FCAI Response to Vehicle emissions for cleaner air Draft Regulatory Impact Statement

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KEY MESSAGES

The widespread availability of EN standard fuels is a key enabler for globally consistent vehicle emissions standards and proposed Australian CO_2 targets. As such, Australian fuel standards and availability must be first defined before implementation of Euro 6 pollution emission standards can be properly contemplated.

Overview:

- The FCAI welcomes the establishment of the Ministerial Forum on Vehicle Emissions as vehicle pollutant emission standards, CO_2 emissions and fuel quality standards are interrelated and must be considered as a single system to deliver the environmental and health benefits from reductions in light vehicle pollutant emissions and CO_2 emissions.
- The Australian automotive industry is committed to continuing to make a strong contribution to national efforts to reduce the impact of global climate change and improve air quality.
- Australia is a small market comprising only 1.5% of global production. For the industry to be able to offer vehicles with world-class fuel consumption and pollutant emission technology, Australia must harmonise pollutant emission and fuel standards with leading overseas markets.
- Vehicle pollutant emission standards need to be considered together with CO_2 standards or targets and fuel quality standards as they are all interrelated. This position is shared by many governments, research organisations and the global automotive industry.
- The anticipated health benefits of adopting Euro 6 pollutant emission standards for light vehicles will not be realised until such time as petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards e.g. biodiesel and ethanol blends) is widely available in Australia.
- Consideration of the introduction timing of Euro 6 and CO_2 targets for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN590 for Diesel) to support the introduction of both Euro 6 and CO_2 targets.
- The timeframe for the required fuel to be available to the market will then determine the timeline for new vehicle models and the timeline for the introduction of regulatory standards. Moving ahead with new emission regulations without resolving fuel quality questions would increase the cost of new vehicles and adversely affect the operability of new emission technologies without delivering the anticipated environment and health benefits.

Integrated approach:

- A whole of government approach that includes on-road operation of light vehicles must be taken to achieve real world CO_2 and pollutant emission reductions:
    - Fuel quality standards, which must match the emission technology in our vehicles and how to encourage/ensure consumers use the correct fuel grade.
    - The Australian consumer preference for heavier vehicles with larger and more powerful engines and automatic transmissions.

- The use of light vehicles in Australia; in particular, how to relieve congestion in our major cities. There is significant potential benefit, a reduction of up to 10% of fuel use, from vehicle-to-infrastructure (V2I) technology.
  - Driver behaviour and how eco-driving can reduce fuel use.
  - Vehicle technology and the refueling infrastructure required to support new technologies such as electric vehicles, hybrid electric vehicles and hydrogen fuel cell vehicles.
  - Increasing consumer demand through raising awareness and creating incentives for people to adopt new technology.
  - Steps to reduce the age of the vehicle fleet, as newer vehicles emit fewer pollutants and are more fuel efficient.
- To focus on only one area will increase the overall cost to the community without delivering the expected CO_2 and pollutant emission reduction benefits.

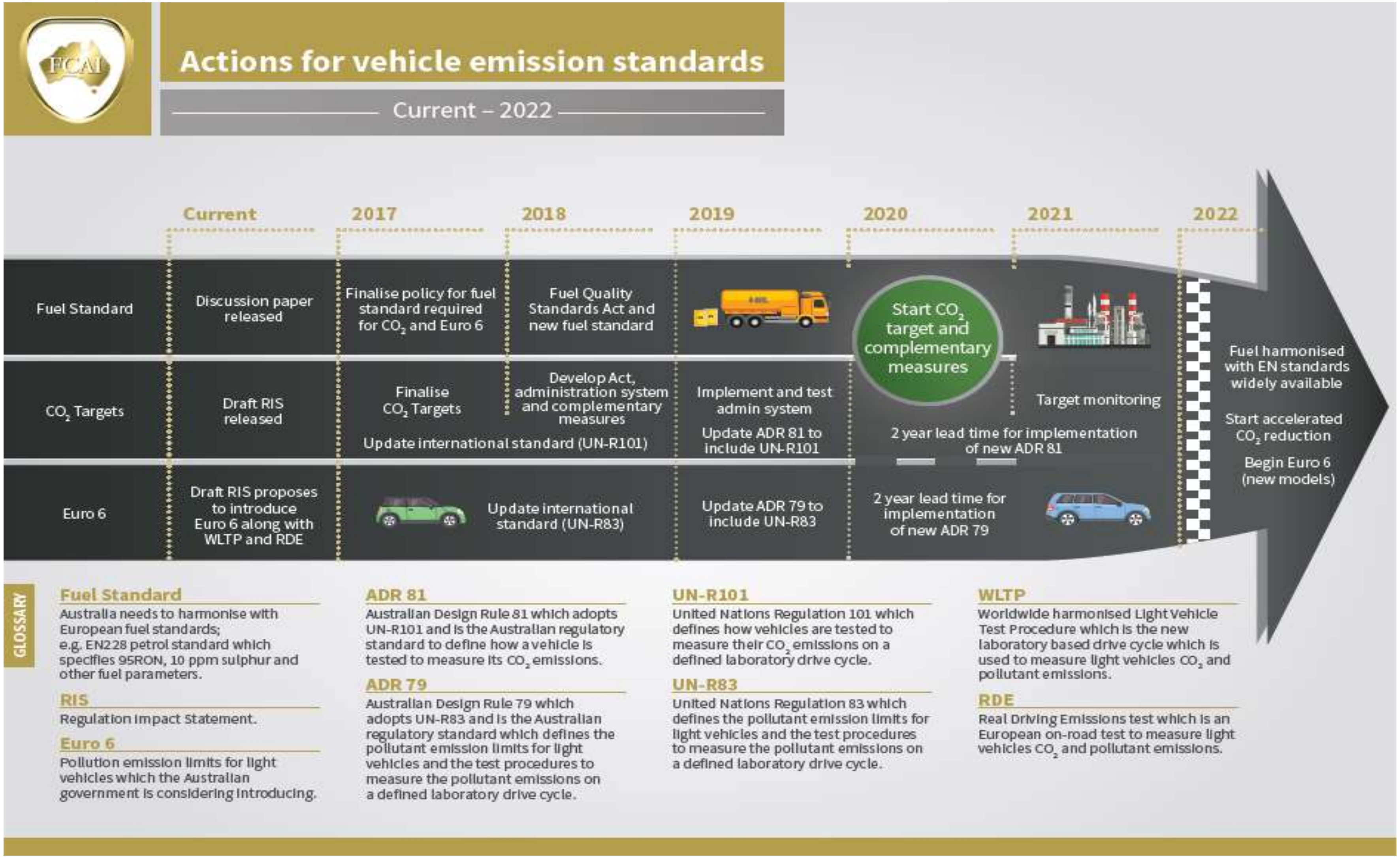
Pollutant Emission Standards (Euro 6):

- Adoption of Euro 6 standards in Australia will be most efficiently achieved by applying United Nations Regulation 83 (UN R83). The FCAI therefore welcomes the advice from DIRD that Australia intends to apply UN R83.
- Euro 6d is not currently included in the international vehicle emission standard, UN R83. As the Government's policy is to align with the international regulatory standards, i.e. the United Nations Regulations, the introduction of an ADR would need to wait until UN R83 is updated to include both test cycles (WLTP and RDE) and any subsequent change to emission limits.
- Taking into consideration the steps required to introduce Euro 6 into Australia leads to an earliest implementation timing of 2022 for "new models". However, this timing is contingent on widespread availability of petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards, e.g. biodiesel and ethanol blends).
- As there are multiple stages of Euro 6, and significant changes from Euro 5 through to Euro 6d, there needs to be a staged implementation. The "new models" date cannot be before petrol meeting EN228 and diesel meeting EN590 is widely available and the "all vehicles" introduction date must be at least 4 years later.
- The costs to move from Euro 5 to Euro 6d, in the draft RIS are underestimated and need to be reviewed. Moving from Euro 5 to Euro 6d will result in an increased cost per vehicle in the range of $500 to $1500 per vehicle; resulting in a total increased annual cost across sales of all new light vehicles of (approx.) $800 million to $1 billion per annum.
- The lower cost estimates used in the draft RIS (and previously supplied by the FCAI) were to change from Euro 5 to the initial stage of Euro 6 (i.e. Euro 6b). To provide a more realistic estimate of the cost to supply Euro 6d compliant light vehicles, the cost estimate in the draft RIS needs to be reviewed and increased by a factor of at least 2.

Implementation Timing

- Petrol meeting EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting EN590 must be widely available in time for implementation of both Euro 6 pollutant emission standards and a CO_2 standard.

- The infographic below provides an overview of the major government actions that need to be undertaken between 2017 and 2022 to provide for the implementation Euro 6 for "new models" and the start of an accelerated CO_2 reduction.



Conclusion:

- A real and sustained reduction in vehicle emissions (both CO_2 and pollutants) will only be achieved through an integrated approach that takes a whole-of-government approach to CO_2 standards, vehicle pollutant emission standards, fuel quality standards and on-road vehicle operation.
- Consideration of the introduction timing of Euro 6 and CO_2 targets for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN590 for Diesel) to support the introduction of both Euro 6 and CO2 targets.
- The timeframe for the required fuel to be available to the market will then determine the timeline for new vehicle models and the timeline for the introduction of regulatory standards. Moving ahead with new emission regulations without resolving fuel quality questions could increase the cost of new vehicles and adversely affect the operability of new emission technologies without delivering the anticipated environment and health benefits.

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1.0 INTRODUCTION

The FCAI welcomes the opportunity to respond to the Federal Government's "Vehicle emissions for cleaner air" Draft Regulatory Impact Statement[1]. The Federal Chamber of Automotive Industries (FCAI) is the peak industry organisation representing the manufacturers and importers of passenger vehicles, light commercial vehicles and motorcycles in Australia.

The Australian automotive industry is committed to continuing to make a strong contribution to national efforts to reduce the environmental and health impact of pollutant emissions from light vehicles. To achieve a reduction in pollutant emissions from private road transport an "Integrated Approach" is required. The Integrated Approach includes vehicle technology, alternative fuels, driver behaviour, infrastructure measures and price signals.

The FCAI welcomes the establishment of the Ministerial Forum on Vehicle Emissions as vehicle pollutant emission standards, CO_2 emissions and fuel quality standards are interrelated and must be considered as a single system to deliver the environmental and health benefits from reductions in light vehicle CO_2 emissions and vehicle pollutant emissions.

[1] Australian Government, Department of Infrastructure and Regional Development, "Vehicle emissions for cleaner air", Draft Regulatory Impact Statement, December 2016 (DIRDa)

2.0 CO2, POLLUTANT EMISSIONS AND FUEL QUALITY STANDARDS

Main Points from Section 2.0 CO_2, Pollutant Emissions and Fuel Quality Standards:

- CO_2 standards or targets, pollutant emission standards and fuel quality standards all need to be considered together, as they are all interrelated.
- This position is not unique and is shared by the global automotive industry, regulators and research organisations alike.
- The Government has recognised the inter-relationship between fuel consumption (CO_2), pollutant emissions and fuel quality standards by the formation of the Ministerial Forum on Vehicle Emissions.
- On-road operation of light vehicles must be considered to achieve CO_2 and pollutant emission reductions and an "Integrated Approach" that covers the following aspects is required:
  - Vehicle technology
  - Fuel quality standards
  - Alternative fuels and energy platforms
  - Driver behaviour
  - Infrastructure measures
  - Price signals
  - Average fleet age

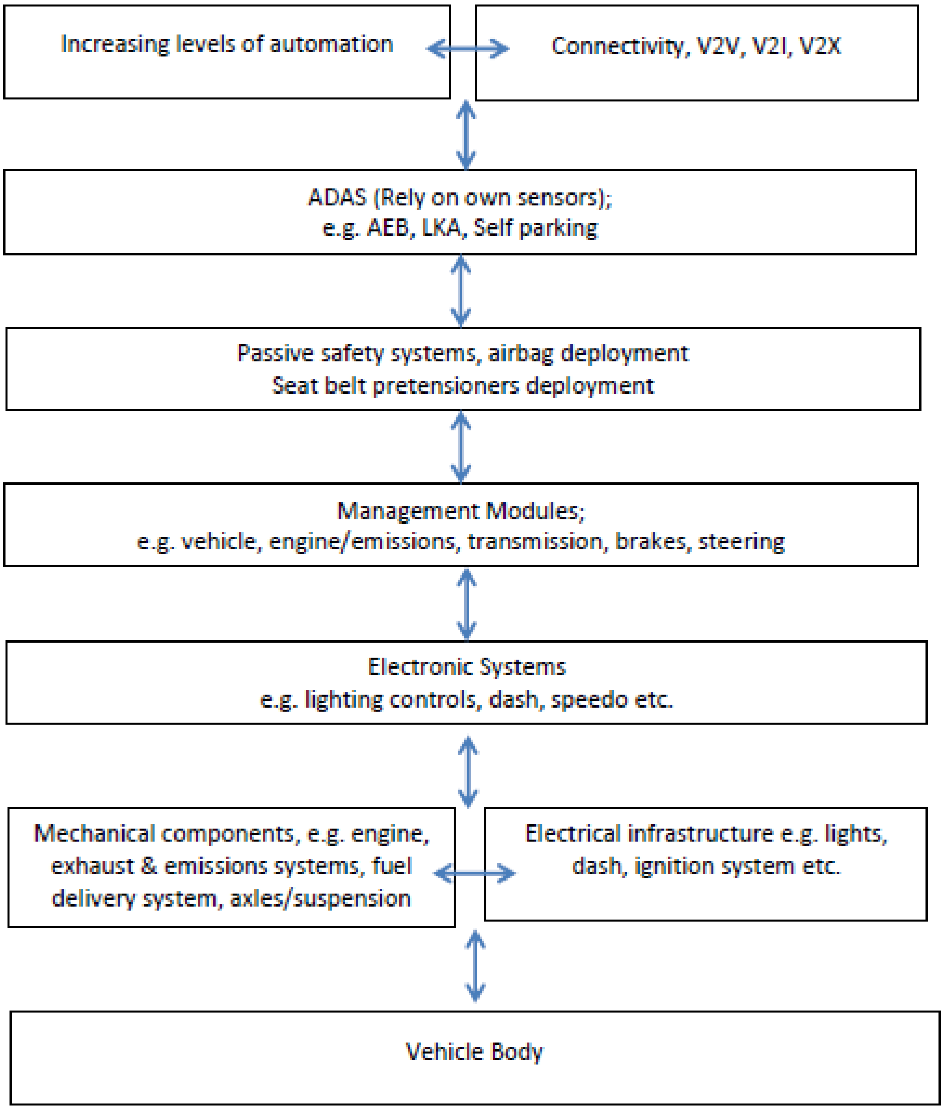
2.1 Inter-operability of Vehicle Systems

Modern vehicles are very complex with a range of sophisticated mechanical and electrical components and electronic modules that are integrated to deliver the performance, safety and emissions expected by customers and government. Figure 2.1 (below) represents how the various systems are integrated and need to be inter-operable to operate correctly.

Vehicles are designed and developed to meet GHG emissions (CO_2) targets and air pollutant emission standards with an expectation of fuel quality in a particular market. To continue to deliver reduced CO_2 emissions and corresponding expected air quality benefits (i.e. reduction in pollutant emissions) with the introduction of advanced vehicle emission standards, market fuel of the relevant standard (i.e. consistent with the EN fuel standards[2]) must be available. If market fuel of the necessary standard is not utilised, higher exhaust emissions (both CO_2 and pollutants) will be generated during a vehicles' operation with lower than expected environmental and health benefits.

[2] EN are European Standards published by the European Committee for Standardisation (CEN)

Figure 2.1 Block Diagram showing Inter-operability of Vehicle Systems



2.2 Whole-of-Government Approach

The FCAI's longstanding position is that CO_2 standards or targets, pollutant emission standards and fuel quality standards all need to be considered together, as they are all interrelated. This position is not unique and is shared by the global automotive industry, regulators and research organisations alike.

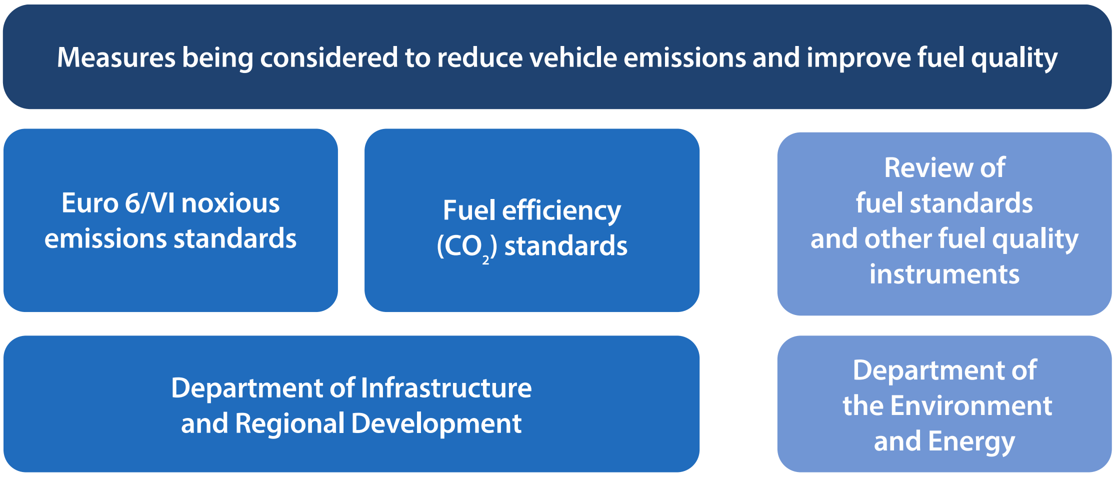
A whole-of-Government approach is required to incorporate all associated issues, including fuel quality standards, which have a significant impact on vehicles' ability to meet both GHG (CO_2) and air pollution emission standards. In the absence of such an approach, Australians will not receive the full benefit of the additional cost for improved emission technology in new light vehicles.

The Government has recognised the inter-relationship between fuel consumption (CO_2), pollutant emissions and fuel quality standards by the formation of the Ministerial Forum on Vehicle Emissions. The comprehensive package of activities being undertaken by the Ministerial Forum on Vehicle Emissions includes the release of three papers (Figure 2.2):

- *Improving the efficiency of new light vehicles*, Draft Regulation Impact Statement (December 2016).

- *Vehicle Emission standards for cleaner air*, Draft Regulation Impact Statement (December 2016).
- *Better fuel for cleaner air,* Discussion Paper (December 2016).

Figure 2.2 Ministerial Forum on Vehicle Emissions Activities[3]



Separately, the FCAI will outline in more detail our positions on fuel quality standards, in our response to *Better fuel for cleaner air*, Discussion Paper, and on CO_2 standards in our response to the *Improving the efficiency of new light vehicles*, Draft Regulation Impact Statement.

2.3 Integrated Approach

In addition to a whole-of-Government approach to vehicle emissions and fuel standards, consumer purchasing choice, vehicle use, road infrastructure and fuel quality will continue to be major influences on the rate of growth of private road transport related CO_2 and pollutant emissions.

To achieve a reduction in both CO_2 and pollutant emissions from private road transport an "Integrated Approach" is needed that includes:

- Vehicle Technology – Improve the performance of new light vehicles (passenger cars, SUVs and light commercial vehicles) to reduce their average CO_2 emissions.
- Fuel Quality Standards – Compatible market fuel must be available to support the vehicle technology and deliver the expected CO_2 (and pollutant) emission reductions.
- Alternative Fuels and Energy Platforms – Support of alternative fuels and energy platforms and the infrastructure to deliver them.
- Driver Behaviour – Educate drivers on techniques to reduce fuel consumption and CO_2 emissions, which can also improve road safety (see the golden rules of eco-driving at www.ecodrive.org).
- Infrastructure Measures – Improve traffic flow and avoid wasteful congestion. Emerging Cooperative Intelligent Transport Systems (C-ITS) technology has the potential to deliver significant reductions in traffic congestion.

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[3] Australian Government, Department of the Environment and Energy, "Better fuel for cleaner air", Discussion paper, December 2016

- Price signals (including incentives) – Influence consumer choice to produce changes in driving behaviour, and purchase and operating decisions for lower CO_2 emissions.
- Average fleet age – Incentives to increase the uptake of newer light vehicles and reduce the average age of the in-service fleet.

Focusing on just a single area, (e.g. vehicle technology) could increase overall cost to the community without delivering the expected benefits in the real world.

3.0 VEHICLE INDUSTRY

Main Points from Section 3.0: Vehicle Industry:

- The Australian automotive industry is committed to making a strong contribution to national efforts to reduce the impact of global climate change.
- The internal combustion engine (ICE) will remain the dominant type of engine for vehicles out to 2030 and it is expected the majority of light vehicles introduced into Australia during this period will have gasoline direct injection (GDI) engines.
- Complementary measures such as incentivising the purchase of electric vehicles will be required to encourage a change in consumer choice and increase the uptake of electric vehicles and other advanced technology powertrains.

3.1 Background

The Australian automotive industry is committed to making a strong contribution to national efforts to reduce the impact of global climate change and improve air quality. But it must be recognised that the on-road operation of light vehicles[4] also needs to be considered. For example, due to increasing congestion in our major cities owners of passenger cars, SUVs and light commercial vehicles are experiencing increasing travel times and consequently are using more fuel, and emitting more CO_2 and pollutant emissions year-on-year without corresponding increases in travel distance.

As at 31 January 2016 there were (approx.) 18 million motor vehicles registered in Australia, of which (approx.) 16.8 million were light vehicles[5]. In 2016, more than 1.14 million new passenger cars, SUVs and light commercial vehicles were sold.[6] Annual sales of new light vehicles are equivalent to (approx.) $1/16^{th}$ or 6.75% of the light vehicle in-service fleet.

The predominant powertrain of light vehicles in Australia is a petrol engine. Almost 79% of light vehicles registered in 2016 had petrol engines, while just under 19% had diesel engines (predominately light commercials) and the remaining 2% were "other fuel types" that included LPG, dual fuel and electric vehicles.[7]

3.2 Australian Light Vehicle Market

The consumer preferences in the new Australian light vehicle market have changed significantly from 2000 to 2016 (Figure 3.1) with a significant growth in the SUV and light commercial vehicle (LCV) segments, a large proportion of which in 2016 were diesel vehicles (33% of SUVs and 89% of LCVs).[8]

In 2016, Australian new car buyers had a diverse range of choice of models across all market segments. This is demonstrated by top ten sellers (Table 3.1) comprising three LCVs, one SUV, four small cars and two large/medium cars. Table 3.1 demonstrates the significant change in the light vehicle market in terms of both segment shift from passenger cars (in 2005, eight out of the top ten sellers were passenger cars) and also the significant fragmentation of the market.

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[4] Light vehicles in this submission refers to passenger cars, sport utility vehicles (SUVs) and light commercial vehicles up to 3.5 tonne GVM (LCVs)

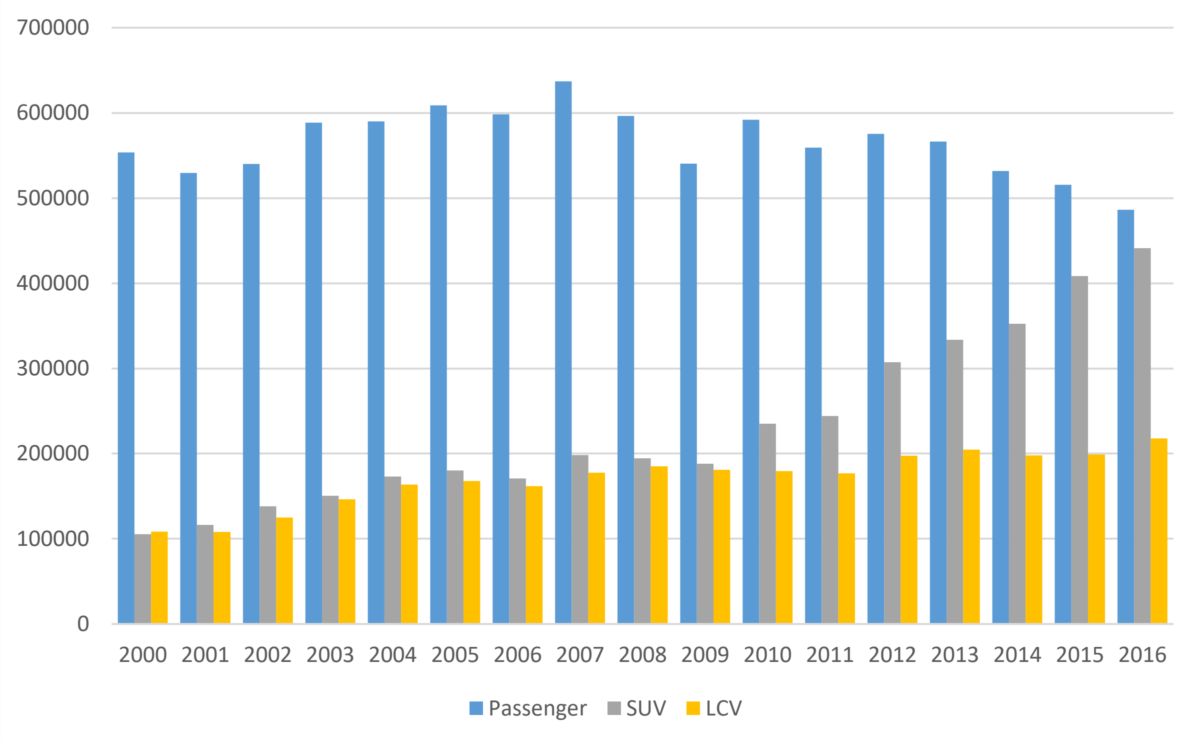
[5] Australian Bureau of Statistics, 9309.0 – Motor Vehicle Census, Australia, 31 Jan 2016.

[6] Vfacts National Report, New Vehicle Sales, December 2016.

[7] Australian Bureau of Statistics, 9309.0 – Motor Vehicle Census, Australia, 31 Jan 2016.

[8] Vfacts National Report, New Car Sales, 2000 to 2016

Figure 3.1 Light Vehicle Sales 2000-2016



The change in the market is demonstrated by a comparison of the top ten selling models in 2005 and 2016 (Table 3.1). In 2005 the top ten sellers accounted for approx. 1/3rd of all new vehicle sales with top selling Holden Commodore selling more than 66,000 units which was 6.8% of the market.[9] While in 2016 the top ten models represented only 26.5% of the (almost) 20% larger new vehicle market with the top selling Toyota Hi-Lux selling less than 2/3rd of the 2005 Commodore volume (at 43,735) and accounting for less 3.6% of the total market.

Table 3.1 Top Ten Light Vehicle Sales in 2005 and 2016

Rank	2005		2016	
	Model	Sales	Model	Sales
1.	Holden Commodore	66,794	Toyota Hi-Lux	42,104
2.	Ford Falcon	53,080	Toyota Corolla	40,330
3.	Toyota Corolla	46,415	Hyundai i30	37,772
4.	Holden Astra	33,070	Ford Ranger	36,934
5.	Mazda3	32,570	Mazda3	36,107
6.	Toyota Camry (4 cyl)	24,446	Toyota Camry	26,485
7.	Holden Utility (4x2)	20,813	Holden Commodore	25,860
8.	Ford Falcon Ute	20,123	Mazda CX-5	24,564
9.	Nissan Pulsar	17,643	Mitsubishi Triton	21,897
10.	Honda Accord	17,579	Volkswagen Golf	20,367
	33.6% to total market of 988,268		26.5% of total market of 1,178,133	

[9] In 2002 the Holden Commodore sold 102,269 units and accounted for 12.4% of the total new vehicle market.

Over the five year period from 2011 to 2016, there was a significant change in the number of diesel engine passenger vehicles (cars and SUVs) and light commercial vehicles (LCVs) registered, increasing by 92 per cent and 63 per cent, respectively. However, diesel engine light vehicles are still a relatively small part of the in-service light vehicle fleet. In 2016, diesel engine passenger vehicles comprise (approx.) 7 per cent of all registered light vehicles, while diesel engine light commercials make up (approx.) 10 per cent of all registered light vehicles.[10]

Growth in the particulate intensive diesel segment has implications for air quality. For many years Europe has focused on CO_2 reductions with policies including fuel taxation that made diesel cheaper than petrol. These policies lead to an increase in diesel passenger cars in many European countries. Now there are a number of European cities (and other congested cities around the world with air quality and particulate matter issues) that have announced they will (or are considering) banning diesel cars from their city centres by 2025 in response to the air quality and health related problems created by the emission of particulate matter from diesel vehicles.

This is a lesson for the Australian Government with consideration of a CO_2 target. Any Government policy aimed at influencing light vehicle CO_2 emissions, must also consider if there are any adverse implications for vehicle pollutant emissions. E.g. if a CO2 target and associated complementary measures encourage a greater uptake of diesel engine light vehicles, there may be a negative health and air quality impact.

3.3 Future Light Vehicle Powertrains

The internal combustion engine (ICE) will remain the predominate powertrain for Australian light vehicles out to 2030. Research conducted for the FCAI by IHS Advisory Services,[11] and presented to the Government, in 2016 concluded that;

> *"The internal combustion engine (ICE) will be the dominant source of power in passenger cars through to 2030. Hybrids will expand significantly (but they still have ICE's in them). Pure EV's will be niche."*

The BP Energy Outlook 2017 edition[12] supports this view and estimates that the global car fleet will double from 0.9 billion cars in 2015 to 1.8 billion in 2035. While the number of electric cars will increase from 1.2 million in 2015 to around 100 million in 2035 it will only be 6% of the global fleet. BP considers the key drivers for the uptake of electric vehicles (including PHEVs and BEVs) are:

- Fuel economy standards.
- Pace at which battery costs continue to fall.
- Size and durability of subsidies and other government policies supporting EV ownership.
- Improvements in fuel efficiency of ICE.
- Consumer preferences.

One of the expected drivers of development of PHEVs, especially for light commercial vehicles and large SUVs, is the US 2017-2025 vehicle fuel consumption and CO_2 (GHG standards) targets. The advice from IHS Advisory Services was that significant levels of hybridization of light commercial vehicles and large SUVs would be required in the US to meet their 2025 targets.

[10] Australian Bureau of Statistics, 9309.0 Motor Vehicle Census, Australia, 31 Jan 2016. http://www.abs.gov.au/ausstats/abs%40.nsf/mf/9309.0 [accessed 17 April 2015]

[11] Paul Haelterman, IHS Advisory Services, Global Automotive Regulatory Requirements: Regulatory Environment and Technology Roadmaps, February 2016

[12] BP Energy Outlook 2017 edition, www.bp.com/energyoutlook [downloaded 27 February 2017]

To inform the draft RIS on *Improving the efficiency of new light vehicles*[13], the government engaged ABMARC to undertake a study on the costs that may be incurred and the technologies that are likely to be required to achieve the range of CO_2 targets for 2020 and 2025 that were developed by the Climate Change Authority (CCA) in 2014.[14,15]

In their study, ABMARC concluded that significant shifts in powertrain mix will be necessary to meet any of the CO_2 targets considered. ABMARC modelled a mix of petrol, diesel, hybrid, electric and LPG powertrains for each of the CCA proposed targets. To meet the most stringent CO_2 target, ABMARC estimated that in 2025 electric vehicles must constitute at least 9.5% of all light duty vehicle sales, along with diesel powertrains at 9.5% and an increase in hybrid powertrains to 17.8% of the market. This is far in excess of the estimates of increase in EVs (both pure battery EVs and PHEVs) from both BP and IHS. ABMARC did acknowledge that these levels were very high and unlikely to be achieved without strategies such as incentivizing the purchase of EVs.[16]

3.4 Summary

A whole-of-Government approach is required that incorporates all associated issues, including fuel quality standards, that have a significant impact on vehicles' ability to meet both CO_2 targets and air pollution emission standards. The FCAI and member brands are committed to continue to work with the Government to develop an approach that meets government policy objectives.

[13] Australian Government, Ministerial Forum on Vehicle Emissions, Improving the efficiency of new light vehicles, Draft Regulation Impact Statement, December 2016

[14] ABMARC, Analysis of the Australian 2015 New Light Vehicle Fleet and Review of Technology to Improve Light Vehicle Efficiency: Study for Department of Infrastructure and Regional Development, December 2016,

[15] Australian Government Climate Change Authority, Light Vehicle Emissions Standards for Australia Research Report, June 2014

[16] ABMARC, *op. cit*., p.7

4.0 FUEL QUALITY STANDARDS FOR EURO 6

Main Points from Section 4.0: Fuel Quality Standards for Euro 6

- Vehicles are designed and developed to meet air pollutant emission standards and/or CO_2 targets with an expectation of suitable/appropriate fuel quality in a particular market.
- Fuel quality standards, pollutant emission standards (Euro 6) and CO_2 standards all need to be considered together, as they are all interrelated.
- Consideration of the introduction timing of Euro 6 for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN590 for Diesel) to support the introduction of both Euro 6 and CO_2 targets.
- The timeframe for the required fuel to be available to the market will then determine the timeline for new vehicle models and the timeline for the introduction of regulatory standards. Moving ahead with new emission regulations without resolving fuel quality questions could increase the cost of new vehicles and adversely affect the operability of new emission technologies without delivering the anticipated environment and health benefits.
- The European fuel standards for petrol (EN228) and diesel (EN590) are required to deliver the Euro 6 level pollutant emissions reductions in-service.
- The EN228 limit on Aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection engines.
- If the government is determined to mandate Euro 6, the introduction date for “new models” should not be before 2022 and must be linked to the start of a CO_2 standard and widespread availability of EN standard petrol and diesel. There needs to be a staged implementation with an introduction date for “all vehicles” at least 4 years later than the corresponding “new models” date and not before Australia adopts the European Fuel Standards EN228 and EN590.

4.1 Introduction

Vehicles are designed and developed to meet air pollutant emission standards and/or CO_2 targets with an expectation of compatible fuel quality in a particular market. While the Government has mandated Euro 5 (through ADR 79/03 and ADR 79/04), the Government has not mandated the associated European fuel quality standard (EN228[17] for petrol and EN590[18] for diesel).

If Australia does not adopt EN228 for the petrol standard and EN590 for the diesel standard, vehicles will be unable to comply with Euro 6 in-service requirements and will be unable to deliver the anticipated fuel efficiency improvements. It also risks the possibility of future vehicle models shifting Australia's vehicle fleet towards lower grade offerings than other advanced markets. This potentially degrades Australia's progress towards more technologically advanced and efficient vehicles.

Improving the quality of Australian market fuel will deliver improvements for the entire motor vehicle fleet, not just new motor vehicles.

To continue to deliver the air quality benefits from reduced pollutant emissions (and reduced CO_2 emissions) with the introduction of advanced vehicle emission standards, market fuel of the relevant

[17] EN228 is the European gasoline (petrol) fuel quality standard and specifies a range of fuel parameters including RON and maximum sulphur levels. Throughout this response the FCAI refers to RON and sulphur as these are the main parameters that affect fuel consumption and pollution emissions (see ABMARC report in Appendix D), however, there are other fuel parameters (e.g. aromatics) that also impact indirectly on vehicle emissions and operability and need to be considered.
[18] EN 590 is the European diesel fuel quality standard and specifies a range of fuel parameters.

standard (i.e. consistent with the European EN fuel standards) must be widely available. If market fuel of the necessary standard is not utilised, higher exhausts emissions (both CO_2 and pollutants) will be generated during a vehicles' operation with lower than expected improvements to air quality and health outcomes.

4.2 Pollution Emissions Standards (ADR 79)

Through the Australian Design Rules, the Government has introduced successively more stringent pollutant emission standards for vehicles. New light vehicles (passenger cars, SUVs and light commercial vehicles) introduced into Australia need to meet the Euro 5 standards (ADR 79/03 introduced from 1 November 2013 and ADR 79/04 introduced from 1 November 2016).[19]

The progressive tightening of vehicle emissions standards, especially over the last 10+ years as Australia has progressed from Euro 2, through Euro 3 to Euro 4 and now Euro 5 standards, has contributed to improvements in air quality in Australian cities. For example, a 2013 study by the CSIRO for the Victorian EPA found that by 2030 total motor vehicle exhaust emissions will have significantly reduced and that improved technology is entering the vehicle fleet at a faster rate than growth of vehicle use.[20]

Adoption of Euro 6 standards have efficiently been achieved by the government agreeing to "apply"[21] United Nations Regulation 83 (UN R83). This will allow those brands whose vehicles can operate effectively on the current market fuel (including diesel engine vehicles) to be offered to the market. Advice from some member brands is that some of their models that meet the initial Euro 6b standards are able to operate on Australian market PULP (which commonly has less than 30 ppm sulphur[22]). However, the long-term impact on the durability of the engine and emissions systems of these vehicles is unknown.

The successful introduction of the next step in light vehicle pollutant emission standards, Euro 6, is dependent on the widespread availability and use in Australia of fuel meeting European Fuel Standards, i.e. Petrol meeting EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting EN590 being widely available at price parity with base grade market petrol (e.g. ULP) and diesel.

4.3 Draft RIS Proposal

The draft RIS[23] considers a range of options and concluded that the greatest health benefits would be delivered through a new ADR 79/05 that mandated the Euro 6 pollutant emission standards that will commence in the European Union in September 2017, along with the new laboratory drive cycle (WLTP) and the new on-road test (RDE). This is commonly referred to as Euro 6d and has the following key parameters:

- A 55 percent reduction in NOx limits for light diesel vehicles.

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[19] Vehicle Emissions Standards, www.infrastructure.gov.au [accessed 5 January 2017]

[20] EPA Victoria, Future air quality in Victoria-Final Report, Publication 1535 July 2013

[21] Once a UN Regulation has been "applied" Australia has an obligation (under the "Mutual Recognition" provisions of the 1958 Agreement) to accept UN Approvals issued by any other Contracting Party (CP). The basic principle is that when a CP agrees to "apply" a UN Regulation, the Regulation is regarded as being consistent with that country's national legislation. Therefore a vehicle that conforms to an "applied" Regulation must be allowed free access to that country's market, without the imposition of additional mandatory requirements.
The benefit of Australia "applying" a UN Regulation is that Australia will have access to vehicles that comply with later (than specified in the ADR "Alternative Standards" clause) versions of UN Regulations without the need for additional certification approval. That is, vehicles meeting later safety or environmental standards will be certified without additional administrative workload for either the Government or industry.

[22] AIP, 2016, *Submission to the Vehicle Emissions Working Group on the Vehicle Emissions Discussion Paper February 2016*, 8 April 2016.

[23] DIRDa, *Op. Cit*. p.4

- The introduction of a particulate number limit for vehicles with Gasoline Direct Injection (GDI) engines.
- More stringent requirements for on-board diagnostics (OBD) to monitor the emissions systems including:
    - a reduction in OBD thresholds to trigger a malfunction warning; and
    - Increased frequency of monitoring in-service (via an In-Use Performance Requirement [IUPR]).
- Adoption of the new Worldwide harmonised Light vehicle Test Procedure (WLTP) as the certification test procedure.
- Introduction of the on-road Real Driving Emissions (RDE) test.

Without explicitly recommending an introduction timeframe for Euro 6, the draft RIS, Section 3.2.6 *Option 6 – Mandatory standards (Euro 6/IV) for light and heavy vehicles* (p. 27) includes the following statement:

> *"Taking into account the international situation, the Department considers that if new ADRs were to be determined in 2017, a phase-in period of 2019-2020 would be the earliest practical timeframe without unduly disrupting business planning."*

This timing is not achievable for either the Government or the vehicle industry. The Euro 6 pollutant emission standards that will be introduced into the EU from 1 September 2017 as European Commission Regulations and are not suitable to be introduced into Australia as ADR 79/05 without significant reworking.

Australia is a signatory to the United Nations 1958 Agreement[24] and the Government's policy to align with the international vehicle regulatory standards, i.e. the United Nations Regulations.

An important point that is not sufficiently recognised in the draft RIS is that Euro 6d is not currently included in the international vehicle emission standard, United Nations Regulation No. 83[25] (UN R83). The current level of Euro 6 in R83 is Euro 6c (see summary of Euro 6 levels in Figure 4.1). Neither the new laboratory test cycle (Worldwide harmonised Light vehicle Test Procedure or WLTP) nor the new on-road test cycle (the European derived Real Driving Emissions test or RDE) are yet to be included in United Nations Regulation No. 83[26] (UN R83). Substantial additional work is required (and is underway) to transpose both WLTP and RDE into UN R83. Therefore, Australia cannot adopt Euro 6d levels until this work is completed.

The introduction of a new ADR 79/05 (to adopt Euro 6) should to wait until UN R83 is updated to include both test cycles (WLTP and RDE) and any subsequent change to emission limits.

Taking into consideration the steps required to introduce Euro 6 into Australia, the earliest implementation timing, for new models, is 2022 (however this is contingent upon petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards, e.g. biodiesel and ethanol blends) is widely available in Australia.

The steps required to introduce Euro 6 into Australia include:

1. Australian government to finalise policy position in 2017.
2. UN WP. 29 to complete transposition of WLTP, along with any emission limit changes into UN R83 during 2017 and 2018.

[24] United Nations Economic Commission for Europe, Inland Transport Committee, Agreement Concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or be used on Wheeled Vehicles and the Conditions of Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions.

[25] United Nations Regulation No. 83 (UN R83) Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements

[26] United Nations Regulation No. 83 (UN R83) Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements

3. WP.29 to update RDE and introduce into R83 during 2018 and 2019.
4. ADR 79 (and the necessary administrative tools such as SE Forms) are updated to reflect new UN R83 in 2019.
5. Minimum two year lead time (2020 and 2021) to introduce new ADR leads to a 2022 introduction for “new models”. (Note: The 2022 date is contingent on the widespread availability of EN standard petrol and diesel. There needs to be a staged implementation with an introduction date for “all vehicles” at least 4 years later than the corresponding “new models” date and not before Australia adopts the European Fuel Standards EN228 and EN590.)

Adopting a 2022 implementation for “new models” is also beneficial to the government as they will be able to learn from the experience in the EU where the Euro 6d emission levels with WLTP and RDE will have been in place for a 2-3 years. For example, the Australian government will be able to benefit from the EU’s experience on having an RDE as part of the pollutant emission standard. Many issues that are yet to be finalized in the EU such as In-Use-Conformity, final PHEV procedure and PN fuel index will have been resolved. In short, Australia will be able to adopt a fully finalized test procedure.

4.4 Better fuel for cleaner air Discussion Paper

In our response to the Government’s “Better fuel for cleaner air Discussion paper”,[27] the FCAI strongly supported Policy Alternative B: **Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards**.

The FCAI’s response to the Government’s *Better fuel for cleaner air* Discussion paper, outlined the need to harmonise with EN standard fuels to deliver the governments objectives with introducing a CO_2 target and Euro 6 pollutant emission standards.

This has been the FCAI’s longstanding position that fuel quality standards, CO_2 standards and pollutant emission standards all need to be considered together, as they are all interrelated. This is not a unique position and is shared by the global automotive industry, regulators and research organisations alike. Appendix C contains a list of references and quotes from leading international regulators, the automotive industry, research organisations and the Australian Government that demonstrate this position is universally acknowledged.

[27] Australian Government, Department of the Environment and Energy, *Better fuel for cleaner air* Discussion paper for Ministerial Forum on Vehicle Emissions, December 2016 (DEE)

Figure 4.1 Summary of Euro 6 (petrol light vehicles)

Table 1: Euro 6 as introduced into the EU[i,ii]

Euro 6 Level[iii]		6b	6c	6d Temp	6d[iv]
Date of introduction	New approvals	1 Sep 14		1 Sep 17	1 Jan 20
	All vehicles	1 Sep 15	1 Sep 18	1 Sep 19	1 Jan 21
Emission Limits	THC (mg/km)	100	100	100	100
	NMHC (mg/km)	68	68	68	68
	NOx (mg/km)	60	60	60	60
	CO (mg/km)	1,000	1,000	1,000	1,000
	PM[v] (mg/km)	4.5	4.5	4.5	4.5
	PN (Nb/km)	6.0x 10^{12}	6.0x 10^{11}	6.0x 10^{11}	6.0x 10^{11}
OBD Thresholds	CO (mg/km)	1,900	1,900	1,900	1,900
	NMHC (mg/km)	170	170	170	170
	NOx (mg/km)	150	90	90	90
	PM (mg/km)	25	12	12	12
Tests: lab	NDEC			Can use either NEDC or WLTP	
	WLTP				
Tests: on-road	RDE			Temporary C.F.[vi] & monitoring phase	Final C.F.[vii]

Table 2: UN-R83/07 (Euro 6)[viii]

Euro 6 Level[ix]		6b	6c	6d Temp	6d
Date of introduction	New approvals	1 Sep 2014	1 Sep 2017	TBD	TBD
	All vehicles	1 Sep 2015	1 Sep 2018	TBD	TBD
Emission Limits	THC(mg/km)	100	100		
	NMHC (mg/km)	68	68		
	NOx (mg/km)	60	60		
	CO (mg/km)	1,000	1,000		
	PM (mg/km)	4.5	4.5		
	PN[v] (Nb/km)	6.0x 10^{12}	6.0x 10^{11}		
OBD Thresholds	CO (mg/km)	1,900	1,900		
	NMHC (mg/km)	170	170		
	NOx (mg/km)	150	90		
	PM (mg/km)	25	12		
Tests: lab	NDEC				
	WLTP				
Tests: on-road	RDE				

Glossary:

(red)	Not part of regulation/standard
(orange)	Temporary or alternative standard/limit
(green)	Part of regulation/standard

NEDC – New European Drive Cycle; the current laboratory based drive cycle which is used to measure light vehicles CO2 and pollutant emissions

WLTP – Worldwide harmonised Light vehicle Test Procedure; the new laboratory based drive cycle which is used to measure light vehicles CO2 and pollutant emissions

RDE – Real Driving Emissions; a European on-road test to regulate light vehicles pollutant emissions (NOx and PN) from Sep 2017

C.F – Conformance Factor; the multiple of the laboratory based test limits for pollutant emissions (NOx and PN) that set the limits for the RDE.

RM – Reference mass: the unladen mass of the vehicle increased by 100 kg.

Unladen mass - the mass of the vehicle in running order unoccupied and unladen with all fluid reservoirs filled to nominal capacity including fuel, and with all standard equipment.

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[i] Commission Regulation (EU) 2016/427 of 10 March 2016

[ii] Delphi, 2016/2017 Worldwide Emissions Standards, Passenger Cars and Light Duty

[iii] Emission limits and OBD thresholds in this table apply to M1 (passenger cars up to 9 seats and maximum mass not exceeding 3.5 tonnes) and N1 Class I vehicles (i.e. LCVs up to 1305kg RM). There are different (increased) emission limits and OBD thresholds for N1 Class II (1305kg<RM≤1760kg) and N1 Class III (RM>1760 kg

[iv] Unknown if emission limits and OBD thresholds will be revised with introduction of WLTP

[v] PN (particulate number) only apply to GDI engines

[vi] Temporary conformity factor: NOx limit x 2.1 (incl. measurement tolerance)

[vii] Final conformity factor: NOx and PN limit x 1.5 (1.0 + 0.5 measurement tolerance). Measurement tolerance of 0.5 subject to regular reviews and possible adjustment.

[viii] Date of entry into force:22 January 2015

[ix] Emission limits and OBD thresholds in this table apply to M1 (passenger cars up to 9 seats and maximum mass not exceeding 3.5 tonnes) and N1 Class I vehicles (i.e. LCVs up to 1305kg RM). There are different (increased) emission limits and OBD thresholds for N1 Class II (1305kg<RM≤1760kg) and N1 Class III (RM>1760 kg

4.5 Interaction of pollutant emission standards (Euro 6), CO_2 targets and fuel quality standards

The interaction of pollutant emission standards, CO_2 targets and fuel quality standards is a complex issue. Recognising the benefit from a better understanding of the operation of engine and emission system technology, in 2016, the FCAI commissioned a Melbourne based firm, ABMARC, to prepare a technical report to explain how a spark ignition petrol engine works with a focus on designs for light duty vehicles and the technologies required to meet future emission standards (contained in Appendix E).[28]

ABMARC summarised their report into a two page infographic (Figures 4.1 and 4.2) covering:

1. Fuel, engine technology and exhaust after treatment must be considered as a system to reduce both CO_2 and pollutant emissions.
2. The types of engine technology along with the benefits and downsides, e.g. gasoline direct injection (GDI) engines have improved fuel efficiency (compared to multi-point fuel injection), but the combustion process produces particulate matter that must be treated by an exhaust after treatment system with a particulate filter.
3. The main components of the exhaust after treatment system, i.e. catalytic convertor and particulate filter (required by GDI engines to meet Euro 6c and 6d particulate requirements).
4. The importance of fuel standards and in particular the impact of sulphur on the catalyst and how higher RON provides for higher engine efficiency and reduces CO_2.

The conclusions from the ABMARC study included:

- Achieving low vehicle emissions with spark ignition engines requires a compromise between pollutants and CO_2.
- Low vehicle emission can only be achieved using engine and exhaust aftertreatment technology that is complemented by high quality fuel.

[28] ABMARC, 2016, Technical Report: Engine and Emission System Technology, Spark Ignition Petrol Euro 5 & Beyond, Light Duty Vehicle, August 2016

Figure 4.2 Petrol Engine and Emissions System Technology (1)

PETROL ENGINE AND EMISSIONS SYSTEM TECHNOLOGY
Spark Ignition Petrol: Euro 5 & Beyond

ABMARC

INTRODUCTION

Advanced engine technology, exhaust after treatment and high quality fuel are all required to deliver low CO_2 and pollutant emissions. Modern petrol engines are highly complex and provide a compact, economical power plant that is capable of meeting the customer requirements of light duty vehicles while satisfying stringent global standards which limit CO_2 and pollutant emissions.

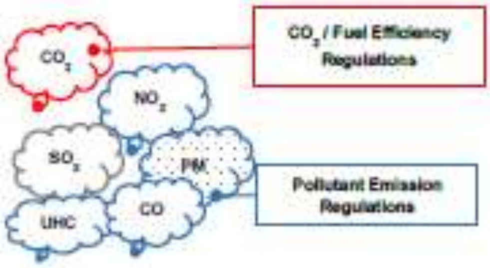
In order to ensure performance and durability for the designed vehicle service life, careful consideration must be made to meet the needs and limitations of the engine and emission reduction technologies.

01 OVERVIEW

Low vehicle tailpipe emissions require advanced engine technology, exhaust after treatment and high quality fuel.

Pollutants from Combustion

Pollutants are produced during combustion due to the engine design and operation combined with impurities in the fuel

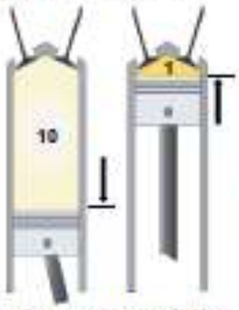


02 ENGINE

Petrol Combustion

Fuel, air, compression and a source of ignition are required for combustion within an engine.

Compression Ratio



10:1 Compression Ratio

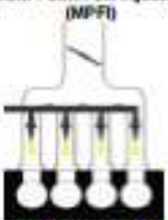
Compression ratio is the ratio of the volume of air and fuel that enters the engine divided by the final, compressed volume prior to combustion. This is presented as 10:1, for example.

Increasing compression ratio increases efficiency and reduces CO_2 emissions, but makes an engine more prone to knocking.

Fuel Injection Types

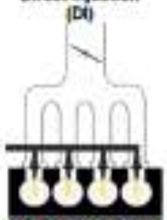
Current vehicles use either Multi Point Fuel Injection (MPFI) or Direct Injection (DI). The proportion of petrol engines using DI has increased over the last ten years due to the reduction in CO_2 emissions and increased power that is offered over MPFI. This helps vehicle manufacturers meet increasingly stringent global CO_2 and greenhouse gas standards.

Multi-Point Fuel Injection (MPFI)



- One fuel injector per cylinder
- Fuel is injected into the air intake
- Good fuel mixing

Direct Injection (DI)



- One fuel injector per cylinder
- Fuel is injected directly into the cylinders
- Improved combustion

Particulate Formation

- DI engines are more prone to particulate production than MPFI as fuel is sprayed directly into the combustion chamber.
- Fuel that hits relatively cold surfaces like pistons, valves and cylinder walls leads to particulate formation, through a mechanism known as wall wetting.

Figure 4.3 Petrol Engine and Emissions System Technology (2)

PETROL ENGINE AND EMISSIONS SYSTEM TECHNOLOGY
Spark Ignition Petrol: Euro 5 & Beyond

ABMARC

03 EXHAUST EMISSIONS REDUCTION

Catalytic Converter

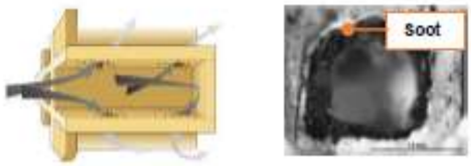
All petrol vehicles are fitted with a catalytic converter in order to meet stringent emission standards.

Source: AECC

- It encourages reactions between the pollutants and oxygen in the exhaust gas, forming CO_2 as a by-product.
- Pollutant conversion efficiency is sensitive to exhaust gas air: fuel ratio, temperature and deactivation (poisoning) from sulfur compounds.
- The efficiency of catalytic converters tends to reduce over time due to detrimental conditions, however, they are rarely replaced or renewed.

Particulate Filter

In order to meet European Euro 6c and 6d emission standards, all vehicles with direct injection petrol engines will require particulate filters.



Sources: Corning & Argonne National Laboratory

- A particulate filter is fitted in the exhaust system to trap soot particles in microscopic pores of a ceramic or metallic honeycomb.
- Pore size is around 11 times thinner than a human hair.
- Up to 90% of the mass of particles produced by the engine can be trapped, reducing tailpipe particulate emissions.

04 AUSTRALIAN FUEL

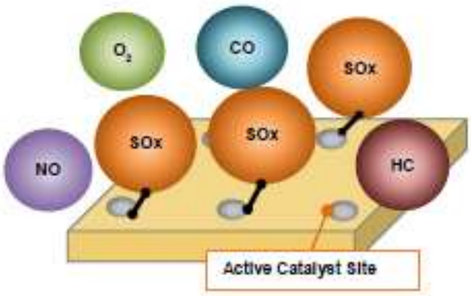
Fuel Sulfur Content

Sulfur in fuel forms compounds during combustion which inhibit the performance and durability of catalytic converters, increasing pollutant emissions. Other advanced markets have lower maximum sulfur content.

Petrol Type	Minimum Octane Rating	Maximum Sulfur Content
ULP	91 RON (Lower Octane)	150 ppm
PULP	95 RON (Higher Octane)	50 ppm
(From 2017)		10 ppm

RON = Research Octane Number
ppm = parts per million

Impact on Pollutants

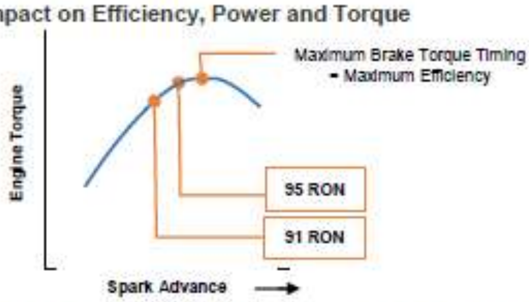


- The higher sulfur content of 91 RON ULP leads to higher levels of sulfur oxides (SO_X) in the exhaust gas.
- SO_X inhibits catalytic converter performance by bonding with the catalyst sites, reducing the reactions between other pollutants.
- 91 RON ULP leads to increased CO, UHC and NO_X emissions compared with 95 RON PULP due to its higher sulfur content.

Fuel Octane Rating

Higher octane fuel resists engine knock and enables high compression ratio engines to improve fuel efficiency and reduce CO_2 production. The European fuel standard requires a minimum octane rating of 95 RON.

Impact on Efficiency, Power and Torque



- For modern engines designed to use 95 RON fuel, using 91 RON will likely result in engine knock.
- To reduce engine knock, spark advance is retarded. This reduces the engine torque and decreases engine efficiency.
- Using 95 RON enables the engine spark timing to operate closer to the point of Maximum Brake Torque Timing (MBT)
- 95 RON enables higher engine efficiency, reducing CO_2

CONCLUSION

Achieving low vehicle emissions with spark ignition engines requires a compromise between pollutants and CO_2.

Low vehicle emissions can only be achieved by using engine and exhaust after treatment technology that is complemented by high quality fuel. 95 RON fuel offers a reduction in real world CO_2 and pollutant emissions over 91 RON.

From 2017, Europe, Japan and the USA will all have fuel standards with a maximum sulfur content of 10 ppm, enabling advanced engine and exhaust emission reduction technologies to meet stringent pollutant emission regulations in both the real world and in the laboratory.

4.6 Fuel Quality Standards: New Vehicles and Euro 6

The successful introduction of the Euro 6 level vehicle pollutant emission standards, is dependent on the widespread availability and use in Australia of fuel meeting European Fuel Standards:

- Petrol: matching the European standard, EN228 that includes 95 RON, 10 ppm sulphur, 35% v/v max aromatics as well as other parameters.[29] 95 RON petrol is currently available in the market, as Premium Unleaded Petrol (PULP). The Australian standard currently allows up to 50 ppm sulphur and also allows higher aromatics and olefins than EN228.

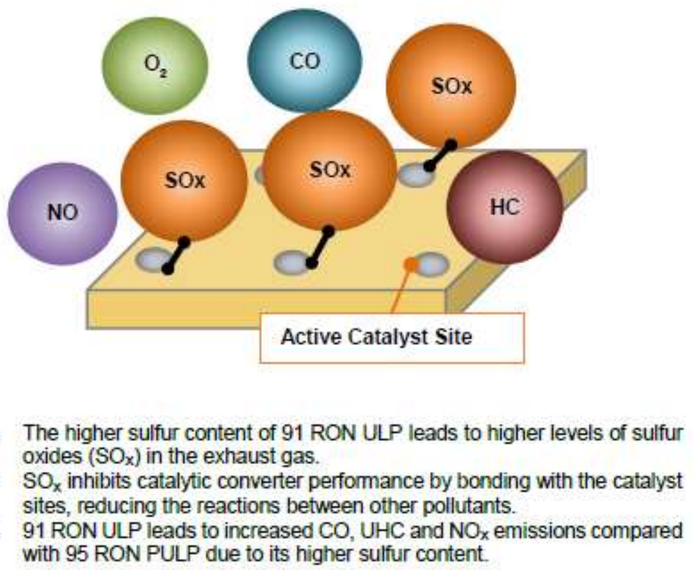
- Diesel: matching the European standard, EN 590. 10 ppm sulphur diesel is the current diesel standard and all diesel market fuel (both locally refined and imported) must meet this standard.

The full anticipated environmental benefits of encouraging the purchase and supply of petrol engine vehicles that meet Euro 6 will not be realised until such time as petrol meeting the European standard, EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) is widely available and used in the Australian market.

Individual fuel parameters cannot be considered in isolation. For example:

- Higher octane allows the use of higher compression engines leading to greater fuel efficiency (i.e. less fuel used) and lower CO_2 and pollutant emissions (NO_x, SO_x, PM, CO and UHC).
- Lower sulphur in the fuel means less SO_x is formed and captured on the catalyst (see figure 4.4 below), which in turn means less frequent regeneration[30] of the emission after-treatment systems (catalyst and particulate filter), which in turn leads to less fuel used.
- Reducing aromatics in petrol has been shown to reduce vehicle CO_2 emissions and reduce vehicle particulate emissions. The EN228 limit on Aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection engines.

Figure 4.4 Impact of Pollutants on Catalyst[31]



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[29] Note: the certification fuel standard for Euro 6 (UN R83/07) includes 95 RON, 10 ppm sulphur and max aromatics of 35% v/v for E5 and 32% for E10.

[30] Regeneration of emission after-treatment systems uses fuel to increase the exhaust gas temperature

[31] ABMARC, 2016, Technical Report: Engine and Emission System Technology, Spark Ignition Petrol Euro 5 & Beyond, Light Duty Vehicle, August 2016

The Australian transport fuel standards (especially for petrol) are lower than other markets that have introduced, or intend to introduce, advanced pollutant emission standards equivalent to Euro 6, including the EU, Japan, the USA, India and China.

A report prepared for the Australian Government in 2014 by Hart Energy, *International Fuel Quality Standards and Their Implications for Australian Standards*[32], demonstrates where Australian fuel quality standards are behind international levels and provides a series of recommendations where Australian fuel quality specifications need to be reviewed and upgraded in line with international standards.

The first recommendation for gasoline (petrol) in the Hart Energy Report[33] is:

> *For gasoline, Hart Energy Research & Consulting suggest alignment for two parameter (sulfur and aromatics) including …. ;*
>
> - *Sulfur: Align with the EU, Japan and South Korea by reducing the limit for the current 150 ppm for all grades and 50 ppm for premium-grade gasoline (PULP) to 10 ppm for all grades to enable advanced emission controls that are being produced and driven in markets such as Australia today;*
> - *Aromatics: Align with the EU by reducing the limit from the current cap of 45 vol% (42% pool average over 6 months) to 35 vol% max to help further reduce NOx, benzene and PM emissions in Australia;*

The lack of appropriate market fuel quality restricts the introduction of some engine variants by some brands and it also inhibits the performance of the latest generation of engines (i.e. Euro 6 compliant), particularly due to higher sulphur concentration in petrol. This is highlighted by Hart Energy:[34]

> *Sulfur impacts engine life and it can lead to corrosion and wear of the engine systems. … the EU reduced sulfur content in fuels .. among the following sectors:*
>
> - *Automotive sector; vehicles' ability to conform with vehicle emission standards – e.g. NOx technologies – enables them to upgrade vehicles with new emissions capturing systems."*

Throughout 2016, many vehicle brands presented to the Vehicle Emissions Forum governmental working group providing details on the need for 10 ppm sulphur petrol for correct operation of Euro 6 level engines and emissions systems. In addition to producing higher pollutant emissions, fuel with greater than 10 ppm sulphur will cause increased wear and degradation of engine and emission systems components including:

- Higher in field emissions due to reduced catalyst efficiency.
- Risk of OBD system MIL lamp illumination - vehicles needing repair.
- Early (prior to regulated 160,000km life) replacement of catalytic converter.
- Gasoline particulate filter blockage requiring more frequent regeneration cycles and fuel consumption/CO2 emission increases.
- Increased oil consumption.
- Piston and cylinder bore seizures.

[32] Hart Energy Research and Consulting, October2014*, International Fuel Quality Standards and Their Implications for Australian Standards, Final Report*

[33] Hart Energy, *Ibid*; p.2

[34] Hart Energy, *Ibid*; p. 14

In our response to the Vehicle Emissions Discussion Paper[35], the FCAI provided references to a range of documentation from the global automotive industry, regulators and research organisations that all demonstrate the need to consider fuel standards with vehicle pollutant emission standards, and in particular the need for ultralow (i.e. 10 ppm max) sulfur levels.[36] For completeness these references are included in Appendix C.

To attempt to determine if Euro 6 compliant vehicles would be able to operate on current Australian market fuel, in 2016 the Australian Government commissioned IHS Advisory Services to undertake a study of existing published research. One of the key learnings from IHS Advisory Services' research[37], was "It is clear that "Sulfur is a catalyst poison". IHS also found that all countries that have, or plan to introduce advanced emission standards are also moving to 10 ppm sulphur. The IHS study found that while there is no compelling available evidence that Euro 6 level vehicles would not be able to operate for the 160,000 km regulated durability period on fuel with up to 30 ppm sulphur, **the emission output would be higher than the Euro 6 levels:**[38]

- *You can use 30ppm to 50ppm fuel in cars calibrated for Euro-6, but the emissions output of those vehicles will not likely meet Euro-6 levels*
- *Vehicles designed to meet Euro-6 must have gasoline of 10 ppm or less to provide the desired emissions levels required by the Euro-6 requirements.*

The interaction of CO_2 targets, pollutant emission standards and fuel quality standards is a complex issue. Recognising the benefit for all stakeholders, from an understanding of the operation of engine and emission system technology, in 2016 the FCAI commissioned a Melbourne based firm, ABMARC, to prepare a technical report to explain how a spark ignition petrol engine works with a focus on designs for light duty vehicles and the technologies required to meet future emission standards (contained in Appendix E).[39]

In the Executive Summary, ABMARC summarises the need for 10 ppm sulphur to meet Euro 6;

> *The Euro 6 emissions standards, currently in force in Europe, introduces limits on particulate matter, forcing the use of particulate filters for engines which use direct injection as a means of reducing CO_2. As a result, particulate filters are required in the exhaust after treatment system of DI engine vehicles. Although these trap around 90% of the mass of particulates produced by a petrol engine, they must be periodically regenerated to burn off the carbon based soot inside the filter and reduce the resistance to exhaust gas flow, otherwise engine power and fuel economy would suffer.*
>
> *TWC (three-way catalyst) pollutant conversion efficiency is degraded by incorrect air: fuel ratio, excessive temperature and deactivation by sulfur compounds. Advanced engine management systems controlling technologies such as Multi Port Fuel Injection (MPFI) and Direct Injection (DI) fuel systems combined with variable valve and ignition timing improve combustion, hence the exhaust air/fuel ratio and temperature can be maintained within satisfactory limits for optimum Three Way Catalytic Converter pollutant conversion. However, these developments in engine technology have no impact on the production of sulfur compounds within the engine. To mitigate this detrimental impact on pollutant conversion by the TWC, reduction of sulfur compounds can only be achieved by limiting the concentration of sulfur in the fuel.*

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[35] Australian Government, Department of Infrastructure and Regional Development, "Vehicle Emissions", Discussion Paper, February 2016

[36] FCAI Response to Vehicle Emissions Discussion Paper, 8 April 2016

[37] IHS Advisory Services, *Fuel Quality Standards and Emission Standards in Australia: Fuel Sulfur Impacts on Euro 6 Compliance*. November 2106 – Final Report, p.44

[38] IHS Advisory Services, *ibid*, p. 42

[39] ABMARC, 2016, Technical Report: Engine and Emission System Technology, Spark Ignition Petrol Euro 5 & Beyond, Light Duty Vehicle, August 2016

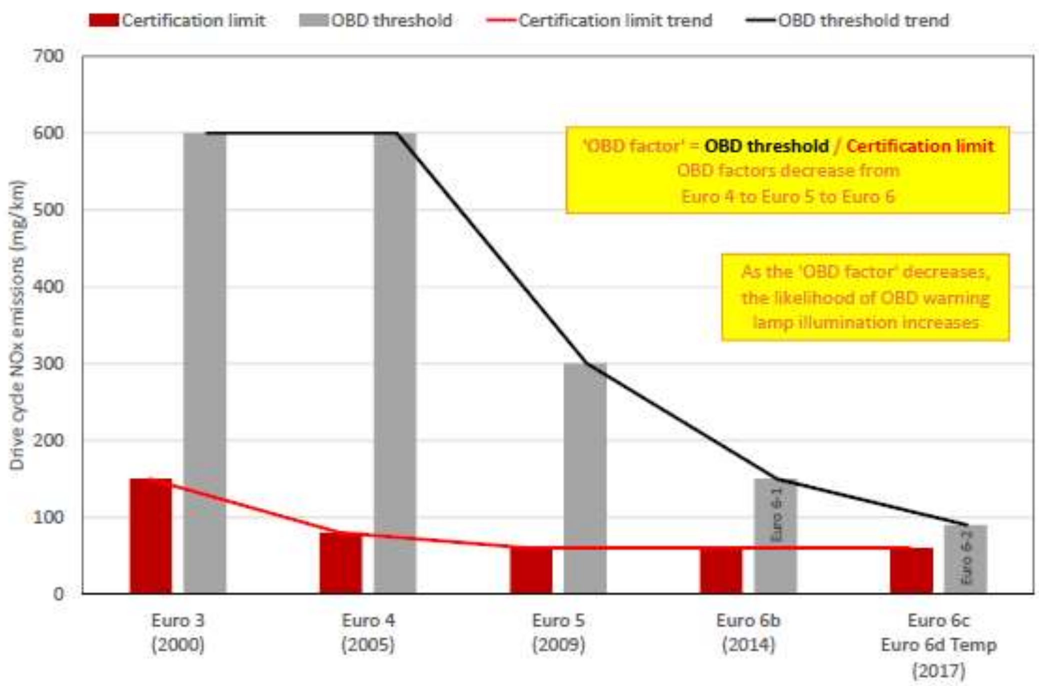
In Europe, the USA and Japan the emissions regulations have been aligned with fuels standards as regulators treat fuel quality and emissions standards as a system in order to maximise real world emissions reductions. From 2017, Europe, the USA and Japan will all require petrol to have a maximum sulfur content of 10 ppm. In Australia, fuel standards are not currently aligned with emissions standards.

In summary, high sulphur petrol will lead to increased fuel consumption from the engine needing to run rich more often to increase the exhaust gas temperature to de-sulphurise the catalyst. More frequent de-sulphurisation cycles will also reduce the service life of the catalyst leading to the need for more frequent replacement. Both these events result in increased emissions and increased costs for consumers.

Euro 6 also introduces OBD threshold limits and in-use performance requirements (IUPR) which tighten from Euro 5 to Euro 6b and then again with Euro 6c and 6d. Euro 6 also includes an in-service conformity requirement of 160,000 km or 5 years. This means that vehicles need to operate to closer tolerances throughout their service life up to a period of 160,000 km or 5 years which makes the need for wide availability of the correct grade of market fuel more critical.

In addition to the impact fuel borne sulphur has on the emission of regulated pollutants for petrol engines described in the ABMARC report, sulphur also affects On-Board Diagnostic (OBD) system performance. An on-board diagnostic system that monitors in-use emissions performance is required under all modern emissions legislations, including Euro 6. Figure 4.5 shows the progressive reduction in the NOx OBD thresholds since Euro 3 and the requirement to detect in-field emissions system degradation with much lower margins at Euro 6. High sulphur fuel usage reduces the effective margin and increases the likelihood malfunction indicator lamp (MIL) illumination and vehicles needing repair, particularly at higher mileage.

Figure 4.5 OBD threshold Limit Increases from Euro 3 to Euro 6c/d



The FCAI remains of the view that a maximum of 10 ppm sulphur is required for successful operation of Euro 6 compliant vehicles throughout their 160,000 km regulated durability requirement.

4.4 Fuel Quality Standards for Euro 6: Summary

Consideration of the introduction timing of Euro 6 (and CO_2 targets) for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN 590 for Diesel) to support the introduction of both Euro 6 and CO_2 targets.

The timeframe for the required fuel to be available to the market will then determine the timeline for new vehicle models and the timeline for the introduction of regulatory standards. Moving ahead with new CO_2 (and pollutant) emission regulations without resolving fuel quality questions could increase the cost of new vehicles and adversely affect the operability of new emission technologies without delivering the anticipated environment and health benefits.

The government is not able to introduce the Euro 6 standard that is in force in Europe as at 1 September 2017, along with WLTP and RDE as this is an EU standard. The EU standard is not suitable to be introduced into ADR 79 without significant re-work.

The international vehicle regulations, UN R83 does not currently include Euro 6d. The current level of Euro 6 in R83 is Euro 6c (see summary of Euro 6 levels in Figure 4.1) with the existing NEDC drive cycle. Substantial additional work is required (and is underway) to transpose both WLTP and RDE into UN R83. Australia should not adopt Euro 6 until this work is completed.

The earliest that Euro 6 could be introduced into Australia is 2022 (for new models) based on the timeframe to update ADR 79 as outlined above. However, this is also contingent on the widespread availability of European standard fuel at price parity to the base grade market fuel to encourage consumers to purchase and use the higher quality fuel.

As there are multiple stages of Euro 6, and significant changes from Euro 5 through to Euro 6d, there needs to be a staged implementation. The introduction date for “all vehicles” must be at least 4 years later than the corresponding “new models” date and not before Australia adopts the European Fuel Standards EN228 and EN590.

5.0 COMMENTS ON DRAFT RIS

Main Points from Section 5.0: Comments on Draft RIS

- The cost to comply with Euro 6d will be higher than estimated in the draft RIS due to the need for new technology and systems such as fitting Gasoline Particulate Filters (GPF) to vehicles which have Gasoline Direct Injection (GDI) engines.
- Euro 6 pollutant emission standards for light vehicles cannot be mandated in Australia until such time as petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards, e.g. biodiesel and ethanol blends) is widely available in Australia.
- The EN228 limit on Aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection engines.
- The earliest that Euro 6 could be introduced into Australia is 2022 (for "new models") based on the timeframe to update ADR 79 as outlined above. However, this is contingent on the widespread availability of European standard fuel at price parity to the base grade market fuel to encourage consumers to purchase and use the higher quality fuel.
- There needs to be a staged implementation with an introduction date for "all vehicles" at least 4 years later than the corresponding "new models" date and not before Australia adopts the European Fuel Standards EN228 and EN590.

The FCAI offers these additional comments and areas of clarification for the Government to consider when preparing the final RIS.

5.1 Costs of Implementing Euro 6

The cost to comply with Euro 6 derives from the need for new technology and systems such as fitting gasoline particulate filters (GPF) to gasoline direct injection (GDI) vehicles (note: GDI will need to be introduced to meet more stringent fuel consumption requirements)[40] to meet the Particulate Number (PN) limits in Euro 6c and 6d levels in particular.

The FCAI estimates that the (typical) additional cost of supplying a Euro 6c/d compliant vehicle over a Euro 5 compliant vehicle ranges from $500 to $1500 per vehicle (and up to $1800 for some models as shown in Table 19 of the draft RIS[41]), depending on vehicle type and engine, resulting in an annual cost increase across sales of all new light vehicles of (approx.) $800 million to $1 billion per annum.

The lower cost estimates previously supplied to the government (e.g. in the FCAI response to the Vehicle Emissions discussion paper) was for moving from Euro 5 to Euro 6b. To provide a more realistic estimate of the cost to supply Euro 6d compliant light vehicles (over the current Euro 5 levels), the estimate in the draft RIS needs to be reviewed and increased by a factor of at least 2.

5.2 Benefits

The FCAI notes that the benefits from introducing Euro 6 estimated in the draft RIS are based on certification test results. The certification test (petrol) fuel standard differs in important areas from

[40] The FCAI conducted a survey of members who confirmed that GPF will be fitted to GDI vehicles introduced into Australia to meet Euro 6c/d requirements.
[41] DIRDa, (2016), *Op. Cit.*; p.49

the Australian fuel quality standard (i.e. market fuel) that are likely to increase pollutant emissions from a vehicle during the 160,000 km in-service requirement.

In the IHS study conducted for the draft RIS, it was found that without 10 ppm sulphur petrol available **the emission output would be higher than the Euro 6 levels:**[42]

Table 5.1 Significant Petrol Fuel Standard Differences

Fuel (Petrol) Parameter	Australian fuel standard[43]	ADR 79 (UN R83) Certification test fuel specification[44]
Research Octane Number (RON)	ULP: 91 RON PULP: 95	95 RON (min) 98 RON (max)
Sulphur	ULP: 150 ppm (max) PULP: 50 ppm (max)	10 ppm (max)
Aromatics	42% v/v pool average over 6 months with a cap of 45% v/v	E5: 35% (max) E10: 32% (max)
Olefins	18% (max)	13% (max)

The anticipated health benefits of adopting Euro 6 pollutant emission standards for light vehicles will not be realised until such time as petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards, e.g. biodiesel and ethanol blends) is widely available in Australia.

5.3 Implementation Timing

Consideration of the introduction timing of Euro 6 (and CO_2 targets) for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN590 for Diesel) to support the introduction of both Euro 6 and CO2 targets.

As there are multiple stages of Euro 6, and significant changes from Euro 5 to Euro 6d, there needs to be a staged implementation. The “new models” date cannot be before 10 ppm sulphur petrol is widely available and the “all vehicles” introduction date must be at least 4 years later and cannot be before the fuel standard specifies both petrol and diesel meeting the European standards (EN228 and EN590).

Prior to the introduction of Euro 6, the Government also needs to take into account that R83 and R101 are not yet updated to include Euro 6d limits, WLTP and RDE. These updates are required prior to the inclusion of Euro 6 in an updated ADR 79. Otherwise certification costs would be imposed on the industry for vehicle make/model/variants that are not delivered to Europe and would not have approval to the European Commission Regulation. This will include many SUVs and LCVs, as well as Japanese and Korean brand passenger cars that have different engine/transmission configuration than delivered to the EU market.

As outlined in Section 4.3, taking into consideration the steps required by the Government to introduce Euro 6 into Australia, leads to an earliest implementation timing of 2022 for new models.

[42] IHS Advisory Services, 2016, *Op. Cit*., p. 42
[43] Fuel Standard (Petrol) Determination 2001 (28 June 2008 compilation)
[44] UN Regulation No. 83, Revision 5, 07 series of amendments to the Regulation – Date of entry into force: 22 January 2015

Adopting a 2022 implementation timing for new models is also beneficial to the government as they will be able to learn from the experience in the EU where, by 2022, the Euro 6d emission levels with WLTP and RDE will have been in place for 2-3 years. For example, the Australian government will be able to benefit from the EU's experience on having an RDE as part of the pollutant emission standard and many issues that are yet to be finalized in the EU such as In-Use-Conformity, final PHEV procedure and PN fuel index, will have been resolved. In short, Australia will be able to adopt a fully finalized test procedure.

It must also be recognised that brands already have development programs that are planned many years in advance based on product cycle plans and timings. All existing resources (both people and financial) are fully committed to current development programs.

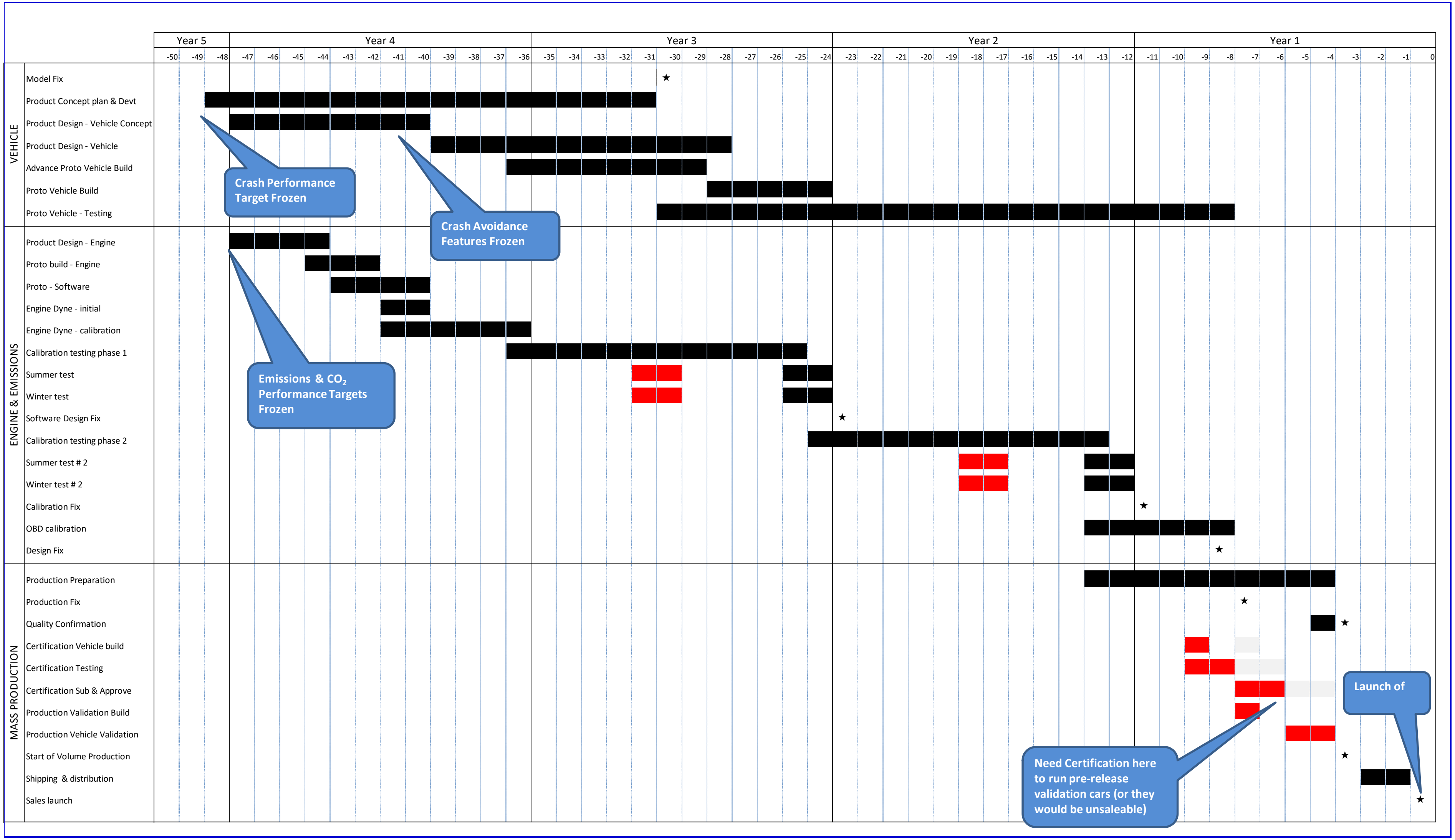
The introduction timing of an updated ADR 79 must allow for certification of around 400 models of light vehicles from more than 50 brands from a range of source countries from Asia, Europe and the US.

The actions required to be undertaken by industry, once a vehicle model design has been fixed, are outlined in summary in Table 5.2 and Figure 5.1 below.

Table 5.2 Actions Required to Introduce a New Model to the Market

Time to Market	Actions
5 to 7 years	• Design of vehicle architecture • Incorporate improved side impact protection in vehicle structure • Work with Tier 1 suppliers to design and develop sub-system (e.g. engine management system, exhaust aftertreament systems)
4+ years	• Design and development of the major sub-systems that are not part of vehicle structure and integration into vehicle, e.g. integration or packaging of catalyst and GPF. • Build of prototypes and installation of new systems (catalyst and GPF in this case) in model prototype. • Initial calibration and laboratory testing.
3 years	• Undertake on-road calibration. • Undertake initial seasonal variation (i.e. winter/summer) testing.
2 years	• Finalise on-road calibration testing. • Additional seasonal variation testing.
1 year	• Confirm production preparation with system suppliers. • Build certification pre-production vehicles. • Undertake certification testing. • Undertake certification processes and receive certification approval. • Production build and distribution to market. Note: in many companies, production will not begin until certification approval has been received.

Table 5.1: Generic Engine and Emissions Systems Development Schedule



6.0 CONCLUSION

The Australian automotive industry is committed to making a strong contribution to national efforts to improve air quality and reduce the impact of global climate change.

To deliver the Government's policy objectives, and deliver the environmental and health benefits, from introducing both Euro 6 emissions standards and a light vehicle CO_2 standard petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% aromatics, etc.) and diesel meeting the European standard EN590 must be widely availability at price parity to any other base grade market fuel. The EN228 limit on aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection (GDI) engines. Otherwise, the benefits estimated using the results of the regulation certification laboratory testing will not be delivered.

A real and sustained reduction in vehicle emissions (both CO_2 and pollutants) will only be achieved through an "Integrated Approach" that takes a whole-of-government approach to CO_2 standards, vehicle pollutant emission standards, fuel quality standards and on-road vehicle operation.

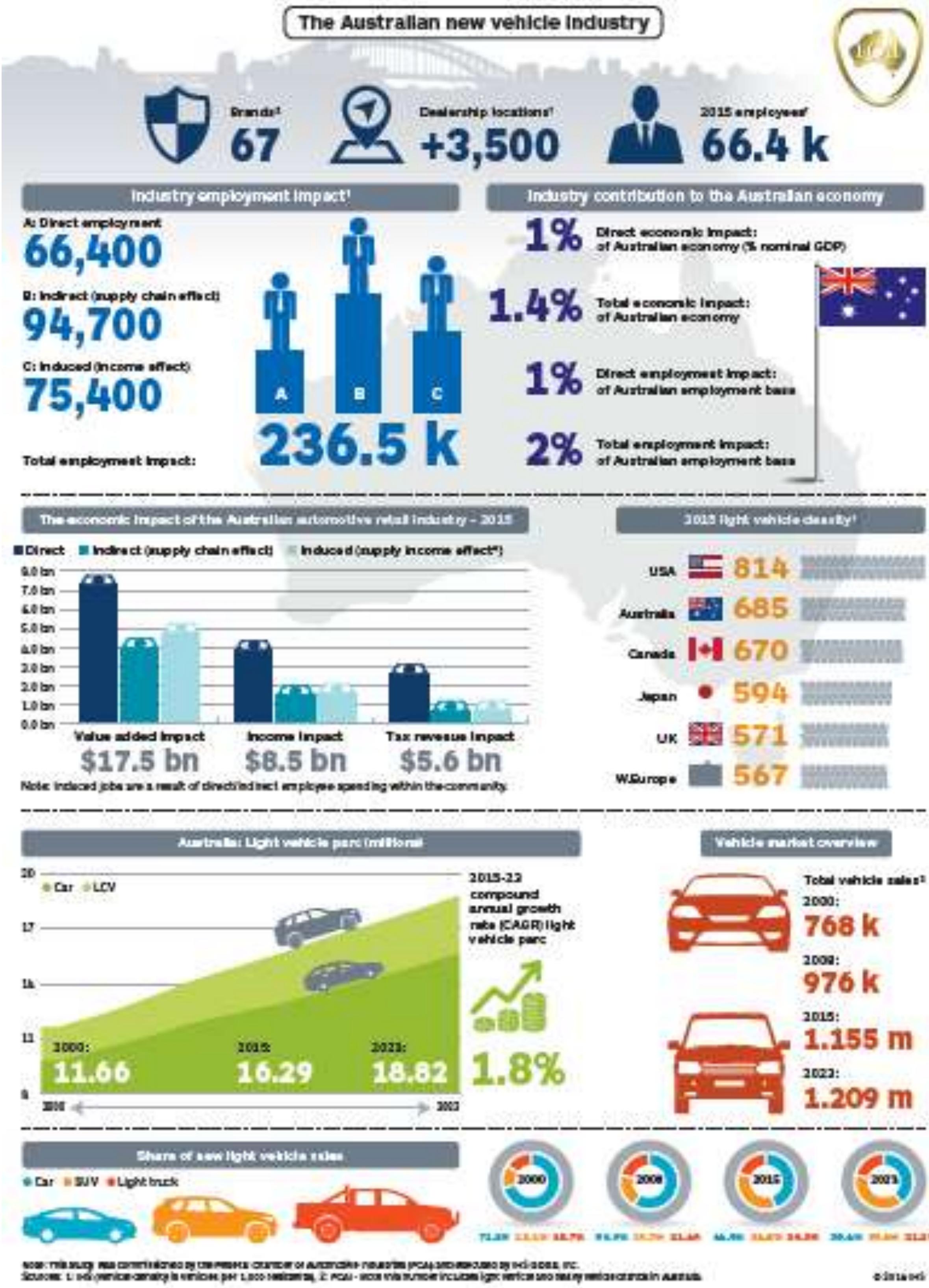
Consideration of the introduction timing of pollutant emission standards (i.e. Euro 6) for new vehicles cannot be undertaken until a detailed consideration of changes to Australian fuel quality standards has been completed. Of central concern is how the Government is planning to transition to the European fuel standards (EN228 for Petrol and EN590 for Diesel) to support the introduction of both Euro 6 and CO_2 targets.

The timeframe for the required fuel to be available to the market will then determine the timeline for new vehicle models and the timeline for the introduction of regulatory standards. Moving ahead with new emission regulations without resolving fuel quality questions could increase the cost of new vehicles and adversely affect the operability of new emission technologies without delivering the anticipated environment and health benefits.

Taking into consideration the steps required to introduce Euro 6 into Australia, leads to an earliest implementation time of 2022 for "new models". However, this is contingent on the widespread availability of European standard fuel at price parity to the base grade market fuel to encourage consumers to purchase and use the higher quality fuel.

As there are multiple stages of Euro 6, and significant changes from Euro 5 through to Euro 6d, there needs to be a staged implementation. The introduction date for "all vehicles" must be at least 4 years later than the corresponding "new models" date and not before Australia adopts the European Fuel Standards EN228 and EN590.

APPENDIX A THE AUSTRALIAN AUTOMOTIVE INDUSTRY



APPENDIX B INTEGRATED APPROACH

The "Integrated Approach" includes;

- Vehicle Technology – Improve the performance of new light vehicles (passenger cars, SUVs and light commercial vehicles) to reduce their average CO_2 emissions.
- Fuel Quality Standards – Compatible market fuel must be available to support the vehicle technology and deliver the expected CO_2 (and pollutant) emission reductions.
- Alternative Fuels and Energy Platforms – Support of alternative fuels and energy platforms and the infrastructure to deliver them.
- Driver Behaviour – Educate drivers on techniques to reduce fuel consumption and CO_2 emissions, which can also improve road safety (see the golden rules of eco-driving at www.ecodrive.org).
- Infrastructure Measures – Improve traffic flow and avoid wasteful congestion. Emerging Cooperative Intelligent Transport Systems (C-ITS) technology has the potential to deliver significant reductions in traffic congestion.
- Price signals (including incentives) – Influence consumer choice to produce driving behaviour and purchase decisions for lower CO_2 emissions.
- Average fleet age – Incentives to increase the uptake of newer light vehicles and reduce the average age of the in-service fleet.

Focusing on just a single area, (e.g. vehicle technology) could increase overall cost to the community without delivering the expected benefits in the real world.

B.1 Vehicle Technology

The industry will continue to deliver new vehicle technology to reduce the CO_2 and pollutant emissions of new light vehicles (passenger cars, SUVs and light commercial vehicles).

B.2 Fuel Quality Standards.

To deliver the expected CO_2 and pollutant emission reductions, market fuel that meets European Fuel Standards EN228 (petrol) and EN590 (diesel) must be widely available in Australia.

While 95 RON, Premium Unleaded Petrol (PULP) is widely available it comes at a price premium over Unleaded Petrol (ULP). To encourage consumers to use PULP and consequently receive the CO_2 benefits from advanced vehicle technologies the price of PULP will need to be comparable to ULP and ideally there would be no price difference.

Another significant issue with Australia's market fuel is the level of sulphur in petrol. Many new engine and emission technologies require a maximum of 10 ppm sulphur for full utilisation and to deliver the anticipated environmental benefits. However, Australia's fuel quality standard for petrol still allows up to 150 ppm sulphur for 91 RON petrol and up to 50 ppm sulphur for 95 RON petrol. [45]

In contrast, the diesel fuel quality standard has specified a maximum of 10 ppm sulphur since 2009.[46] Diesel fuel refined in Australia meets this standard.

[45] Department of Environment, Petrol Fuel Quality Standard, www.environment.gov.au [accessed 4 April 2016]
[46] Department of Environment, Diesel Fuel Quality Standard, www.environment.gov.au [accessed 4 April 2016]

The EN228 limit on Aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection engines.

The high sulphur content and high aromatics content in petrol currently supplied to the Australian market limits the adoption/import of some existing petrol engines that meets Euro 6. The situation will continue until such time that 10 ppm sulphur petrol is widely available in the Australian market.

It should also be noted that the Indian Government's recent rulemaking process recognised that petrol meeting EN228 is a pre-requisite to mandating Euro 6.

B.3 Alternative Fuels and Energy Platforms

An important part of an Integrated Approach is support of alternative fuel sources and the infrastructure required to deliver vehicles with alternative energy platforms, e.g. electric vehicles (EVs), plug-in hybrid electric vehicles (PHEV), hybrid electric vehicles (HEV) and hydrogen fuel cell vehicles (HFCV).

Australia needs to be aware of all these technologies and facilitate the entry into the market of all technologies, rather than locking the country into one approach.

EVs, PHEVs, HEVs and also HFCVs can potentially have significant impact on energy saving and deliver light vehicle CO_2 reduction. However, there are still a number of issues that need to be addressed[47]:

- HFCV: System cost reduction and development of hydrogen infrastructure are required.
- EV:
    - Recharging infrastructure is necessary for expansion.
    - Improved battery performance and cost reduction.
    - Consumers are still concerned about range, performance, recharge time and return on investment (i.e. resale value of car).
- PHEVs: Additional models, including light commercial vehicles, are likely to be introduced in the US post 2020/25 to meet the US CO_2 targets.

The Australian Government needs to consider what role it will play in this area. Approaches that are used in other countries to encourage the uptake of these alternative energy platform vehicles include:[48]

- Japan: Government-led consumer incentives and infrastructure investment played significant roles in the uptake of vehicles with these technologies. Japan has an official government target to deploy 2 million slow charging and 5,000 fast charging points for EVs by 2020.
- US: The mandated CO_2 targets include credits for hybrid, electric and hydrogen fuel cell vehicles ranging from 4.3% (in 2015) to 12.2% (in 2025). The US Government provided up to $7500 electric car tax credit and many US states also provide financial incentives.
- Canada: Some Canadian Provinces have rebates for purchasing EVs or PHEVs and also for installing home recharging.
- Norway: Owners of EVs and PHEVs have been exempt from paying road tax. This has helped Norway become the largest EV fleet per capita in the world with around 55,000 EVs in 2015. Incentives are being wound back with owners of EVs needing to pay half of the road tax from 2018 and the full road tax from 2020.

[47] IHS Consulting, Feb 2016, Global Automotive Regulatory Requirements: Regulatory Environment and Technology Roadmaps
[48] IHS Consulting, Feb 2016, Global Automotive Regulatory Requirements: Regulatory Environment and Technology Roadmaps

- Netherlands: Had financial incentives for purchasing PHEVs. The incentive expired in January 2014 and sales dropped from 9,000 in December 2013 to a little more than 500 in January 2014. This demonstrates the need for long term financial incentives to create price parity of EVs, PHEVs and HEVs with conventional engine vehicles.
- China: The Chinese government offer a nationwide subsidy of RMB 3,000 to consumers who purchase any passenger vehicle with an engine capacity of under 1.6 litre and that consume 20% or less fuel than government standards.

B.4 Driver Behaviour

Vehicle engine technology and performance has improved rapidly, while most drivers have not adapted their driving style. Educating drivers on techniques to reduce fuel consumption and CO_2 emissions (which can also improve road safety) can reduce fuel consumption from road transport so that less fuel is used to travel the same distance.

Ecodriving[49] is a term used to describe energy efficient use of vehicles and represents a driving culture to makes best use of advanced vehicle technologies. Ecodriving offers numerous benefits, including GHG emissions reductions, fuel cost savings, as well as greater safety and comfort.

Many organisations, including some Australian motoring clubs, promote “eco-driving.”

Following are the “Golden Rules of Eco-driving” as promoted by Ecodrive.org:

1. Anticipate Traffic Flow: Read the road as far ahead as possible and anticipate the flow of traffic. Act instead of react – increase your scope of action with an appropriate distance between vehicles to use momentum (an increased safety distance equivalent of about 3 seconds to the car in front optimises the options to balance speed fluctuations in traffic flow – enabling steady driving with constant speed).
2. Maintain a steady speed at low RPM: Drive smoothly, using the highest possible gear at low RPM.
3. Shift up early: Shift to higher gear at approximately 2,000 RPM. Consider the traffic situation, safety needs and vehicle specifics.
4. Check tyre pressures frequently (at least once a month) and before driving at high speed. Keep tyres properly inflated as low tyre pressure is a safety risk and wastes fuel. For correct tyre pressure (acc. To loading, highest pressure and speed driven), check the car’s manual or tyre placard.
5. Any extra energy used costs fuel and money: Use air conditioning and electrical equipment wisely and switch it off if not needed. Electrical energy is converted from extra fuel burnt in a combustion engine, so electrical equipment doesn’t work “for free” – it always costs extra energy and money. Avoid unnecessary weight and aerodynamic drag.

B.5 Infrastructure Measures

Improvements to infrastructure to improve traffic flow and avoid wasteful congestion.

Emerging Cooperative Intelligent Transport Systems (C-ITS) technology has the potential to deliver significant reductions in traffic congestion. In 2008 Austroads estimated the use of C-ITS systems to improve traffic management systems and reduce congestion could reduce GHG emissions by 5.5 million tonnes in 2020, which is approximately 5 per cent of the estimated annual transport related GHG emissions[50].

[49] Ecodriving.org, What is Ecodriving?, www.ecodriving.org [downloaded 25 March 2016]
[50] Austroads, 2008, Intelligent Vehicles and Infrastructure: The Case for Securing 5.9 GHz

During the 2015 ITS World Congress, papers presented in the Technical Sessions estimated up to 10% of fuel savings through vehicle-to-infrastructure (V2I) C-ITS through technology such as 'green-wave' traffic signals. Similar data was presented to the Driverless Vehicle Conference held in Adelaide in November 2015.

While the vehicle industry can (and will) supply C-ITS equipped vehicles there is a significant role for Federal and State/Territory governments including;

- A standardised interface harmonised with the European standards as Australian vehicle safety and environmental regulatory standards are harmonised with the European standards.
- A regulatory model that ensures vehicles fitted with C-ITS being delivered to Australia meet the European standards and will operate within the specified spectrum.
- Roll out of infrastructure to enable vehicle-to-infrastructure (V2I) communications.

B.6 Price Signals

Price signals can influence consumer choice to change driving behaviour and purchase decisions resulting in lower CO_2 emissions. For example, the BITRE found that when petrol prices are relatively high buyers shifted to more fuel efficient vehicles.[51]

An existing Government policy that is an example of providing a price signal to increase the rate of CO_2 emission reductions is the Government's Emission Reduction Fund (ERF). However, light vehicles have effectively been excluded from the Government's signature climate change policy, the Emissions Reduction Fund (ERF), at this stage.

The proposal that initially appeared to be most likely to be taken up by FCAI members and subsequently allow light vehicles to be part of the ERF is not open to light vehicles. The proposal was being able to aggregate sales of low emission vehicles (e.g. electric vehicles, hybrids or alternative fuel vehicles) across many owners for the purpose of calculating emission reductions. The Government advised the proposal is no longer open to light vehicles due to:

- Concerns over how to establish a baseline rate of improvement and light vehicle turnover.
- Acknowledgment that light vehicles currently have a rate of improvement that is among the highest of any sectors.
- CO_2 reductions in light vehicles is high-cost (i.e. doesn't meet the Government's objective of lowest cost abatement).

B.7 Average Fleet Age

The average age of registered passenger vehicles in Australia (as at 31 January 2015) is 9.8 years and has slightly increased from 9.7 years in 2010. The average age of light commercial vehicles is slightly older at 10.4 years and has remained steady since 2010 while the average age of the entire Australian registered vehicle fleet is 10.1 years.[52]

It is widely acknowledged that newer vehicles are more environmentally friendly in terms of both reduced CO_2 and pollutant emissions as demonstrated by the National Average Fuel Consumption (NACE) figures.

[51] Australian Government, Bureau of Infrastructure and Regional Economics (BITRE), 2014, *New passenger vehicle fuel consumption trends, 1979 to 2013,* Information Sheet 66, (p. 7) BITRE, Canberra.

[52] Australian Bureau of Statistics (ABS), 9309.0 - Motor Vehicle Census, Australia, 31 Jan 2015

An important consideration of improving the fleet environmental performance is to continue to reduce the average fleet age. Recognising that due to the large number of vehicles already in-service policies to reduce the fleet age will require a number of years to be effective.

The government also needs to be aware of policies or legislative changes which have the unintended effect of increasing the average age of the national fleet that will put at risk the broader policy objective of improved environmental outcomes. For example, if CO_2 targets results in brands withdrawing lager model SUVs and/or LCVs from sale, buyers who have a lifestyle and/or business that requires these vehicles may decide to keep an older model on the road.

APPENDIX C SUMMARY OF FUEL STANDARDS REFERENCES

The FCAI's longstanding position that fuel quality standards, CO_2 standards and pollutant emission standards all need to be considered together, as they are all interrelated, is not a unique one. It is shared by the global automotive industry, regulators and research organisations alike.

Following is a list of references and quotes from leading international regulators, the automotive industry, research organisations and the Australian Government that demonstrate this position is universally acknowledged.

C.1 US EPA

The US EPA stated in their Tier 3 Motor Vehicle Emission and Fuel Standards:[53]

> *"This program includes new standards for both vehicle emissions and the sulfur content of gasoline, considering the vehicle and its fuel as an integrated system."*

and

> *"The systems approach enables emission reductions that are both technologically feasible and cost-effective beyond what would be possible looking at vehicle and fuel standards in isolation."*

and

> *"EPA is not the first regulatory agency to recognize the need for lower-sulfur gasoline. Agencies in Europe and Japan have already imposed gasoline sulfur caps of 10 ppm, and the State of California is already averaging 10 ppm sulfur with a per gallon cap of 20 ppm."*

The US EPA Tier 3 Gasoline Sulfur program sets an in-service gasoline standard of 10ppm sulphur from 1 January 2017:[54]

> *"The final Tier 3 Gasoline Sulfur program is part of a systems approach to addressing the impacts of motor vehicles on air quality and public health, by considering the vehicle and its fuel as an integrated system. The program sets new vehicle emissions standards to reduce both tailpipe and evaporative emissions, and lowers the sulfur content of gasoline to a 10 ppm average sulfur level."*

C.2 European Commission

The European Commission (EC) also recognises fuel quality standards are linked to both pollutant and CO_2 standards. On their website page, "Road transport: Reducing CO2 emission from vehicles"[55] the EC state:

> *"Fuel quality is an important element in reducing greenhouse gas emissions from transport."*

[53] US Federal Register Vol. 79 No. 81, 28 April 2014, Part II Environmental Protection Agency 40 CFR Parts 79, 80, 85, et al. Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards: Final Rule

[54] United States Environmental Protection Agency, Gasoline, www.epa.gov/otaq/fuels/gasolinefuels/index.htm [accessed 7 July 2015]

[55] European Commission (EC), Climate Action, Road transport: Reducing CO2 emissions from vehicles, http://ec.europa.eu/clima/policies/transport/vehicles/index_en.htm [accessed 21 November 2014]

C.3 International Council on Clean Transportation

The non-profit research organisation, the International Council on Clean Transportation (ICCT), also recognises the importance of fuel quality standards.

In their inaugural *State of Clean Transport Policy*[56] report, released in 2014, the ICCT states:

> *"A key requirement to world-class vehicle standards, and thus cleaner vehicles, is the availability of ultralow-sulfur fuels."* (Page 4)

and

> *"Fuel quality, most notably the sulfur content of gasoline and diesel, is key to the implementation of advances emission controls. For optimal function of emission controls … Euro 6/VI-equivalent vehicles require fuel as low as 10 ppm sulphur."* (Page 18)

C.4 World Wide Fuel Charter

The global auto industry position is based on the World Wide Fuel Charter[57] (WWFC) which is an extensive and comprehensive compilation of research and testing of engine, fuel and control systems by a wide group of expert contributors. The objective of the WWFC is to promote global harmonisation of fuel to:

- Reduce the impact of motor vehicles on the environment by enabling reduced vehicle fleet emissions;
- Facilitate the delivery of optimised fuels for each emission control category, which will minimize vehicle equipment complexities and help reduce customer costs (purchase and operation); and,
- Increase customer satisfaction by maintaining vehicle performance for a longer period of time.

The WWFC contains both minimum specifications of necessary fuel quality parameters and a summary of the impact of the various fuel parameters on vehicle operation. In the "Technical Background" section there is an excellent overview of the research conducted on the effects of octane and sulphur, in gasoline. The WWFC includes the following statements on octane:[58]

> *"Vehicles are designed and calibrated for a certain octane rating."*
>
> *"Engines equipped with knock sensors can handle lower octane ratings by retarding the spark timing, but this will increase fuel consumption, impair drivability and reduce power; and knock may still occur."*
>
> *"Increasing the minimum octane rating available in the marketplace has the potential to help vehicles significantly improve fuel economy and, consequently, reduce vehicle CO2 emissions. While the improvement will vary by powertrain design, load factor and calibration strategy, among other factors, vehicles currently designed for 91 RON gasoline could improve their efficiency by up to three percent if manufacturers could design them for 95 RON instead."*

In relation to Sulphur, the WWFC[59] states:

> *"Sulphur has a significant impact on vehicle emissions by reducing the efficiency of catalysts."*

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[56] Miller, Joshua D., Facanha, Cristiano, The International Council on Clean Transportation (ICCT), the State of Clean Transport Policy: A 2014 synthesis of vehicle and fuel policy development, 2014.

[57] ACEA, Auto Alliance, EMA and JAMA, World Wide Fuel Charter, September 2013, 5th Edition, www.acea.be [accessed 9 October 2010]

[58] WWFC 5th edition, p.17

[59] WWFC, 5th edition, pp.17-19

"Sulphur also adversely affect heated exhaust gas oxygen sensors"

"Reductions in Sulphur will provide immediate reductions of emission from all catalyst-equipped vehicles on the road."

"Sulphur removal requires prolonged rich operating conditions…"

In relation to aromatics, the WWFC[60] states:

"Fuel aromatic content can increase engine deposits and increase tailpipe emissions, including CO_2."

"Heavy aromatics … have been linked to engine deposit formation, particularly combustion chamber deposits… these deposits increase tailpipe emissions, including HC and NOx."

Relevant to the consideration of a gasoline octane rating and level of sulphur for Australia, the WWFC outlines the required parameters for various fuel categories. The ones of specific relevance to Australia are (Page 1):

Category 4:

Markets with advanced requirements for emission control, for example, markets requiring US Tier 2, US Tier 3 (pending), US 2007 / 2010 Heavy Duty On-Highway, US Non-Road Tier 4, California LEV II, EURO 4/IV, EURO 5/V, EURO 6/VI, JP 2009 or equivalent emission standards. Category 4 fuels enable sophisticated NOx and particulate matter after-treatment technologies.

Category 5:

Markets with highly advanced requirements for emission control and fuel efficiency, for example, those markets that require US 2017 light duty fuel economy, US heavy duty fuel economy, California LEV III or equivalent emission

For both Category 4 and Category 5 gasoline the WWFC specifies a maximum sulphur of 10 ppm and aromatics of 35% v/v. While Category 5 gasoline has a minimum octane of 95 RON (pp. 6-7).

Cetane is a measure of the compression ignition of a diesel fuel and as such is a significant fuel quality parameter in diesel. In the Technical Background (page 41), the WWFC outlines:

"Higher cetane generally enables improved control of ignition delay and combustion stability, especially with modern diesels which use high amounts of exhaust gas recirculation (EGR)."

and

"Cetane influence on NOx is very significant … particularly at low speeds where reductions of up to 9% are achieved"

and

"The cetane increase also reduced HC emissions by 30-40%."

The WWFC specifies a minimum Cetane Index of 55.0 for both Category 4 and Category 5 diesel.

C.5 Department of Environment

The Department of Environment is currently reviewing the Fuel Quality Standards Act 2000. As part of the review two reports were released:

[60] WWFC, 5th edition, pp.28-29

- A report prepared by Orbital Australia in 2013, "Review of Sulphur Limits in Petrol." [61]
- A 2014 report by Hart Energy, International Fuel Quality Standards and Their Implications for Australian Standards.[62]

Orbital Australia reviewed existing standards and research on the impacts of sulphur levels in petrol and reached similar conclusions to the extracts above;

- Fuel standards work in partnership with vehicle emission standards to reduce emissions.
- Exhaust emissions will be higher with existing Australia market fuels (150 ppm or 50 ppm sulphur) than if low sulphur (10 ppm) petrol is introduced.
- Reducing sulphur levels (to 10 ppm) would allow use of some specific technologies and also reduce fuel consumption through the reduction of frequency of catalyst regeneration.

The Orbital report also acknowledges the potential for degraded performance, operability and durability of some vehicle technologies due to low quality market fuel.

The 2014 Hart Energy report, *International Fuel Quality Standards and Their Implications for Australian Standards*, demonstrates where Australian fuel quality standards are behind international levels and provides a series of recommendations where Australian fuel quality specifications need to be reviewed and upgraded in line with international standards. In the Section 1.2 Key Findings, Hart stated:

> *"In Hart Energy Research and Consulting's view, there are a number of specifications in Australian gasoline, diesel and E85 that may require changes."*

Hart then recommended that for sulphur in gasoline (petrol):

> *"Align with the EU, Japan and South Korea by reducing the limit from the current 150 ppm for all grades and 50 ppm for premium-grade (PULP) to 10 ppm max for all grades to enable advanced emission controls on the vehicles that are being produced and driven in markets such as Australia today."*

In relation to aromatics (in gasoline) Hart recommended:

> *"Align with the EU by reducing the limit from the current cap 45vol% (42% pool average over 6 months) to 35 vol% max to help further reduce NOx, benzene and PM in Australia;"*

(Note: in their 2015/16 rulemaking process to introduce Euro 6 vehicle pollutant emission standards, the Indian Government has recognised that availability petrol (gasoline) with a limit of 10 ppm sulphur and a maximum aromatics content of 35 %volume was necessary.[63])

C.6 Climate Change Authority

The FCAI considers that the analysis undertaken by the Climate Change Authority when developing its cost/benefit analysis of mandatory CO_2 targets[64] did not address the implications of in-service fuel and subsequent in-field vehicle performance. In particular, the Climate Change Authority paper uses certification results to develop its benefit analysis. The certification fuel is 95 RON 10 ppm sulphur petrol.

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[61] Orbital Australia Pty Ltd, 2013, Review of Sulphur Limits in Petrol, Produced for Fuel Policy Section, Department of Sustainability, Environment, Water, Population and Communities, 10 Jun 2013.

[62] Hart Energy Research and Consulting, October2014, International Fuel Quality Standards and Their Implications for Australian Standards, Final Report

[63] Shakun & Company (Services) Private Limited, Copy of Notification, Motor Vehicles Act, G.S.R 18(E), (published in the Gazette of India on 22nd February 2016).

[64] Australian Government Climate Change Authority (CCA), Light Vehicle Emission Standards for Australia: Research Report, June 2014

If the equivalent fuel is not available in the market, it cannot be guaranteed that the same result will be delivered in service, especially if a vehicle owner is likely to use ULP which, in Australia, is currently regulated to be 91 RON 150 ppm (max) sulphur. Therefore, the FCAI questions whether the full benefit as calculated will be delivered and considers that this cost/benefit analysis cannot form the basis for any rigorous regulatory analysis without additional testing to confirm in-service operation on market fuel will deliver the same result. Otherwise, to deliver the estimated benefits, the market fuel would have to be consistent with the certification fuel (i.e. 10 ppm sulphur, 95RON) to fully deliver a continued reduction in CO_2 emissions.

C.7 Australian Institute of Petroleum

In their 2013 publication, *Downstream Petroleum 2013*,[65] the Australian Institute of Petroleum acknowledged the benefits of cleaner fuels in reducing vehicle pollutant emissions (p.12):

> *"Government regulated fuel quality standards facilitate the introduction of advanced engine technologies. Benefits include improved urban quality (through reduced smog and particulates from motor vehicles), reduced greenhouse gas emissions, and improved fuel efficiency."*

C.8 FCAI Position

The FCAI has been consistent in its call for concomitant market fuel since 2010 in the FCAI's submission to the 2010 Regulatory Impact Statement (RIS) considering the introduction of Euro 5/6 emission standards. The Australian Design Rules for mandating Euro 5 vehicle emission standards (ADR 79/03 and ADR 79/04) specifies 95 RON, max 10 ppm sulphur, 35% max aromatics petrol as the test fuel.

Euro 6 pollutant emission standards for light vehicles cannot be mandated in Australia until such time as petrol meeting the European standard EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting European standard EN590 (as well as other applicable fuel standards, e.g. biodiesel and ethanol blends) is widely available in Australia.

The EN228 limit on Aromatics (35% v/v max) is critical to meet Euro 6c and Euro 6d Particulate Number (PN) limits for gasoline direct injection (GDI) engines.

[65] Australian Institute of Petroleum (AIP), Downstream Petroleum 2013, www.aip.com.au [downloaded 25 March 2016]

APPENDIX D ABMARC REPORT

(Supplied as separate file)