "effectively eliminate differences between the most harmful particulate emissions in new petrol and diesel vehicles". For heavy vehicles (diesel and gas fuelled), Australia requires the Euro V emissions standards for all vehicles manufactured since 1 January 2011, or that vehicles comply with United States and Japanese standards.

The discussion paper indicates that most developed countries have adopted standards equivalent to the Euro 6 emission standards for light vehicles and the Euro VI for heavy vehicles. The Euro 6 standard reduces NO_x in diesel vehicles by 55% from the Euro 5 standards and sets limits for UFPs from petrol vehicles with direct injection fuelling systems. The Euro VI standards reduce heavy vehicle NO_x emissions by 80% and PM by 66% relative to the Euro V standard, and aim to reduce UFPs by adopting a particle number limit.

CAR supports introduction of more stringent emissions and vehicle manufacturing standards (such as the Euro 6 and Euro VI standards) in an effort to reduce UFP emissions from vehicles, so that levels of all pollutants are lowered (or at least no pollutant levels are increased). Care needs to be taken to avoid the scenario that led to increased NO_x and PM levels in the United Kingdom and Europe as a result of encouraging diesel vehicle use as a way of reducing CO_2 emissions. Introduction of new standards must ensure that there is not an unintended effect of increasing other hazardous pollutants.

Specific questions

Should the Australian Government conduct a review to consider whether noxious emissions standards for motorcycles should be adopted in Australia (pg. 14 & pg. 17)?

CAR supports a review on motorcycle emissions. Although motorcycles are thought to contribute only a small proportion to overall emissions (as indicated in the discussion paper), individual users of motorcycles are likely to be exposed to higher levels of air pollutants.

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Testing procedures

The discussion paper (pg. 17) states that the European Union plans to replace its current testing procedure with the Worldwide Harmonised Light Vehicles Test Procedure to address the gap between laboratory tested and real word emissions. This is an issue of concern as evidenced by the recent Volkswagen disclosures and needs to be monitored closely.

Conclusions

In summary, CAR supports any measures to reduce overall exposures to vehicular emissions, and therefore in principle, supports more stringent requirements for fuel make-up and vehicle manufacturing so that emissions are reduced to as low a concentration as possible. It is important, however, that any measures leading to reductions in one pollutant do not also lead to an increase in other, potentially more hazardous, pollutants. Hence, any changes to standards and practices should be accompanied by appropriate testing and monitoring of emissions.

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