Submission to

The Vehicle Emissions Working Group
The Department of Infrastructure and Regional Development

By

Mobil Oil Australia Pty Ltd
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On

The Vehicle Emissions Discussion Paper
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INTRODUCTION

Mobil Oil Australia Pty Ltd ("Mobil") is pleased to have the opportunity to comment on the "Vehicle Emissions Discussion Paper" issued by the Vehicle Emission Working Group within the Department of Infrastructure and Regional Development on behalf of the Ministerial Forum.

Mobil has operated in Australia for 120 years, including through predecessor companies. Mobil is a major supplier of petroleum fuels to resellers, other wholesalers and end users, including aviation customers, around Australia. Mobil's wholly owned subsidiary, Mobil Refining Australia Pty Ltd (MRA), owns and operates the Altona refinery in Melbourne. Mobil Altona Refinery has been fuelling Victoria for nearly 70 years. Operating 24/7, the refinery processes crude oil to manufacture a range of petroleum products that meet about half of Victoria's transportation fuel needs.

Mobil Altona Refinery plays an important role in Australia's fuel supply chain and significantly contributes to the economy by providing high-skilled employment, supporting suppliers and industrial customers, as well producing refined fuel products essential to everyday life.

Mobil Altona Refinery currently processes more than 80,000 barrels of crude oil to produce 13 million litres of refined fuel products per day, including unleaded petrol, diesel, and jet fuel. The refinery also supplies feedstocks to the nearby chemical complexes.

Altona Refinery makes a major contribution to the Australian and Victorian economies:

- Contributes around $270 million to the Victorian economy every year.
- Provides full time employment for around 350 people while indirectly supporting thousands of other jobs, paying approximately $2.9 million in annual payroll taxes to the Victorian Government.
- Contributes over $10 million in rates, port fees, wharfage and utlilities

In addition to the Altona refinery, Mobil operates major bulk petroleum terminals in Melbourne (Yarraville), Sydney (Silverwater) and Adelaide (Birkenhead) and aviation fuel facilities at Melbourne (Tullamarine) and Adelaide airports, and has ownership interests in or long term throughput arrangements at other fuel terminals around the country.

Mobil also regularly ships product into Australia, primarily sourced from Singapore, and is one of the largest importers of petroleum fuels into this country.

Mobil and MRA are subsidiaries of ExxonMobil Australia Pty Ltd, which in turn is a subsidiary of Exxon Mobil Corporation. Exxon Mobil Corporation has many subsidiaries and affiliates and for convenience and simplicity the terms ExxonMobil, Esso, Mobil, Corporation, company, our, we and its may be used throughout this document to refer to the Corporation or to any or all of its affiliates and subsidiaries.

In Australia, ExxonMobil primarily operates its business through two subsidiaries, Esso Australia Pty Ltd and Mobil Oil Australia Pty Ltd and employs around 1800 people.

RESPONSE TO THE DISCUSSION PAPER

Mobil is a member company of the Australian Institute of Petroleum (AIP), and fully endorses their submission to this Inquiry.

Mobil is supportive of the discussion paper and we believe it lays out the key issues in a considered and balanced manner.

Mobil accepts the community imperatives for improving urban air quality, and supports the development of policy based on sound science, free market, appropriate cost/benefits considerations, and a clear and reasonable regulatory framework.

Our primary comments relate to the Fuel Quality Standards, as changes to fuel properties would have a very material impact on our business.

1. Fuel Quality Standards

The discussion paper explores whether petrol with maximum 10 ppm sulfur is needed to encourage the supply of more efficient and lower-emitting vehicles.

Further tightening of the petrol standard is not needed and would be a costly

Mobil does not support any further tightening of the petrol standards and in particular does not support the introduction of a 10ppm sulfur limit in Australia, as we believe vehicle efficiency and emissions gains can be achieved with existing fuel quality and any additional fuel environmental or operability benefits are unlikely to exceed the substantial cost to the refining industry and to society.

The Altona Refinery does not have the capability to supply 10 ppm sulfur petrol and would require extensive modifications to meet this specification, including the construction of a new desulfurisation unit.

It is also important to understand that the methods available to remove sulfur have a negative impact on petrol octane, so further investment and operating costs would be incurred in restoring lost octane.

Reconfiguring the refinery to meet a requirement to produce 10 ppm sulphur petrol would thus be a major and costly undertaking. It would require a commitment from our shareholder to invest significant capital, and in the current capital-constrained environment, such a commitment would not be guaranteed. A requirement to produce 10ppm sulphur petrol would thus threaten the financial viability of the Mobil Altona Refinery.

Any Regulatory Impact Statement (RIS) examination of refinery 10 ppm sulfur options will be a resource-intensive and costly exercise

Given the acute impact on the refinery, Mobil will need to devote considerable technical and business resources to fully study its technical and business continuity options if a change to fuels standards is considered further. This assessment would take 18-24 months. Mobil therefore requests that a sound emissions, air quality, and operability benefits case be demonstrated before the refining industry is required to participate in a full RIS.

Usual lead-time for construction of 10 ppm sulfur petrol facilities would be five years

The lead-time to design, procure, modify the existing plant, and construct new 10 ppm facilities from the point legislation is promulgated would nominally be five years.

A project of this nature would require a major refinery shutdown to facilitate tie-in works and this would incur significant cost to the business due to lost production if required to occur outside of normal maintenance shutdown timing. The refinery typically operates for several years between major planned outages. We request sufficient lead time for implementation to

allow the work to take place during scheduled shutdowns, this would be the best outcome from both a cost-minimisation and supply continuity perspective.

There are no operability benefits and only minimal environmental benefits in further reducing petrol sulfur limits

10 ppm sulfur petrol is not necessary for the introduction of Euro 5/6 vehicle emissions standards and Euro 5/6 will deliver considerable emissions benefits with existing fuel.

Legislated petrol maximum sulfur levels in Australia have been progressively reduced over the last 15 years to support more stringent vehicle emissions standards, however we believe that further reduction in sulfur levels will deliver only minimal additional emissions benefits and are not needed for implementation of the Euro 5/6 petrol vehicle emissions rules.

Our view is supported by *the Review of Sulphur Limits in Petrol* undertaken by Orbital Australia in 2013 for the Fuel Policy Section supports that operability of Euro5/6 vehicles with 50 ppm petrol is expected to be unimpaired and that 50 ppm will not be a barrier to the certification of the vehicles against the Australian Design Rules.

Orbital Review and most other Australian reviews have assessed the legislated maximum sulfur levels (50ppm PULP/ 150ppm ULP), whereas the actual quality of petrol at the pump is already typically much better than the legislated maximums with PULP in Victoria in 2014 - 2015 averaging less that 30ppm and ULP averaging 60 ppm.[1] Sydney is supplied by imports which are even lower sulfur. Assessments of airshed vehicle emissions inventories need to take these actual pump fuel sulfur levels into account as it will further reduce any assessed environmental benefit.

It is however important to retain the existing legislated limits as, although actual fuel sulfur will typically be lower, the flexibility to produce up to the existing maximum at times provides greater flexibility in crude oil selection and petrol blend management that can translate to important refining business benefits.

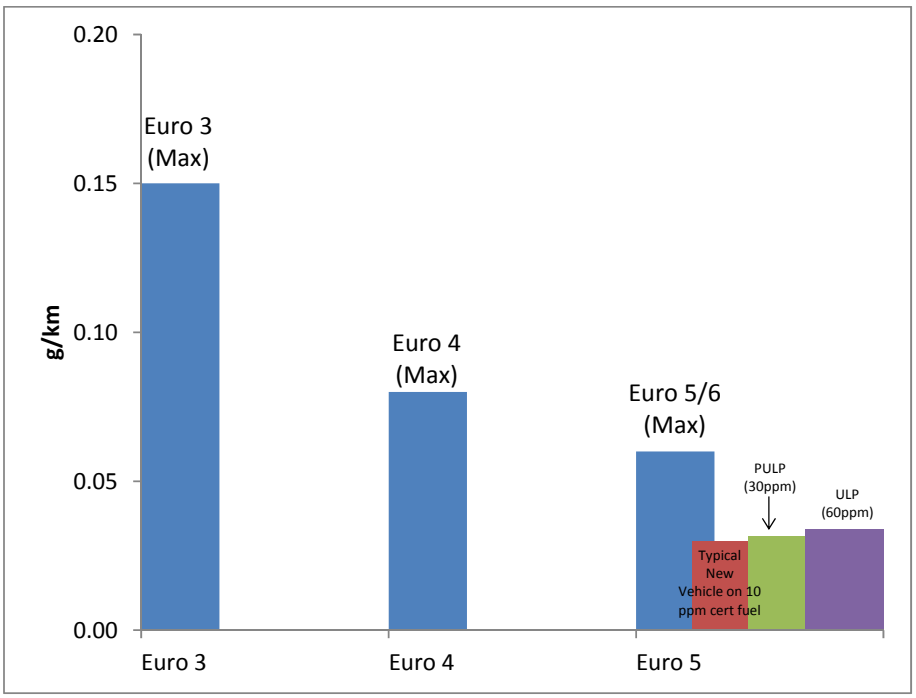
Importantly, work published in June 2013 by SGS[2] confirms that exposure of catalyst to these higher sulfur levels is reversible and therefore emissions performance will be driven by typical sulfur levels rather than any temporary production maximums.

Mobil has drawn on the ExxonMobil technical organisation to review the Orbital Report and make an assessment of the indicative real-word impact of operating on current petrol sulfur levels relative to 10 ppm sulfur. The examination focused on NOx as it is typically the more challenging pollutant to control. The analysis is contained in Appendix 1 and from that Mobil concludes the fuel sulfur impact on NOx emissions in running new Euro 5/6 vehicles is approximately 0.28% per ppm change in sulfur. Based on the 2014-2015 average sulfur levels for Melbourne, this indicates NOx emissions would be only approximately 0.0014 g/km (4%) lower if fuelled on 10 ppm sulfur petrol versus PULP and 0.0039 g/km (12%) for ULP. This is shown in Figure 1 which emphasises that the primary reductions in vehicle emissions g/km have been achieved through the adoption of more stringent vehicle standards and that these benefits will continue to accrue as the older vehicle population progressively turns over. The impacts of current petrol quality on Euro 5/6 vehicles are small in this context.

[1] Data collated by AIP shows that the average sulfur level of petrol supplied during 2014-2015 in Melbourne was 28 ppm for PULP (vs 50 ppm max) and 60 ppm for ULP (vs 150 ppm max).

[2] "Reversibility of Gasoline Sulfur Effects on Exhaust Emissions from Later Model Vehicles"; Vertin and Reek; SGS Environmental Testing Corp.; June 2013

Figure 1 – New vehicle NOx exhaust emission standards and fuel sulfur impacts on Euro 5/6 vehicles



Orbital assessed in Table 8.2 of their report that new vehicles are likely to be manufactured with a 50% engineering margin for NOx (i.e. emit at 50% of the limit). This is represented in the chart by the red "typical new vehicle" bar.

Mobil is not aware of any data to indicate that the current fuel quality inhibits performance or materially impedes the choice of vehicles or technologies in Australia. It is expected that by now there have been considerable imports of Euro 5 and Euro 6 (and equivalent) vehicles. To our knowledge these vehicles have operated without issue on current quality pump fuel.

The existing petrol standards do not impact fuel economy

The discussion paper asks whether there are changes to fuel quality standards that could assist with reducing CO_2 emissions.

Mobil's view is that the current petrol standards have negligible impact on conventional three-way catalyst vehicle fuel efficiency/CO_2 emissions, especially given the current low average sulfur levels. Three-way catalyst vehicles currently make up all but a few percent of the petrol fleet and we are not aware of any likely medium-term change to this.

We are not aware of any current mainstream engine technology being constrained by sulfur levels other than for lean-burn gasoline direct injection (GDI) engines.

During the mid-1990s Lean-Burn GDI technology was developed which was considered at the time to be the best future for fuel efficiency/CO_2 reduction. Lean-Burn GDI vehicles are adversely impacted by petrol sulfur levels due decreased performance of their NOx Trap catalyst exhaust treatment which is uniquely required due to the lean exhaust environment of these vehicles. These vehicles can operate satisfactorily on Australian fuel, but would see a decreased benefit as they would have to run in rich mode more often to regenerate the catalyst thereby decreasing fuel economy.

It is Mobil's view that the primary impetus to reduce petrol sulfur to 10 ppm in Europe was the expectation this would facilitate the wide adoption of Lean-Burn GDI technology. It is apparent that this did not eventuate and that vehicle manufactures have instead followed other CO_2 efficiency pathways (such as light weighting and downside turbo-boosted stoichiometric GDI engines) that do not require 10 ppm.

Many modern engines, particularly downsized turbo-boosted GDI, can be calibrated by the vehicle manufacturer to benefit from the use of 95RON octane to deliver fuel economy benefits without compromising performance. High octane fuel is available in Australia if specified by the vehicle manufacturer as either 95PULP or 98PULP.

No further tightening of fuel parameters is necessary

It is Mobil's view there is no compelling reason to further tighten any other fuel property in the Australian context and temperate ambient conditions – including cetane, aromatics, and distillation, and that there are groundwater contamination risks associated with the introduction of higher levels of MTBE.

Uncertain supply-demand profile for 10 ppm sulfur petrol in the region

Whilst there are a number of refineries around Asia Pacific capable of producing low-sulfur petrol, the market can be unpredictable and the future supply/demand picture is uncertain.

A number of refinery expansions in the region are currently being wound back or put on hold. For example, Chinese projects are delayed due to domestic slow down, and projects in India have been pushed out with timing delayed from original announcements.

A 10 ppm specification would limit the flexibility of Australian fuel companies to access a broader pool of imports. As the Regional demand for 10 ppm fuel will rise over time with changes in specifications scheduled across various Asian countries in coming years, with a resulting impact on availability and price. The price premium for low-sulfur fuel could lead to higher fuel prices for Australian consumers.

Closure of Australian refineries driven by a tightening of petrol standards would further accentuate the demand for low sulfur petrol imports.

Domestic fuel supply security must be considered in any proposal to further tighten fuel standards

Australian oil refineries operate in an open global market, competing with refineries across the Asia-Pacific region and fuel traders who have no significant barriers to delivering fuel to local markets which meets Australian quality standards. Australian refineries are small by regional and global standards and suffer economies of scale disadvantages versus significantly larger regional refineries. Many of these are newer and more efficient, with more sophisticated processing facilities than Australia's domestic refineries.

The downstream petroleum industry has responded to these challenges with stringent cost controls and enhanced efficiency. Change has been occurring at all levels of the fuel supply chain, to adapt to the changing environment and ensure ongoing competitive and reliable fuel supply to the domestic market. Since 2003 there have been four refineries closed down, including the Mobil Adelaide Refinery, and the industry is now importing an increasing proportion of Australia's fuel requirements.

Despite the challenges described above, the Australian petroleum industry has demonstrated its ability to adapt, and to continue to reliably meet local fuel demands. The

industry has adequate fuel supply infrastructure and robust supply chain processes in place. However in Mobil's view, some level of domestic refining capacity is highly desirable to provide additional flexibility to cope with the short term product supply interruptions or imbalances which can occur. Any additional cost impost on local refineries will exacerbate competitive disadvantage and undermine long term viability, with implications for domestic supply security.

Some adaption to the fuels standards is needed to better accommodate alternative fuels

As explained in the AIP submission, the current fuel standards for diesel and biodiesel blends constraints that limit the ability of fuel manufacturer to blend fuels freely within the limits of the specifications. Biodiesel fuel suppliers must currently rely on Section 13 variations to manage the disparity between Cetane limits in the current diesel and biodiesel standards the lack of allowance for density increase on blending with biodiesel.

2. Vehicle Fuel Efficiency (CO_2) Standards

We believe the long-term objective of climate policy should be to reduce the risks posed by climate change at minimal society cost, in balance with other social priorities. We believe that effective climate policies will be those that:

- promote global participation and let market prices drive the selection of solutions;
- ensure a uniform and predictable cost of GHG emissions across the economy;
- minimize complexity and administrative costs, while maximizing transparency; and
- provide flexibility for future adjustments to react to developments in climate science and the economic impacts of policy.

We believe that market based systems that impose a uniform, economy wide cost on GHG emissions are more economically efficient policy options than mandates or standards.

We believes in market-based mechanisms for transport such as a fuel carbon tax or fuels with a cap and trade mechanism are the most appropriate approaches to reducing GHG emissions while minimising societal costs and maintaining technology neutrality. Mobil does not support mandates of any kind, however where vehicle efficiency standards exist, they should be cost-effective on a life cycle basis and allow for compliance by implementing vehicle improvements, paying for obligations and market carbon price, or a combination.

3. Alternative Fuels and Electric Vehicles

Mobil's transport policy / alternative fuels policy position

Mobil believes that good transportation policies are based on:

- Free market: level playing field, technology-neutral, and promote the choice of solutions – no mandates;
- Sound science: impact analysis on a "well-to-wheels" basis and take into account realistic projections for technology development;

- Appropriate cost/benefit considerations: cost-effective to implement, economically sustainable without subsidies, and benefits to society should exceed overall costs;
- Clear and reasonable regulatory framework: appropriate, flexible, and consistently enforced compliance scheme.

Battery electric vehicles

Mobil offers the following general comments with respect to battery electric vehicles (BEV) recharged from the grid:

- On a ‘cradle-to-grave’ basis, taking into account battery manufacturing and operating lifetimes, BEVs do not necessarily lead to greenhouse has savings compared to conventional cars.
- Societal costs to promote BEVs are very high; improvements to conventional car technologies are still the most cost-effective way to reduce GHG emissions without investing in new infrastructure for alternatives fuels.
- Latest generations of conventional cars have significantly reduced their pollution emissions and compare favourably with those from BEVs.
- Technological improvements in battery performance can be expected by 2030, but they will remain expensive and will not enable BEVs to achieve driveability ranges comparable to conventional cars.
- Technologies grow when they naturally bring a societal benefit and should not need long-term subsidies or other incentives to encourage their market uptake.

Appendix 1

ExxonMobil Research and Engineering Assessment of Gasoline Sulfur Impact on NOx Emissions for Australia

The Australian government have launched a review of vehicle emissions, as outlined in their "Vehicle Emissions Discussion Paper" published on February 11, 2016. While this government review is quite expansive covering transport vehicles and fuels along with their associated CO_2 and criteria emissions, due to the time constraints we have been asked by Mobil Oil Australia to only provide an analysis of the potential NOx emissions impact of changes to the light-duty vehicle fleet associated with changes in gasoline sulfur level. In order to provide context for Australia, we have, where possible, relied on information and linkages to the June 2013 Orbital report "Review of Sulphur Limits in Petrol".

Vehicle emissions certification levels will have a significant impact on the contribution of NOx emissions from individual vehicles. In Australia today, there is a mix of Euro 3, 4, 5 vehicles with some newer vehicles already meeting Euro 6 standards. The benefit of moving to newer, more stringent vehicle emissions standards is evident from the NOx emission limit data shown in Table 1 below however these limits are the maximum emission levels for each vehicle and are set using the appropriate certification fuel which have differing fuel sulfur levels.

Table 1: European Union Exhaust NOx Emissions Standards for New Passenger Cars

Certification Level	Cert. Fuel S, ppm	NOx Emissions Limit (g/km)
Euro 3	150	0.150
Euro 4	50	0.080
Euro 5	10	0.060
Euro 6	10	0.060

To understand the NOx emissions impact of fuel sulfur change on the Australian fleet we need to understand how the vehicles respond to varying fuel sulfur levels and then determine the typical fuel sulfur available in the market.

Individual vehicle NOx emissions response to fuel sulfur levels varies, with some vehicles showing no change in emissions as fuel sulfur level is varied, indicating the ability of vehicle manufacturers to develop robust catalyst systems. However, in order to understand the entire vehicle population under consideration (on-road, new sales, or certification level) "fleet average" response levels for fuel sulfur are developed. In their June 2013 report, Orbital remove "outliers" from the data set they are evaluating and then develop NOx response curves to arrive at an "average worst case scenario" response change in emissions for a change in fuel sulphur (Table 8.1 in the report). We see no reason to exclude data especially when the underlying report providing the data did not but instead noted that "…some models have sulfur responses that are statistically different in magnitude from each other". We have therefore developed our own response curves and compare them to those provided by Orbital in Table 2 below. Note that Orbital mention high and low mileage response but do not show a value for each in their report.

Table 2: Comparison of Orbital and ExxonMobil "Average" Response Changes in NOx Emissions for a Change in Fuel Sulphur

Change in Sulphur	Orbital	EM Low Mileage	EM High Mileage
10 to 50 ppm	31%	11%	21%
10 to 150 ppm	108%	31%	69%

As noted above, to assess the impact of reducing gasoline sulfur level on individual vehicles, understanding current fuel quality is important. Recent data collected for Australia indicate sulfur levels of 30ppm average for Premium 95PULP (50 ppm spec.) and 50 ppm average for Regular 91ULP (150 ppm spec.). We utilize this data along with that shown in Table 2, and the engineering margin provided by Orbital (50% at low mileage and 30% at high mileage, Table 8.2 in their report) to develop certification level, low and high mileage, NOx emission response to varying fuel sulfur levels (Table 3).

Table 3: Fuel Sulfur Impact on Exhaust NOx Emissions (g/km) as a Function of New Vehicle Emissions Certification Level

Cert. Level	Mileage	10ppm	30ppm	50ppm	150ppm
Euro 3	Low	N/A	N/A	N/A	N/A
Euro 4	Low	0.0360	0.0378	0.0400	0.0472
Euro 5/6	Low	0.0300	0.0315	0.0333	0.0393
Euro 3	High	0.0621	0.0683	0.0752	0.1050
Euro 4	High	0.0463	0.0509	0.0560	0.0782
Euro 5/6	High	0.0420	0.0462	0.0508	0.0710

For the high mileage vehicles the analysis assumes fuel sulfur reversibility. We base this assumption on the work published in June 2013 by SGS where they tested six late model vehicles to determine if the exhaust emissions effects caused by exposure to 80 ppm high sulfur fuel were reversible, after the vehicles were refueled with 10 ppm sulfur fuel. Catalysts and sensors were aged to full useful life in the laboratory using fuel with sulfur content ranging from 18.5 to 43 ppm. A statistical analysis concluded that there was no difference in the mean emissions of NOx measured before and after the high sulfur fuel exposure. The emissions effects caused by high sulfur fuel exposure were reversible for all vehicles with 95% confidence. We also note that NOx response to fuel sulfur levels of these aged vehicles was similar to the 1998 program work noted in Figure 8.1 of the Orbital study.

Our analysis above supports the statements provided by Orbital in their report:
“The continued use of 50 ppm fuel sulphur on the incoming Euro 5/6 fleet is assessed as being unlikely to significantly increase emissions of … NOx at low mileage.”
“Temporary use of 150 ppm ULP in a vehicle designed to use 50 ppm or 10 ppm PULP is likely to be reversible.”

We would further suggest that given the current market fuel quality in Australia, the first statement above can easily be extended to encompass high mileage Euro 5/6 vehicles as well.

References:

1. “Vehicle Emissions Discussion Paper”; Australian Government; February, 2016. http://minister.infrastructure.gov.au/pf/releases/2016/february/pf018_2016.aspx

2. “Review of Sulphur Limits in Petrol”; Orbital Australia Pty Ltd; June, 2013. http://www.environment.gov.au/protection/publications/review-sulphur-limits-petrol
3. “Effect of Fuel Sulfur on Emissions in California Low Emission Vehicles” SAE Paper 98-2726; Schleyer, et al.
4. “Reversibility of Gasoline Sulfur Effects on Exhaust Emissions from Late Model Vehicles”; Vertin and Reek; SGS Environmental Testing Corp.; June 2013.