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Vehicle Emissions Working Group
Department of Infrastructure and Regional Development
GPO Box 594
Canberra ACT 2601

Via email: vemissions@infrastructure.gov.au

Subject: Comments on "Vehicle emissions standards for cleaner air" Draft Regulation Impact Statement

To Whom It May Concern:

The International Council on Clean Transportation (ICCT) would like to thank the Department of Infrastructure and Regional Development for the opportunity to provide comments on your "Vehicle emissions standards for cleaner air" Draft Regulation Impact Statement.

The ICCT is an independent research organization that provides unbiased technical research and analysis to regulators focused on improving the environmental performance and energy efficiency of the transportation sector. The ICCT promotes best practices and comprehensive solutions to improve vehicle emissions and efficiency, increase fuel quality and sustainability of alternative fuels, reduce pollution from the in-use fleet, and curtail emissions of local air pollutants and greenhouse gases (GHG) from international goods movement.

The ICCT strongly supports Option 6 – Mandate both Euro 6 for light vehicles and Euro VI for heavy vehicles under the *Motor Vehicle Standards Act 1989* as the best option for Australia to significantly reduce harmful emissions from new motor vehicles, improve urban air quality, and reduce the impacts of air pollution on human health. Detailed comments on the Draft Regulation Impact Statement are included in the following pages.

Please let us know if you have any questions or comments on our response or if there is any way we can be of further assistance.

Best regards,

Anup Bandivadekar
Passenger Vehicles Program Director and India Lead
International Council on Clean Transportation
[redacted]

ICCT responses to the "Vehicle emission standards for cleaner air" Draft Regulation Impact Statement

The ICCT strongly supports Option 6 – Mandate both Euro 6 for light vehicles and Euro VI for heavy vehicles under the *Motor Vehicle Standards Act 1989* as the best option for Australia to significantly reduce harmful emissions from new motor vehicles, improve urban air quality, and reduce the impacts of air pollution on human health.

Motor vehicles contribute significantly to urban air pollution in Australia. The Draft Regulation Impact Statement (RIS) states that 1,483 deaths in 2010 were attributable to air pollution. We note more recent estimates from the Global Burden of Disease project show a higher public health impact of poor air quality in Australia, with an estimated 3,380 premature deaths attributable to ambient air pollution in 2015[1]. The control of emissions from major source types, such as motor vehicles, is a critical component of effective air quality management strategies and is needed for the mitigation of harmful impacts of air pollution on human health. For these reasons, we support the adoption of Euro 6/VI emission standards for light and heavy vehicles in Australia, as described in Option 6 of the Draft RIS.

Australia currently lags behind international best practices for the control of harmful emissions from motor vehicles. Adopting Option 6 of the Draft RIS would put Australia on par with the United States, European Union, Japan, India, China and other global leaders who have either adopted or are in the process of adopting Euro 6/VI level emission standards. This step will improve air quality and human health in Australia and will yield significant economic benefits. The Draft RIS estimates Option 6 to have the highest net benefit, $675 million, of any of the options considered. Adopting only one set of standards (i.e. either Euro 6 for light vehicles or Euro VI for heavy vehicles), as described in Options 4 and 5, would leave potential emissions reductions on the table and would fail to maximize the benefits of the next stage of the Australian vehicular pollution control program.

The adoption of Euro 6/VI level emission standards is also supported by Australia's engagement in international collaborative efforts to reduce the environmental impacts of motor vehicle pollution. Australia is a member of the Climate and Clean Air Coalition (CCAC), a global effort to improve air quality and protect the climate through reductions in emissions of short-lived climate pollutants, such as black carbon. Through the CCAC Marrakech Communique[2], Australia endorsed the CCAC Global Strategy to Introduce Low Sulphur Fuels and Cleaner Diesel Vehicles. This strategy calls for CCAC state partners to adopt world-class diesel vehicle tailpipe emission standards. The introduction of Euro 6/VI-equivalent emission standards in Australia would support this commitment. Similarly, this step would support Australia's participation in the G20 Transport Task Group and the recently adopted G20 Energy Efficiency Leading Programme (EELP)[3]. The EELP provides a framework for G20 member collaboration on energy efficiency, and includes as a key focus area the development and implementation of world-class

[1] Global Burden of Disease Study (GBD). (2016). *Global Burden of Disease Study: Results by location, cause, and risk factor*. Seattle, United States: Institute for Helath Metrics and Evaluation (IHME). http://www.healthdata.org/gbd

[2] http://www.ccacoalition.org/en/resources/marrakech-communique

[3] https://ec.europa.eu/energy/sites/ener/files/documents/G20%20Energy%20Efficiency%20Leading%20Programme.pdf.

policies and programmes to reduce the energy and environmental impacts of motor vehicles, especially heavy vehicles.

Euro VI emission standards represent the current international best practice for controlling emissions from heavy vehicles. Real-world emissions performance is significantly improved in the Euro VI standard relative to previous regulatory stages, such as Euro V, leading to greater reductions in NOx emissions than emission limits alone would indicate.

The adoption of Euro VI emission standards in Australia will ensure new heavy vehicles sold in the country are equipped with best available emission control technologies and will help to address shortcomings in current standards related to poor real-world NOx emissions performance. Current ADR 80/03 standards are equivalent to Euro V level standards and can be met without the key technology needed to effectively control particulate matter emissions from diesel engines, the diesel particulate filter (DPF). Additionally, there is a wide body of evidence showing that Euro V level standards are ineffective in controlling real-world NOx emissions from heavy diesel vehicles. The ICCT described these real-world emission issues in a report entitled "Comparison of real-world off-cycle NOx emissions in Euro IV, V, and VI"[4]. This report details key deficiencies in the Euro V type-approval process that contribute to elevated in-use NOx emissions, including unrepresentative test cycles, the lack of cold-start testing requirement, and weak in-use conformity provisions.

These shortcomings of the Euro V standard are addressed in Euro VI standards through the introduction of more stringent emission limits in addition to test procedures that better represent emissions from real-world operating conditions. The ICCT has summarized the key improvements of Euro VI relative to previous emission standards in a number of recent publications[5,6]. These include:

- **More stringent emission limits**
- **More representative test cycles**
- **In-use conformity requirements**
- **More advanced on-board diagnostic system (OBD) requirements**

Together, these provisions help to ensure state-of-the-art emission control technologies are deployed on Euro VI certified heavy vehicles and that emissions performance demonstrated in laboratory testing is maintained under real-world driving conditions.

Early evidence from Europe indicates these changes have led to significant improvements in the real-world emissions performance of Euro VI vehicles. The ICCT recently reviewed results from real-world emissions testing of Euro VI vehicles carried out by several European laboratories[7]. We found that Euro VI vehicles are meeting expectations; with on-road NOx emissions levels

[4] International Council on Clean Transportation, "Comparison of real-world off-cycle NOx emission control in Euro IV, V, and VI" (March, 2015). http://www.theicct.org/comparing-real-world-nox-euro-iv-v-vi-mar2015
[5] International Council on Clean Transportation, "A technical summary of Euro 6/VI vehicle emission standards" (June, 2016). http://www.theicct.org/sites/default/files/publications/ICCT_Euro6-VI_briefing_jun2016.pdf
[6] International Council on Clean Transportation, "Accelerating progress from Euro 4/IV to Euro 6/VI vehicle emission standards" (March, 2015). http://www.theicct.org/sites/default/files/publications/ICCT_EuroVI_briefing_20150304.pdf
[7] International Council on Clean Transportation, "NOx emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements" (December, 2016). http://www.theicct.org/nox-europe-hdv-ldv-comparison-jan2017

below engine type-approval test limits. These findings indicate transitioning from Euro V to Euro VI will yield larger NOx emission reductions than the 80% reduction in certification limit alone would indicate.

Euro 6d emission standards for light vehicles, which incorporate the Worldwide harmonized Light vehicle Test Procedure (WLTP) and Real Driving Emissions (RDE) testing, are a significant improvement over current ADR 79/03 standards, particularly with respect to diesel-powered light vehicles.

As is the case with Euro VI standards for heavy vehicles, Euro 6d standards for light vehicles are a significant improvement on current standards in Australia. Many of the improvements of the Euro 6d standards relative to current Euro 5 level ADR 79/03 standards have been outlined in the Draft RIS, including more stringent emission limits for petrol and diesel vehicles, particle number limits for petrol vehicles with gasoline direct injection engines, transition to WLTP based type-approval, and introduction of RDE testing for vehicle certification.

The latter two provisions are especially important in light of the growing market share for light diesel-powered vehicles in Australia. There is now widespread evidence of significant disparities between real-world NOx emissions from light diesel vehicles and those measured in the laboratory during the NEDC-based type-approval process used in Euro 5 and initial phases of Euro 6 standards. For example, test data on Euro 6a-c diesel cars published by independent research organizations and EU member state governments alike has shown that, on average, their real-world NOx emissions are 6 to 7 times the limit of 80 mg/km mandated by the Euro 6 standard[8]. The next phase of the Euro 6 standard, Euro 6d, is expected to improve the real-world emissions performance of light vehicles by transitioning to the WLTP, which includes a more representative driving test cycle, and through the introduction of RDE test procedure as an additional requirement for vehicle certification.

The fourth and final package of the RDE legislation in Europe is currently under discussion and scheduled for adoption in 2017. This package will cover in-service compliance and surveillance tests along with specific provisions for light commercial vehicles. Australia should include everything out of this package when transitioning to Euro 6d-equivalent emission standards for light vehicles.

While the adoption of Euro 6d-equivalent standard in Australia would be an important step in mitigating the air quality and human health impacts of light vehicles, it should be recognized that standards more stringent than than Euro 6d have been developed and adopted by other global regions. For example, the United States began the phase-in of Tier 3 emission standards in 2017. Some of the key areas in which Tier 3 standards are stronger than Euro 6 include more stringent pollutant emission limits, a fuel-neutral regulatory approach, more comprehensive evaporative emission control and OBD system requirements, and longer useful life specifications.

Perhaps more relevant to Australia is the case of China, which has recently adopted China 6 standards for implementation beginning in 2020. China, like Australia, has historically followed the European regulatory pathway for light vehicles and adopted Euro standards directly. This

[8] For detailed summaries of this research, and of the EU member state testing results, see the papers and other materials collected at http://www.theicct.org/spotlight/use-nox-emissions

approach was revised in the development of China 6 standards, which incorporate important modifications that serve to address weaker areas of the Euro 6 regulation. These include:

- **More stringent evaporative emission control requirements**: Relative to Euro 6, the introduction of a 48-hr diurnal evaporative emission test for vehicle certification and a refueling emission limit in the China 6 standards will encourage the use of more robust evaporative emission control systems.
- **Enhanced OBD system requirements**: China 6 OBD provisions are largely based on the California OBD II program, which is more comprehensive than the European program[9].
- **Fuel-neutral emission limits**: Under the China 6 standard, petrol and diesel vehicles are subject to the same emission limits. This means diesel vehicles will not be legally allowed to emit more NOx than petrol vehicles, as is the case in Europe.
- **RDE-based in-use conformity testing**: In-use conformity testing using PEMS will be required upon the introduction of RDE test requirements under the China 6 regulation. These provisions are now being discussed as part of the fourth RDE package in Europe.

While there should be no hesitancy for Australia to adopt Euro 6d-equivalent standards, these international examples show there is more that can be done to control emissions from light vehicles.

Another important consideration for the adoption of more stringent emission standards for light vehicles in Australia is fuel quality. Australia already requires diesel fuel sold in the country to meet Euro 6 level specifications for sulfur content (< 10 ppm). This is important, as the lack of ultra-low-sulfur diesel is oftentimes a significant barrier for countries seeking to implement Euro 6/VI-equivalent emission standards. Australia will not face this challenge, and is therefore well positioned to transition to Euro 6 level emission standards for light diesel vehicles.

In contrast to diesel, fuel sulfur specifications for petrol fuel in Australia remain higher than in Europe. The Euro 6 specification for petrol sulfur content is a maximum of 10 ppm. Australia currently has a petrol sulfur limit of 150 ppm for regular unleaded petrol (ULP) and 50 ppm for premium-unleaded petrol (PULP). As noted in the draft RIS, the Australian Institute of Petroleum maintains typical sulfur levels for commercial fuels are generally much lower (16-26 ppm for PULP and 28-60 ppm for ULP). The ICCT recommends updating the *Fuel Quality Standards Act 2000* and setting a timeline for adopting new petrol sulfur limits of 10 ppm. This would align Australia with international best practices and ensure the full air quality and human health benefits of the transition to Euro 6 vehicles are realized.

In the near-term, the lack of 10 ppm sulfur petrol is a not prohibitive obstacle to the introduction of Euro 6 standards for light vehicles in the proposed 2019/2020 timeframe. We have included a more thorough discussion of these issues in our response to the Ministerial Forum's draft fuel quality discussion paper – "Better fuel for cleaner air".

[9] International Council on Clean Transportation, "Review of LDV OBD requirements under the European, Korean, and Californian emission programs" (March, 2016). http://www.theicct.org/review-ldv-obd-requirements-under-european-korean-and-californian-emission-programs

The proposed timeline for implementation of Euro 6/VI level emission standards in Australia, with a phase-in from 2019-2020, is reasonable and consistent with implementation schedules in other regions that have adopted or proposed Euro 6/VI level emission standards.

The implementation timeline for the proposed Euro 6/VI standards (new models from January 1, 2019 and all models from January 1, 2020) is reasonable and will give manufacturers sufficient lead time to adapt emission control solutions developed for other markets to Australian conditions. The majority of engines for heavy vehicles sold in Australia are imported. Also, as noted in the Draft RIS, domestic light vehicle manufacturing will cease in 2018. This means most vehicles and engines subject to the proposed Euro 6/VI-equivalent standards will be imported, mostly from countries where similar standards have already been enacted. Therefore, manufacturers have already developed the technologies required to meet the more stringent emission standards. These technologies are well established and the 2-3 year lead-time is ample for adaptation to Australian conditions.

The proposed implementation timeline is also consistent with developments in other global regions that are transitioning to similar Euro 6/VI level emission standards. For example, India finalized Bharat Stage VI standards for light and heavy vehicles in 2016, with implementation beginning in April 2020[10]. Relative to Australia, India has a more challenging pathway to achieve Euro 6/VI level standards as they will be leapfrogging directly from the Euro 4/IV level and domestic manufacturers lack experience with advanced emission control technologies like DPF and SCR systems.

The trend towards advanced vehicle emission standards is also apparent in other regions. As noted above, China has adopted China 6 light vehicle standards, which will be implemented beginning in 2020. China has also proposed Euro VI-equivalent standards for heavy vehicles. Mexico has issued a proposal to implement Euro VI/U.S. 2010 standards for heavy vehicles in 2018. Most recently, in Brazil the environmental authority for the State of Sao Paulo (CETESB), acting on behalf of the national government, has publicly endorsed the adoption of a Euro VI emission standard for nationwide implementation in 2019[11].

These examples make clear the global push towards cleaner vehicles and fuels. The implementation of Euro 6/VI emission standards in the 2019/2020 timeframe would position Australia amongst this next wave of countries adopting world class motor vehicle emission standards and would ensure the Australian public benefits from the emission control technologies and low-emitting vehicles that will be increasingly deployed and produced in response to these global trends.

The benefit-cost analysis presented in the Draft Regulation Impact Statement shows Option 6 to have the highest net benefits ($675m) over the period 2016-2040. We present evidence below to suggest that this represents a conservative estimate. The total benefits of adopting Euro 6 standards for light vehicles and Euro VI standards for heavy vehicles will likely be substantially greater.

[10] http://www.egazette.nic.in/WriteReadData/2016/171776.pdf

[11] http://www.cetesb.sp.gov.br/2017/02/02/cetesb-apresenta-propostas-para-novas-fases-de-controle-de-poluicao-veicular/

A number of assumptions used in the Euro VI benefit-cost analysis are overly conservative and serve to overestimate the costs of Euro VI emission standards for heavy vehicles. These assumptions include:

(1) Additional fuel costs for Euro VI compliant heavy vehicles
In the core Euro VI scenario, average fuel consumption for Euro VI compliant vehicles was assumed to be 0.5-1% higher than for comparable Euro V vehicles due to increased vehicle weight and higher adoption of exhaust gas recirculation for NOx control. Emerging evidence from the implementation of Euro VI standards in Europe has shown that manufacturers, partly driven by competitive pressure, have been able to offset fuel penalties associated with advanced control equipment with efficiency improvements in other areas of the engine and vehicle. Consequently, Euro VI vehicles are performing at comparable, if not better, efficiency levels as Euro V counterparts.

The transition from Euro V to Euro VI emissions standards involves the addition of additional exhaust aftertreatment and engine controls in order to further reduce NOx and PM emissions. This typically includes the addition of a diesel particulate filter (DPF) as well as a selective catalytic reduction (SCR) system with higher NOx conversion efficiency. Emissions control reductions are the only requirements associated with Euro VI standards - since Euro V and Euro VI are emissions standards only, not fuel efficiency standards. The addition of these technologies alone would result in a small fuel penalty if no concurrent efficiency improvements were made. That being said, many manufacturers have voluntarily taken the opportunity of Euro VI to produce more advanced engines with added efficiency improvements and technologies that outweigh the fuel penalties associated with the improved emissions controls. In fact, the addition of higher efficiency SCR gives manufacturers the opportunity to have higher engine out NOx emissions - which means they are able to operate their engines at a higher efficiency.

A recent test program carried out by the IEA Alternative Motor Fuels Technology Collaboration Programme (AMF) supports the lack of a fuel penalty for Euro VI compliant vehicles[12]. In this study, AMF partners conducted chassis dynamometer testing on 35 commercial vehicles of varying emission control levels in order to investigate energy efficiency and emissions performance. Included in the vehicle test matrix were medium- and heavy-duty trucks certified to Euro V and Euro VI emission standards. Vehicle testing showed no significant difference in the specific energy consumption for Euro V and VI vehicles. Based on these results, the authors conclude “fuel consumption does not increase going from Euro V to Euro VI.”

In light of this emerging evidence on the fuel efficiency of Euro VI vehicles, the scenario considered in the sensitivity analysis in which no change is made to baseline fuel consumption rates is a more accurate representation of the costs of Euro VI implementation. In this case, net benefits increase by a factor of two relative to the baseline scenario, from $264 to $528 million.

(2) Incremental vehicle costs for Euro VI compliant vehicles
In the Draft RIS, a range of $6,000 to $15,000 is assumed for the incremental cost of a Euro VI vehicle relative to a comparable Euro V vehicle. The core Euro VI scenario of the benefit-cost analysis applies the midpoint value from this range, $10,500 per vehicle, with a downward adjustment over time in response to expected introduction of new emission standards and with

[12] IEA Alternative Motor Fuels Technology Program, “Fuel and Technology Alternatives for Commercial Vehicles,” Annex 49 (2016). http://www.iea-amf.org/app/webroot/files/file/Annex%20Reports/AMF_Annex_49.pdf

expansion of the market for the new technology overseas. The cost range selected appears to follow the suggestion of the Australian Trucking Association (ATA), which was included in their submission to the 2016 Vehicle Emissions discussion paper.

We take this opportunity to call attention to an independent assessment of the incremental manufacturing costs of emission control technology to meet Euro VI standards performed by the ICCT[13]. This assessment uses a bottom-up engineering analysis to estimate the direct costs to manufacturers of achieving compliance with various emission levels, relying on publically available information on the costs of emission control technologies. Results from this assessment are shown below in Table 1.

Table 1. Incremental costs of emission control technology for a 12 L diesel engine under U.S. and European regulatory standards.

	Euro III	Euro IV	Euro V	Euro VI	TOTAL
European standards	$426	$3,771	$460	$2,280	**$6,937**
	US 1998	**US 2004**	**US 2007**	**US 2010**	**TOTAL**
U.S. standards	$50	$1,421	$1,650	$3,816	**$6,937**

These results show the incremental cost of additional emission control technologies needed to meet Euro VI level emission standards relative to a baseline Euro V engine to be $2,280 USD (~$3,000 AUD). This estimate is about half the lower range value submitted by ATA, and in of itself represents a conservative estimate of the incremental costs to manufacturers to produce Euro VI compliant engines. This is because the ICCT analysis does not incorporate discounts for process learning or volume sales, nor does it account for new systems that are being brought to the market that are likely to further reduce costs.

Given the information available now on costs to manufacturers of producing Euro VI compliant vehicles, it is our opinion that the "Lower range for extra capital costs" scenario considered in the sensitivity analysis, while still a conservative estimate, is a more accurate representation of the costs of adopting Euro VI emission standards. For this scenario, net benefits of implementing Euro VI emission standards increase from $264 to $942 million.

While not considered directly in the Draft RIS, the net benefits for a scenario in which (1) there is no fuel penalty for Euro VI vehicles and (2) the lower range capital cost estimates are incorporated can be calculated from reported net benefits of the two individual sensitivity scenarios. In this case, net benefits of implementing Euro VI emission standards are $1,206 million and the benefit-cost ratio is 2.04. ***This change also increases the net benefits of Option 6 to $1,617 million and the benefit-cost ratio to 1.62.*** Our review of recent benefit-cost analyses for other countries transitioning to Euro 6/VI-equivalent standards suggests similar or higher benefit-to-cost ratio.[14].

[13] Francisco Posada, Sarah Chambliss, Kate Blumberg, *Costs of Emission Reduction Technologies for Heavy-Duty Vehicles* (ICCT: Washington DC, 2016). http://www.theicct.org/costs-emission-reduction-tech-hdvs

[14] International Council on Clean Transportation, "Impacts of world-class vehicle efficiency and emissions regulations in select G20 countries" (January, 2017). http://www.theicct.org/sites/default/files/publications/ICCT_G20-briefing-paper_Jun2015_updated.pdf.