# FCAI Response to Better fuel for cleaner air Discussion paper


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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 vehicle emission standards and $CO_2$ targets 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 $CO_2$ emissions and vehicle pollutant 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. To offer vehicles with world-class pollutant emission standards, Australia must harmonise fuel standards and pollutant emission with leading overseas markets.
- $CO_2$ standards or targets need to be considered together with fuel quality standards and pollutant emission standards as they are all interrelated. This position is shared by many governments, research organisations and the global automotive industry.
- The anticipated environmental and 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 could 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 is for heavier vehicles with larger and more powerful engines and automatic transmissions, to cater for business and lifestyle requirements (e.g. trade and towing).

- 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).
- 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 drivers to adopt new technology.
- Steps to reduce the age of the vehicle fleet, as newer vehicles are more fuel efficient and emit fewer pollutants.

- To focus on only one area will increase the overall cost to the community without delivering the expected environmental and health benefits from $CO_2$ and pollutant emission reductions.

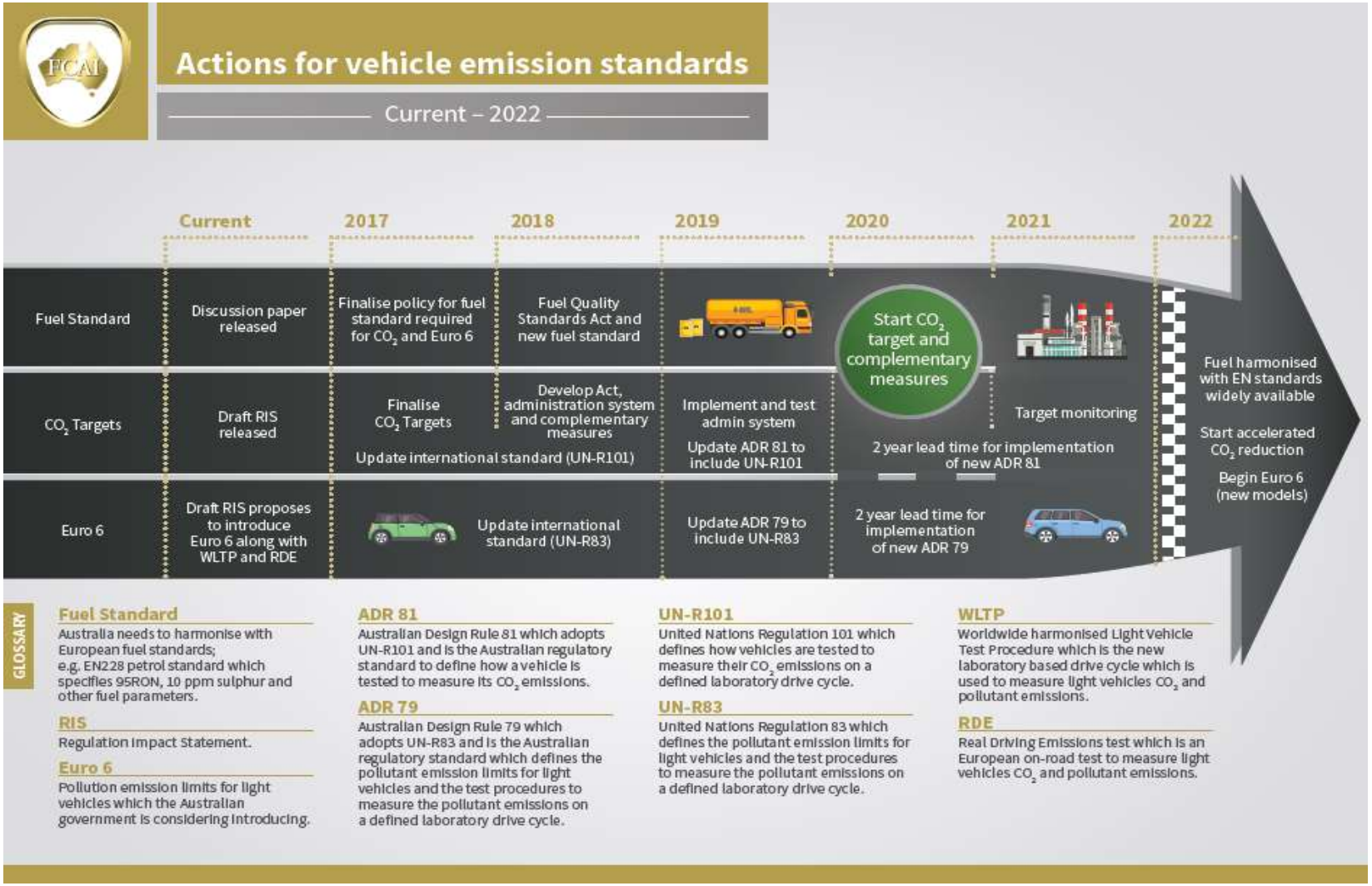
**Fuel Standards:**

- Vehicles are designed and developed to meet $CO_2$ standards and pollutant emission standards with an expectation of appropriate/compatible market fuel quality. Vehicles provided to the Australian market are based on global platforms (with some climatic and other minor variations), with engine technology developed for other markets.
- The automotive industry welcomes the discussion on improving the quality of Australian market fuels.
- The FCAI strongly supports Policy Alternative B: Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards (i.e. EN228 for petrol and EN590 for diesel.
- The FCAI's second preference is Policy Alternative D: Revisions to the fuel standards as per alternative B above, except with even stricter parameters to harmonise with the standards recommended by the Worldwide Fuel Charter.
- Complementary measures are required to encourage greater uptake of higher quality petrol meeting EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) by consumers during a transition away from current ULP (i.e. 91 RON, 150 ppm sulphur). This will have the effect of unlocking additional environmental and health benefits from the existing light vehicle national carparc.
- It should also be noted that many governments (including the EU, USA, Japan, China and India) have recognised that the availability of 10 ppm sulphur petrol is a pre-requisite to mandating Euro 6 (or equivalent) vehicle pollution emission standard.

**Implementation Timing**

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

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



**Conclusion:**

- A real and sustained reduction in vehicle emissions (both CO2 and pollutants) will only be achieved through an integrated approach that takes a whole-of-government approach to CO2 standards, vehicle pollutant emission standards, fuel quality standards and on-road vehicle operation.
- Consideration of the introduction timing of Euro 6 and CO2 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 "Better fuel for cleaner air" Discussion Paper[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 impact of global climate change and to improve air quality. To achieve a reduction in both $CO_2$ and pollutant emissions from private road transport an "Integrated Approach" is required. The Integrated Approach includes vehicle technology, alternative fuels and fuel standards, driver behaviour, infrastructure measures and price signals.

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. 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) 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.

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 the Environment and Energy, "Better fuel for cleaner air", Discussion paper, December 2016

## 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

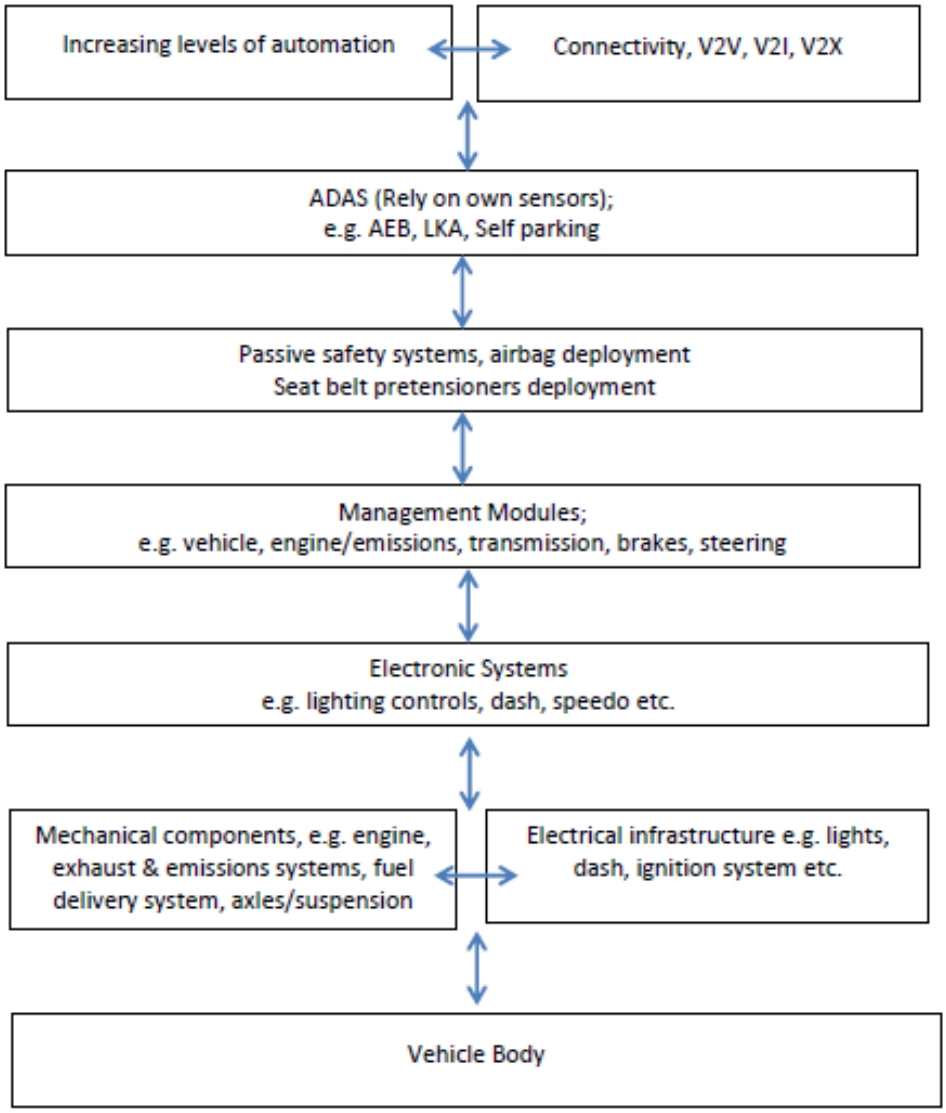
### 2.1 Inter-operability of Vehicle Systems

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.

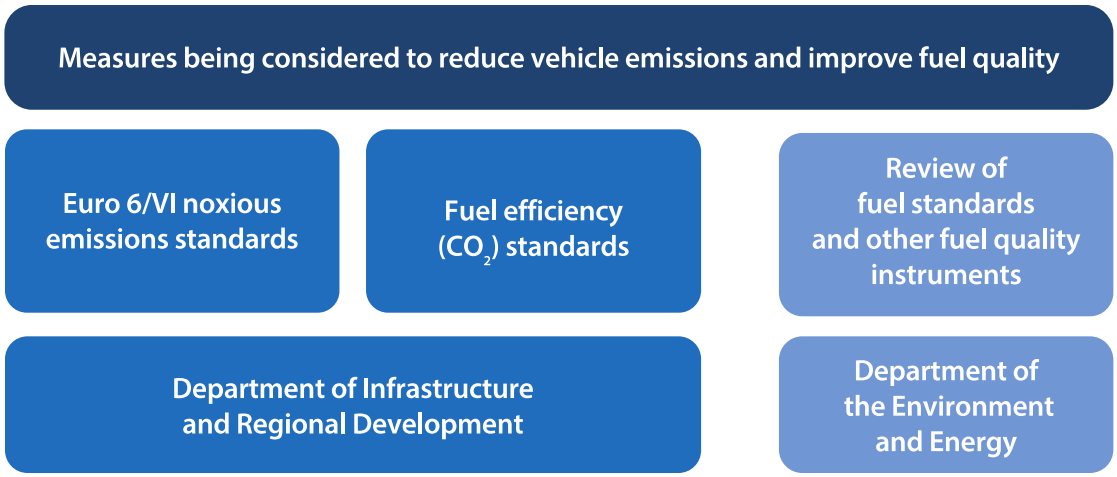
A whole-of-Government approach is required to incorporate all associated issues, including fuel quality standards, which have a significant impact on vehicles' ability to meet both GHG ($CO_2$) and air pollution emission standards. In the absence of such an approach, Australians will not receive the 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 the implementation and standards for both $CO_2$ and pollutant emission in response to the *Improving the efficiency of new light vehicles*, Draft Regulation Impact Statement and *Vehicle Emission standards for cleaner air*, 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.

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

- Price signals – 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.
- Internal combustion engine 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 Fuel Consumption and GHG Emissions

The Australian Government's, *Australia's emissions projections 2014-2015*[8], states (pp.19-20) that transport emissions[9] were 17 per cent of the National Greenhouse Gas Inventory in 2013-14 and that private road transport accounted for 46 per cent of transport emissions in 2013-14. Light vehicles accounted for 10.4 per cent of the National Greenhouse Gas (GHG) Inventory in 2013-14. However, as outlined above, sales of new passenger cars, SUVs and light commercial vehicles are equal to only (approx.) 1/16$^{th}$ of the current light vehicle in-service fleet. Therefore, new light vehicle sales can influence only around 1/16$^{th}$ of the private road transport annual GHG emissions. This equates to less than one per cent (i.e. 1/16$^{th}$ of 7.8 per cent) of the National Greenhouse Gas Inventory.

[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] Commonwealth of Australian (Department of Environment) 2015, Australia's emissions projections 2014-15, p. 19.
[9] Transport emissions includes rail, domestic shipping, domestic air and road transport.

In 2014 the Bureau of Infrastructure, Transport and Regional Economics (BITRE) released a study on the fuel consumption trends of new passenger vehicles sold from 1979 to 2013.[10] The BITRE found that before 2005, the improvements in vehicle technology that produced improved fuel consumption were somewhat offset by a change in the market to increases in power, weight and four wheel drive vehicles. The BITRE also reviewed the performance of the entire light vehicle fleet and found that since 1980;

> *"…the fuel intensity of entire light vehicle fleet has decreased a total of about 12.8 per cent"*

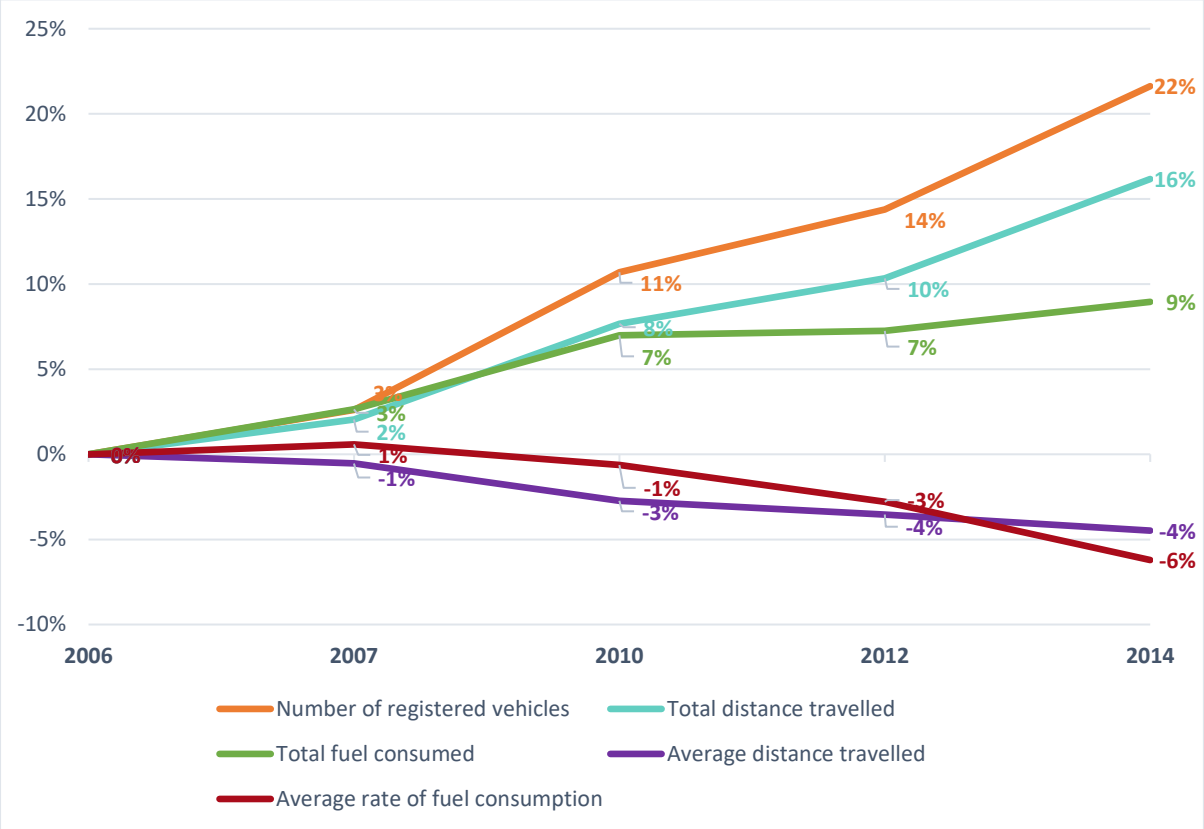
This is supported by the ABS Survey of Motor Vehicle Use.[11] When considering the percentage change in use of light vehicles over the period 2006 to 2014 (see Figure 3.1):

- The numbers of registered light vehicles increased by 22%.
- The total distance travelled by light vehicles increased by 16% and the average distance travelled by each light vehicle decreased by 4%.
- The total fuel consumed increased by 9% while the average fuel consumption of a light vehicle improved by 6%.

The yearly improvements in fuel consumption of new light vehicles lead directly to a reduction in both $CO_2$ and pollutant emissions.

However, the Department of Environment found that transport GHG emissions have steadily increased since 1990 and are projected to continue to increase.[12]

**Figure 3.1 – Changes in Light Vehicle Use: 2006-2016**




[10] Australian Government, Bureau of Infrastructure and Regional Economics (BITRE), 2014, *New passenger vehicle fuel consumption trends, 1979 to 2013, Information* Sheet 66, BITE, Canberra.
[11] Australian Bureau of Statistics (ABS), 9208.0 – Survey of Motor Vehicle Use, Australia, 12 months ended 31 October 2014, 15 October 2015, ww.abs.gov.au
[12] Commonwealth of Australian (Department of Environment) 2015, Australia's emissions projections 2014-15, pp. 19-20.

### 3.3 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).[13]

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.[14]

Adoption of Euro 6 standards have efficiently been achieved by the government agreeing to "apply"[15] 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[16]). 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 suitable fuel quality standards, i.e. Petrol meeting EN228 (i.e. 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc.) and diesel meeting EN590.

### 3.4 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,[17] 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 recently released BP Energy Outlook 2017 edition[18] 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.

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

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

[15] 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.

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

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

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

- 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.

To inform the draft RIS on *Improving the efficiency of new light vehicles*[19], 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.[20,21]

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 an increase in diesel powertrains of 9.5% and hybrid powertrains of 17.8%. 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.[22]

### 3.5 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.

[19] Australian Government, Ministerial Forum on Vehicle Emissions, Improving the efficiency of new light vehicles, Draft Regulation Impact Statement, December 2016
[20] 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,
[21] Australian Government Climate Change Authority, Light Vehicle Emissions Standards for Australia Research Report, June 2014
[22] ABMARC, *op. cit*., p.7

## 4.0 FUEL QUALITY STANDARDS

**Main Points from Section 4.0: Fuel Quality Standards**

- 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 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 $CO_2$ reductions in-service.
- Petrol engine light vehicles will not be able to comply with Euro 6 limits in service unless EN228 fuels are widely used.
- 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.
- 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, $CO_2$ standards and pollutant emission standards all need to be considered together, as they are all interrelated.
- The anticipated environmental benefits of adopting Euro 6 pollutant emission standards and $CO_2$ standards for petrol engine 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.) is widely available in Australia.
- For correct operation of vehicles with advanced pollution emission equipment (i.e. meeting Euro 6) all EN fuel parameters need to be met.
- All advanced markets recognise the need for advanced fuel quality standards (e.g. EN228 for Petrol and EN590 for Diesel) to implement advanced emission standards such as Euro 6.
- The FCAI therefore strongly supports Policy Alternative B: Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards.

### 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[23] for Petrol and EN590[24] 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

[23] 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.

[24] EN 590 is the European diesel fuel quality standard and specifies a range of fuel parameters.

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 reduced $CO_2$ emissions (i.e. reduction in fuel consumption) 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 certification fuel standard) must be employed. 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.

The successful introduction of the next step in light vehicle pollutant emission standards, Euro 6 and a CO2 standard, is dependent on Australia's adoption of European fuel quality standards EN228 (ie 95 RON, 10 ppm sulphur, 35% v/v max aromatics, etc) for petrol and EN590 for diesel.

### 4.2 Discussion Paper Alternative Policy Approaches

The Discussion Paper reviews five alternative policy approaches for updating the existing fuel standards:

A. Australia's fuel standards remain in effect in their current form (business as usual). Petrol standards retained: unleaded petrol (91 RON) with a maximum sulfur limit of 150 ppm; premium unleaded petrol (95 RON) with a maximum sulfur limit of 50 ppm. Diesel standard continues to specify a maximum sulfur limit of 10 ppm and derived cetane number of 51 for diesel containing biodiesel only.

B. Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards. Unleaded petrol (91 RON) would be phased out over a specified period of time (e.g. two to five years). Sulfur in premium unleaded petrol (95 RON) would be limited to 10 ppm and a new octane standard for premium unleaded petrol (98 RON) introduced. More stringent requirements would be introduced for cetane and polycyclic aromatic hydrocarbon levels in diesel.

C. Revisions to the fuel standards to align with the recommendations of the Hart report and to harmonise with European standards as per alternative B above, except that unleaded petrol (91 RON) is retained but with a lower sulfur level of 10 ppm.

D. Revisions to the fuel standards as per alternative B above, except with even stricter parameters (including for cetane levels in diesel) to harmonise with the standards recommended by the Worldwide Fuel Charter (that recommends the fuel quality required by automobile companies to meet particular emission standards).

E. Staged introduction of world standards from 2020, with a review in 2022 to determine next steps. Unleaded petrol (91 RON) would be retained. Sulfur would be reduced to 50 ppm for unleaded petrol (91 RON) and 25 ppm for premium unleaded petrol (95 RON) and a new octane standard for premium unleaded petrol (98 RON) introduced. Revisions to other parameters as per alternative B above.

***The FCAI strongly supports 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 second preference is Policy Alternative D: Revisions to the fuel standards as per alternative B above, except with even stricter parameters to harmonise with the standards recommended by the Worldwide Fuel Charter.***

### 4.3 Fuel Quality Standard: New Vehicles and Euro 6

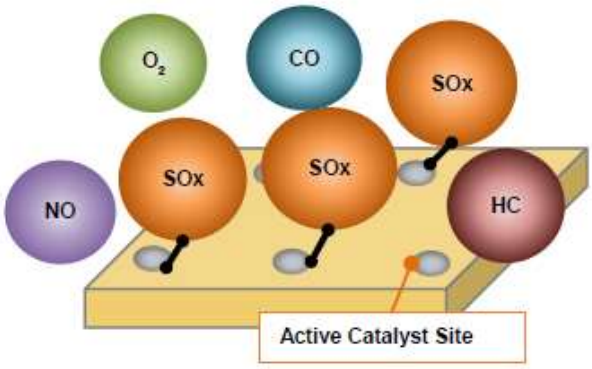
The successful introduction of the Euro 6[25] level vehicle pollutant emission standards, is dependent on suitable fuel quality standards:

- Petrol: matching the European standard, EN228, that includes 95 RON, 10 ppm sulphur as well as other parameters.[26] 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 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). Similarly lower sulphur in the fuel means less $SO_x$ is formed and captured on the catalyst (see figure 4.1 below), which in turn means less often regeneration[27] of the emission after-treatment systems (catalyst and particulate filter), which in turn leads to less fuel used.

**Figure 4.1 Impact of Pollutants on Catalyst[28]**




- 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.

[25] Australian Government, *Vehicle emission standards for cleaner air*, Draft Regulation Impact Statement, Ministerial Forum on Vehicle Emissions, December 2016

[26] 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.

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

[28] 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*[29], 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[30] 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:[31]

> *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.

[29] Hart Energy Research and Consulting, October2014, *International Fuel Quality Standards and Their Implications for Australian Standards, Final Report*
[30] Hart Energy, *Ibid*; p.2
[31] Hart Energy, *Ibid*; p. 14

In our response to the Vehicle Emissions Discussion Paper, the FCAI provided 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.[32] 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, 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[33], 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. IHS also found that 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. However, **the emission output would be higher than the Euro 6 levels:**[34]

- *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 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).[35]

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.*
>
> *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*

[32] FCAI Response to Vehicle Emissions Discussion Paper, 8 April 2016
[33] IHS Advisory Services, *Fuel Quality Standards and Emission Standards in Australia: Fuel Sulfur Impacts on Euro 6 Compliance*. November 2106 – Final Report, p.44
[34] IHS Advisory Services, *ibid*, p. 42
[35] ABMARC, 2016, Technical Report: Engine and Emission System Technology, Spark Ignition Petrol Euro 5 & Beyond, Light Duty Vehicle, August 2016

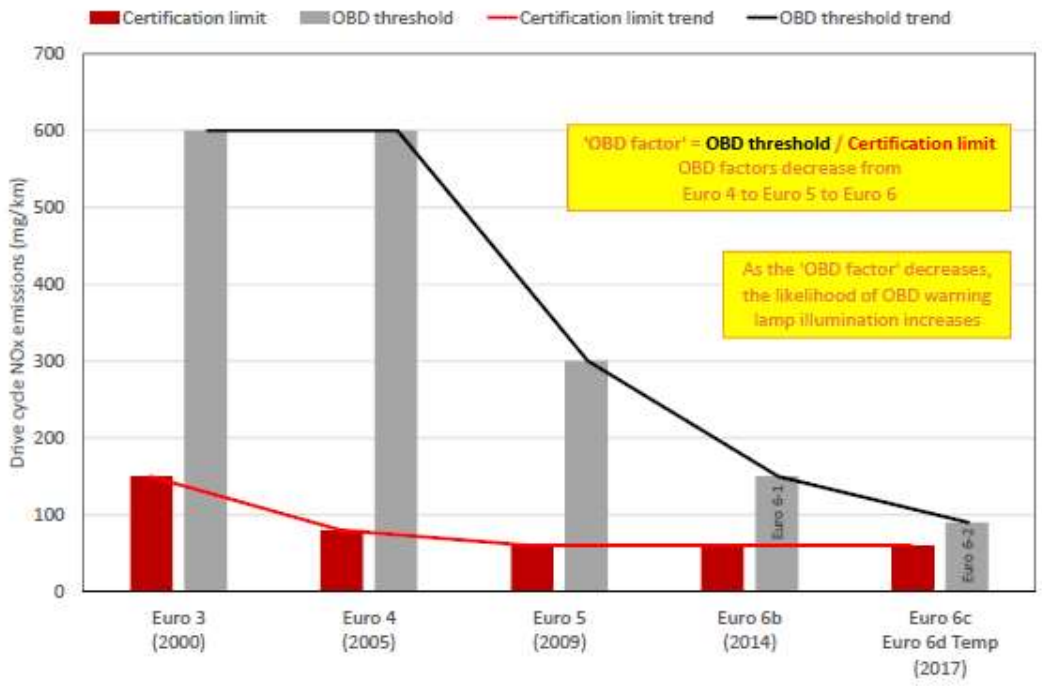
*maximise real world emissions reductions. From 2017, Europe, the USA and Japan will all require petrol to have a maximum sulfur content of 10 ppm. In Australia, fuel standards are not currently aligned with emissions standards.*

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 4.2 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 4.2 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.

### 4.3 Fuel Quality Standard: In-service Vehicles

In their review of the Fuel Quality Standards Act, Marsden Jacobs and Pacific Environment,[36] undertook an air quality assessment and health risk assessment. When considering improving fuel quality standards to facilitate the introduction and operation of better engine and emission control equipment Marsden Jacobs and Pacific Environment concluded (p.55):

> *With respect to the objectives of reducing emissions and improving health outcomes there has been:*
>
> - *a quantifiable reduction in the mass of (assessed) pollutants arising from the use of regulated fuel, with the exception of $O_3$ formation, in both Melbourne and Sydney;*
> - *generally an improvement in health outcomes, with some exceptions associated with exposure to $O_3$;*
> - *indirectly,a reduction in the level of greenhouse gas emissions arising from the use of regulated fuel.*

It is difficult to quantify the health benefits from current in-service vehicles operating on a higher quality fuel (e.g. 95 RON 10 ppm sulphur). However, there is substantial evidence that demonstrates there will be reduced pollutant emissions from existing vehicles through operation on higher quality fuel. The report prepared by for the Department of Environment by Hart Energy in 2014[37] acknowledged the following studies in the EU, Japan and the US:

- EU study that concluded (ultra-low) 10 ppm sulfur gasoline presents the possibility of reducing NOx emissions by 21% and non-methane hydrocarbons (NMHC) emissions by 13% compared to low (i.e. above 10 and below 50/100 ppm) sulfur fuels.
- Japanese tests showed that increasing sulfur content from 1 ppm to 50 ppm resulted in NOx emissions increase of 25 to 35 times.
- US research comparing 33 ppm sulfur and 3 ppm sulfur, the NOx was reduced by 40%. This research was also included in the response by the US Manufactures of Emission Controls Association (MECA)[38] in response to Australian Government's 2016 Vehicle Emissions Discussion Paper.

Each of these studies provided a different estimation of the reduction in pollutant emissions from the use of lower sulphur fuel. This can be due to the different test parameters such as other fuel parameters or different drive cycles as the EU, Japan and US each have a different emission standard and emission test protocol. However, all demonstrate there is a reduction in pollutant emissions from higher quality fuel.

There is also potential for improvements to the existing fleet with use of 95 RON fuel as the base grade market fuel. There are a number of vehicles already in-service with engines designed to operate on 95 RON petrol as this is the certification fuel for the current Euro 5 emission standard. The World Wide Fuel Charter estimates that use of 95 RON fuel in vehicles designed for that fuel will improve fuel consumption by up to 3%.[39]

[36] Marsden Jacobs and Pacific Environment, Review of the Fuel Quality Standards Act 2000; Final Report, May 2016
[37] Hart Energy, International Fuel Quality Standards and Their Implications for Australian Standards – Final Report, Oct 2014
[38] MECA, Written Comments on the Manufacturers of Emission Controls Association on the Australian Government's Vehicle Emissions Discussion Paper, April 2016
[39] World Wide Fuel Charter (WWFC), 5th Edition, p. 17

### 4.4 Fuel Quality Standards: Summary

The FCAI supports Policy Alternative B: Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards.

Introduction of improved fuel quality standards will deliver environmental and health benefits from both new vehicles (meeting Euro 6 level pollution emission standards) and substantial parts of the 16.8 million in-service light vehicle fleet.

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 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.

## 5.0 FCAI RESPONSE TO QUESTIONS IN DISCUSSION PAPER

**Main Points from Section 5.0: FCAI Response to Questions in the Discussion Paper**

- The FCAI supports Policy Alternative B: Revisions to the fuel standards to align with the recommendations of the Hart Report and to harmonise with European standards, i.e. EN 228 for petrol and EN 590 for diesel.
- 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 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 FCAI recommends that all Australian fuel standards should be harmonised with the equivalent European fuel standards (i.e. EN228 for petrol and EN590 for diesel) to ensure vehicles designed for the European emission standards (i.e. Euro 6) operate correctly. If the government implements a different standard for any parameter, the government will need to consider concessions to in-service regulatory requirements.**

### 5.1 Questions from Section 3 Policy Alternatives

***Question Set 1. Questions in relation to the fuel standards***

**Policy alternatives outlined in the paper**

1. Can you provide evidence of the costs and/or benefits of any of the listed policy alternatives (A, B, C, D or E)?
2. Do you have a different alternative which is not covered in this paper?
3. Are there any changes which would improve or clarify the operation of the fuel standards?
4. Should any other fuel standards be developed (other than the proposed fuel standard for the B20 diesel blend)?

**Additional questions**

5. Can you provide evidence of the extent to which the current fuel standards limit the adoption/importation of existing technologies and model that meet higher specifications?
6. What changes to the fuel standards would best reduce emissions, ensure engine operability and facilitate new engine technologies?
7. What changes to the fuel standards do you believe will be required if the Australian government mandates Euro 6 emissions standards for light vehicles?
8. Each fuel standard includes required test methods for analysis of fuel samples. Do you have any comments on the test methods specified in the fuel standards?
9. Are there any other issues you would like to raise in relation to the fuel standards?

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 fuel quality standards for petrol (i.e. 95RON 10 ppm sulphur petrol).

If Australia does not align to higher global fuel quality standards (i.e. 95 RON, 10 ppm sulphur), it 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 which potentially has adverse consequences for other vehicle related issues such as introduction of new vehicle safety technology.

Improving the quality of Australian market fuel will deliver reductions in pollutant emissions for the entire motor vehicle fleet, not just new motor vehicles, and deliver a health benefit.

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 certification fuel standard) must be available. If market fuel of the necessary standard is not available, 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.

Therefore the FCAI strongly supports 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 second preference is Policy Alternative D: ***Revisions to the fuel standards as per alternative B, except with even stricter parameters to harmonise with the standards recommended by the Worldwide Fuel Charter.***

The vehicle-related costs for introducing this policy alternative are being developed by the Ministerial Forum on Vehicle Emissions as the work to introduce $CO_2$ targets and implement Euro 6. This work is also developing the benefits from introducing both a $CO_2$ standard and implementing Euro 6.

***Question Set 2. Questions in relation to the Fuel Quality Information Standards***

10. Do you have any views on the Department's proposal to amend the Fuel Quality Information Standards for Ethanol (E85)?
11. To what extent are you aware of misfuelling (the use of a fuel that is inappropriate for a given vehicle)? Do you believe the Fuel Quality Information Standards are useful in preventing misfuelling?

The FCAI has no objection to the Department's proposal to amend the Fuel Quality Information Standards for Ethanol (E85) noting the proposal will align the wording on E85 pumps with other Fuel Quality Information Standards.

***Question Set 3. Questions in relation to the Fuel Quality Standards Regulations 2001***

12. Have you identified any issues with the Regulations that you would like draw to our attention?
13. Is the definition of 'fuel' adequate to enable all relevant standards to be made? For example, should the definition of fuel be expanded to cover marine diesel, synthetic diesel, methanol-based fuels, etc to enable standards to be made for those fuel types?
14. Currently, aviation gas (avgas) is explicitly excluded from the petrol standard. Do you believe avgas should be covered by a fuel standard?

The FCAI has not identified any issues with the operation of the current Fuel Quality Standards Regulations.

However, the fuel quality standards set under the Regulations need to be consistent with objects of the Act;[40]

> ***3 Objects of Act***
>
> *The objects of this Act are to:*
>
> *(a) regulate the quality of fuel supplied in Australia in order to:*
>
> *(i) reduce the level of pollutants and emissions arising from the use of fuel that may cause environmental and health problems; and*
>
> *(ii) facilitate the adoption of better engine technology and emission control technology; and*
>
> *(iii) allow the more effective operation of engines; and*
>
> *(b) ensure that, where appropriate, information about fuel is provided when the fuel is supplied.*

Of particular interest to the FCAI and our member brands is that the regulations should be developed to "facilitate the adoption of better engine technology and emission control technology." To this end the regulations, and fuel standards, should always align with the level of vehicle emission standards required under the relevant ADR.

This has been recognised in the review of the Fuel Quality Standards Act by Marsden Jacobs who concluded:[41]

> *… that regulation of fuel supplied in Australia via the Fuel Quality standards Act 2000 and supporting regulations and determinations has been effective in achieving the objectives of the Act."*

Marsden Jacobs also recognised that setting vehicle emission standards through the Australian Design Rules and the process of setting fuel quality standards should be more closely aligned. [42]

As fuel quality standards are an integral part of delivering the reduced vehicle emissions (both CO2 and pollutant emissions) there may need to be more regular reviews of fuel quality standards to ensure they are aligned with the introduction of more stringent vehicle emission standards. For example Euro 6 has multiple stages (see Appendix D) with increasing levels of stringency and the quality of market fuel is an important factor in delivering the required emission levels throughout the regulated 160,000km service life.

***Question Set 4. Questions in relation to the Fuel Quality Standards (Register of Prohibited Fuel Additives) Guidelines 2003***

15. Do you agree with the Department's proposal to list the above additives on the Register of Prohibited Fuel Additives? If not, why not?
16. Should MMT (methylcyclopentadienyl manganese tricarbonyl) or other additives such as N-methylaniline be allowed in Australian fuel as an octane enhancer?
17. Are you aware of any other substitute octane enhancers that can be used in place of MTBE and other ethers?

[40] Fuel Quality Standards Act 2000
[41] Marsden Jacobs, *op. cit.,* p.55
[42] Marsden Jacobs, *op. cit.,* p.55

18. What (if any) other substances should be considered for listing on the Register of Prohibited Fuel Additives?

The FCAI supports the Department's proposal to list the additives identified in the Discussion Paper (tetraethyl lead, NMA, MMT[43] and polychlorinated n-alkanes) on the Register of Prohibited Fuel Additives.

The WWFC[44] (p.22) states that ash-forming fuel additives can adversely affect the operation of a vehicle's emissions systems such as high cell density three-way catalysts, ceramic oxygen sensors and engine control modules that provide close closed-loop control. To maintain a vehicle's low emissions, these systems must be kept in an optimal condition and ash-forming fuel additives such as organo-metallic compounds, and metallic contaminants (including calcium, copper, phosphorous, sodium and zinc) can irreversibly adversely affect the operation of the vehicle emissions systems. The WWFC identifies lead (tetra-ethyl lead), manganese (MMT) and iron (Ferrocene) as ash-forming compounds.

Obviously, any adverse impact on the operation of an emission systems will result in less efficient emission control and higher fuel usage and greater pollutant emissions during operation.

***Question Set 5. Questions in relation to the proposed Guidelines for more stringent fuel standards***

19. Are there any areas in Australia that require more stringent fuel standards? If so, which fuel standards should the more stringent standards apply to, and where should they be applied?
20. Are changes to fuel standards necessary to better align them with other legislation such as the *Low Aromatic Fuel Act 2013*?

The FCAI continues to support the concept to allow for guidelines to require more stringent fuel standards in specified areas of Australia.

The FCAI also notes that development of guidelines has not always been necessary. For example, the fuel companies need to be recognised for their initiative to produce and distribute only low aromatic fuels (e.g. BP Opal) to address those areas of Australia where petrol sniffing was a serious health and social issue.

***Question Set 6. General questions regarding the approach for assessing the policy alternatives***

21. Do you have any comments in relation to whether all likely costs or benefits have been identified?
22. Can you provide information that may improve the reliability of the cost and benefit estimates for any of the policy alternatives/

**Cost implications**

23. Do you have any evidence regarding the change in retail price of premium unleaded petrol (95 RON) fuel if unleaded petrol (91 RON) fuel were to be phased out (assuming taxes etc do not change)?

[43] The WWFC (p.22); "Studies have shown that most of the MMT-derived manganese in the fuel remains within the engine, catalyst and exhaust system, The oxidised manganese coast exposed surfaces throughout the system, including spark plugs, oxygen sensors and inside the cells of catalytic converters. These effects result in higher emissions and lower fuel economy."

[44] The World Wide Fuel Charter, 5th Edition, September 2013, *Ash-Forming (Metal-containing) Additives* (pp. 22-26)

24. Noting the economies of scale in the provision of premium and high octane petrol (95 and 98 RON), what impact would phasing out or banning unleaded petrol (91 RON) have?
25. What are the associated issues, costs and benefits of reducing the sulfur parameter in petrol to 10 ppm?
26. If there was an immediate requirement to move to 10 ppm (sulfur), would a stepped approach mitigate problems that might be faced by refineries?
27. What, if any, are the costs in making the changes proposed under the five alternatives? Is there an alternative more cost effective approach that would produce better environmental and health outcomes?
28. To what extent are refineries already producing low sulfur petrol? What might be the additional costs for those refineries that choose to upgrade to produce low sulfur and higher octane petrol?

95 RON premium unleaded petrol (PULP) is currently a "premium" product in the fuel market competing with 91 RON unleaded petrol (ULP) and also E10 in some states. This allows 95 RON PULP to be priced as a premium product with up to (approx.) 10% higher price than ULP.[45]

In their publication, Downstream Petroleum 2013,[46] the Australian Institute of Petroleum (AIP) state that "Australian refineries operate in a global market and must price their products to be competitive with imports (i.e. import parity pricing) from the Asian region." In their Weekly Petrol Prices Report,[47] the AIP benchmark Australian petrol prices against the Singapore MOPS95 Petrol as Singapore is the regional refining/distribution centre.

In a 2015 paper for the Asian Clean Fuels Association (ACFA) it was estimated that Australia's unique fuel standard increases the cost of fuel by up to $3 (US) per barrel over the Singapore price.[48] Any change in the fuel standard to align with international (EN) standards would reduce this cost.

Therefore, whatever is the base grade petrol (i.e. either a 91 or 95 RON product) would continue to be benchmarked against the Singapore MOPS95 Petrol price. As the Singapore MOPS95 Petrol is a 95 RON product, if the base grade market fuel in Australia was also a 95 RON product, it would be unlikely that the retail price experienced by the consumer would be substantially different to the price currently paid for the current base grade petrol, i.e. 91 RON unleaded petrol.

### 5.2 Questions from Section 6 Technical Annex

The FCAI recommends that all Australian fuel standards should be harmonised with the equivalent European (EN) fuel standards (EN 228 for petrol and EN 590 for diesel) to ensure vehicles designed for the European emission standards (i.e. Euro 6) operate correctly. If the government implements a different standard for any parameter, the government will need to consider concessions for in-service requirements.[49]

[45] Estimate based on fuel prices provided on www.mynrma.com.au and www.actfuelwatch.com.au for February 2017.
[46] AIP, Downstream Petroleum 2013, www.aip.com.au [downloaded 4 March 2013]
[47] AIP, Weekly Petrol Prices Report, Week Ending 26 February 2017, www.aip.ocm.au [downloaded 4 March 2017]
[48] Stratas Advisors, Whitepaper on MTBE for the Governments of Australia and New Zealand, Prepared for and submitted to: Asian Clean Fuels Association (ACFA), October 2015
[49] All response to the questions are based on this FCAI position of harmonisation with the relevant EN standard.

### *5.2.1 Questions relating to the petrol Standard*

| **Questions relating to the Petrol Standard** | **FCAI Response** |
|---|---|
| 29. To what extent is the petrol fuel standard currently being met? | The FCAI is not in a position to provide feedback on this issue. There are isolated instances (anecdotal evidence only) of non-standard fuel being supplied resulting in operability issues with vehicles. |
| 30. Should the maximum limit on aromatics be reduced to 35 per cent? | The FCAI supports reducing the maximum limit on aromatics to be reduced to 35% to align with the EN228 standard.<br><br>Adopting 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.<br><br>Aromatic content can increase engine combustion chamber deposits which can increase tailpipe emissions.<br><br>The WWFC summarises results of US AQIRP and the European EPEE studies[50] that showed lowering aromatic levels significantly reduces toxic benzene emissions.<br><br>The European EPEE program demonstrated a linear relationship between $CO_2$ emissions and aromatic content. The reduction of aromatics from 50 to 20% was found to decrease $CO_2$ emissions by 5%.<br><br>Aromatics are good octane components and are high-energy density molecules. Therefore, with a reduction in the aromatic limit to 35%, other options to increase octane need to be considered. |
| 31. Do you think other parameters should be specified (e.g. methanol)? | Inclusions of other parameters to align with EN228 should be considered to eliminate the risk of contamination of fuel that would adversely impact on the vehicle operability or emissions performance.<br><br>Harmonisation with the equivalent European fuel standards will help to avoid a unique Australian fuel specification which has a higher consumer cost and also unique vehicle calibration requirements (which also leads to higher cost to consumers). |

[50] WWFC, *Op. Cit.,* pp.28-29

| | |
|---|---|
| **New Standards** | |
| 32. Considering high octane petrol (98RON) fuels are currently required to meet the premium unleaded petrol (95RON) standard under the *Fuel Equality Standards Act 2000,* should the petrol standard include parameters for high octane petrol (98RON) premium unleaded petrol fuels? | The FCAI recommends that all Australian petrol standards should be harmonised with EN 228 to ensure vehicles designed for the European emission standards operate correctly. |
| 33. Would there be a negative impact to the fuel or motor vehicle industry to implement the EU's MON and RON standards? If yes, please explain. | The FCAI recommends that all Australian petrol standards should be harmonised with EN 228 to ensure vehicles designed for the European emission standards (i.e. Euro 6) operate correctly. There will be an operational improvement for existing vehicles and a consequential health benefit. |
| 34. Are the test methods specified in the fuel standards correct and appropriate? | The FCAI recommends that all Australian petrol standards and test methods should be harmonised with EN 228 to ensure vehicles designed for the European emission standards operate correctly. |
| **MTBE** | |
| 35. What would be the impact for the fuel and motor industry if MTBE limits remained at current limits in petrol? Should the level of MTBE in petrol be greater than 1 per cent? | The EN228 does not include a limit on MTBE and the limit of ethers is controlled by the maximum oxygen content.<br>The FCAI recommends control of "Ether C5 up" as in EN 228 to increase flexibility to increase octane. |
| 36. Should a limit of 5 per cent to 10 per cent MTBE be permitted in high octane petrol (98 RON) petrol? Should similar limits be applied to ethanol in high octane petrol (98 RON) petrol? | |
| 37. Can you identify any other issues regarding emissions or operability? | |
| 38. Should oxygenates such as ethanol be used to increase the octane content of petrol, for example, adding 12% ethanol to ULP to create and E12 premium unleaded petrol (95 RON) fuel? Alternatively, are there other octane enhancers that can be used to create premium petrol? | The FCAI supports aligning the ethanol limit in the Australian petrol standard with the EN 228 limit for ethanol of 10%. |

### *5.2.2 Questions relating to the automotive diesel standard*

| **Questions relating to the automotive diesel standard** | **FCAI Response** |
|---|---|
| 39. Given a minimum value of 51 is proposed in diesel with or without biodiesel (as in the EU), is the current Derived Cetane Number (DCN) appropriate? | The FCAI recommends that all Australian diesel standards should be harmonised with EN 590 to ensure vehicles designed for the European emission standards operate correctly.<br><br>Increasing cetane will improve efficiency and reduce emissions, particularly particulates. |
| 40. What would be the effect of reducing polycyclic aromatic hydrocarbons (PAH) in automotive diesel on industry and other stakeholders? | The FCAI recommends that all Australian diesel standards should be harmonised with EN 590 to ensure vehicles designed for the European emission standards operate correctly.<br><br>Reducing PAH to the EN 590 limit of 8% (max) will reduce tailpipe emissions and particulate deposits. |
| 41. What would be the effect of reducing carbon residue limits in diesel on industry and other stakeholders? | Reducing carbon residue limits will reduce vehicle emissions and deposits. |
| 42. Should the standard apply more broadly to all diesel engines, including ships operating around the Australian coast? | The FCAI notes that the current vehicle emissions forum relates to road vehicles. However, if the intention is to reduce emissions and deliver health benefits, the diesel standards and corresponding emission standard should also apply to non-road diesel engines. |
| 43. Should a standard be prescribed for synthetic diesel (non-crude oil)? | If synthetic diesel will be used in road vehicles, then a standard will need to be prescribed to ensure vehicles designed for the Euro 6 emission standards operate correctly. |
| 44. Are there any other issues regarding emissions or operability? | The FCAI is not aware of other issues regarding emissions or operability. |
| 45. Do you think other parameters need to be specified? | The FCAI recommends that all Australian diesel standards should be harmonised with EN 590 to ensure vehicles designed for the Euro 6 emission standards operate correctly. |

### *5.2.3 Questions relating to the autogas standard*

| **Questions relating to the autogas standard** | **FCAI Response** |
|---|---|
| 46. Should a standard be prescribed for Compressed Natural Gas (CNG)? | The FCAI is not aware of any member brands intending to introduce CNG vehicles.<br><br>However, if conversion of vehicles to operate on CNG is likely to be undertaken, then a standard for CNG will be required to ensure the emission systems operate correctly. |
| 47. Should a standard be prescribed for Liquid Natural Gas (LNG)? | The FCAI is not aware of any member brands intending to introduce LNG vehicles.<br><br>However, if conversion of vehicles to operate on LNG is likely, then a standard for LNG will be required to ensure the emission systems operate correctly. |
| 48. Are there any other issues regarding emissions or operability? | The FCAI is not aware of other issues regarding emissions or operability. |

### *5.2.4 Questions relating to the biodiesel standard*

| **Questions relating to the biodiesel standard** | **FCAI Response** |
|---|---|
| 49. Do you have a view on whether the biodiesel standard allows for advancements in technology? | The FCAI recommends that all Australian biodiesel standards should be harmonised with EN 14214 to ensure vehicles designed for the Euro 6 emission standards operate correctly.<br><br>The FCAI could not support increasing the biodiesel limit in the diesel standard to 7% until the Australian biodiesel standard is fully aligned with EN 41214. |
| 50. Noting that all biodiesel blends have a proposed minimum value of 51; do you believe the current Derived Cetane Number (DCN) appropriate? | Increasing cetane will improve efficiency and reduce emissions, particularly particulates.<br><br>The FCAI notes the Australian biodiesel standard DCN is 51.0 which aligns with the World Wide Fuel Charter. |
| 51. Do you believe a reduction to the acidity parameter (to 0.50mg KOH/g) in biodiesel be achievable? If so, can you identify any consequences for stakeholders? | The FCAI supports to the acidity parameter in biodiesel to align with EN 41214 limit of 0.50mg KOH/g. |
| 52. Would reducing the phosphorus content or increasing the oxidation stability requirements raise any issues for you or your stakeholders? | The FCAI supports reducing the phosphorus content (to 4 mg/kg) and increasing the oxidation stability requirements (to 10 hr) in biodiesel to align with EN 41214 limits. |
| 53. Would you like to raise any other issues regarding biodiesel blends, emissions or operability? | The FCAI is not aware of other issues regarding biodiesel blends regarding emissions or operability. |

*5.2.5 Questions in relation to the ethanol (E85) standard*

| **Questions in relation to the ethanol (E85) standard** | **FCAI Response** |
|---|---|
| 54. Do you believe the test methods are appropriate? | The FCAI is not aware of any member brands intending to introduce E85 vehicles. |
| 55. Would a reduction in the sulfur or acidity parameters raise any issues for you or your stakeholders? | |
| 56. Would an increase in the solvent washed gum parameter raise any issues for you or your stakeholders? | |
| 57. Would you like to raise any other issues regarding emissions or operability? | |

*5.2.6 Questions relating to the proposed B20 standard*

| **Questions relating to the proposed B20 standard** | **FCAI Response** |
|---|---|
| 58. Do you believe the B20 standard allows for advancements in technology? | The FCAI recommends that all Australian biodiesel standards should be harmonised with EN 14214 to ensure vehicles designed for the European emission standards operate correctly.<br><br>The FCAI could not support increasing the biodiesel limit in the diesel standard to 7% until the Australian biodiesel standard is fully aligned with EN 41214. |
| 59. In your view, are the test methods valid? | |
| 60. In your view, are the B20 parameters appropriate? | |

## 6.0 CONCLUSION

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.

To achieve the Government's policy objective to reduce greenhouse gas and pollutant emissions from road transport an Integrated Approach that includes a combination of measures such as the increasing use of alternative fuels, improved fuel quality, better infrastructure and traffic management, adopting an eco-driving style using price signals and reducing the average age of the in-service fleet is required.

Focusing on a single area could increase overall cost to the community without delivering the expected benefits in the real world.

To deliver the Government's policy objectives, and deliver the environmental and health benefits, from introducing both a light vehicle $CO_2$ standard and Euro 6 emissions standards, 95 RON 10 ppm sulphur petrol must be widely available in the Australian market. Otherwise, the benefits estimated using the results of the regulation certification laboratory testing will not be delivered.

The FCAI strongly supports 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 second preference is Policy Alternative D: Revisions to the fuel standards as per alternative B above, except with even stricter parameters to harmonise with the standards recommended by the Worldwide Fuel Charter.

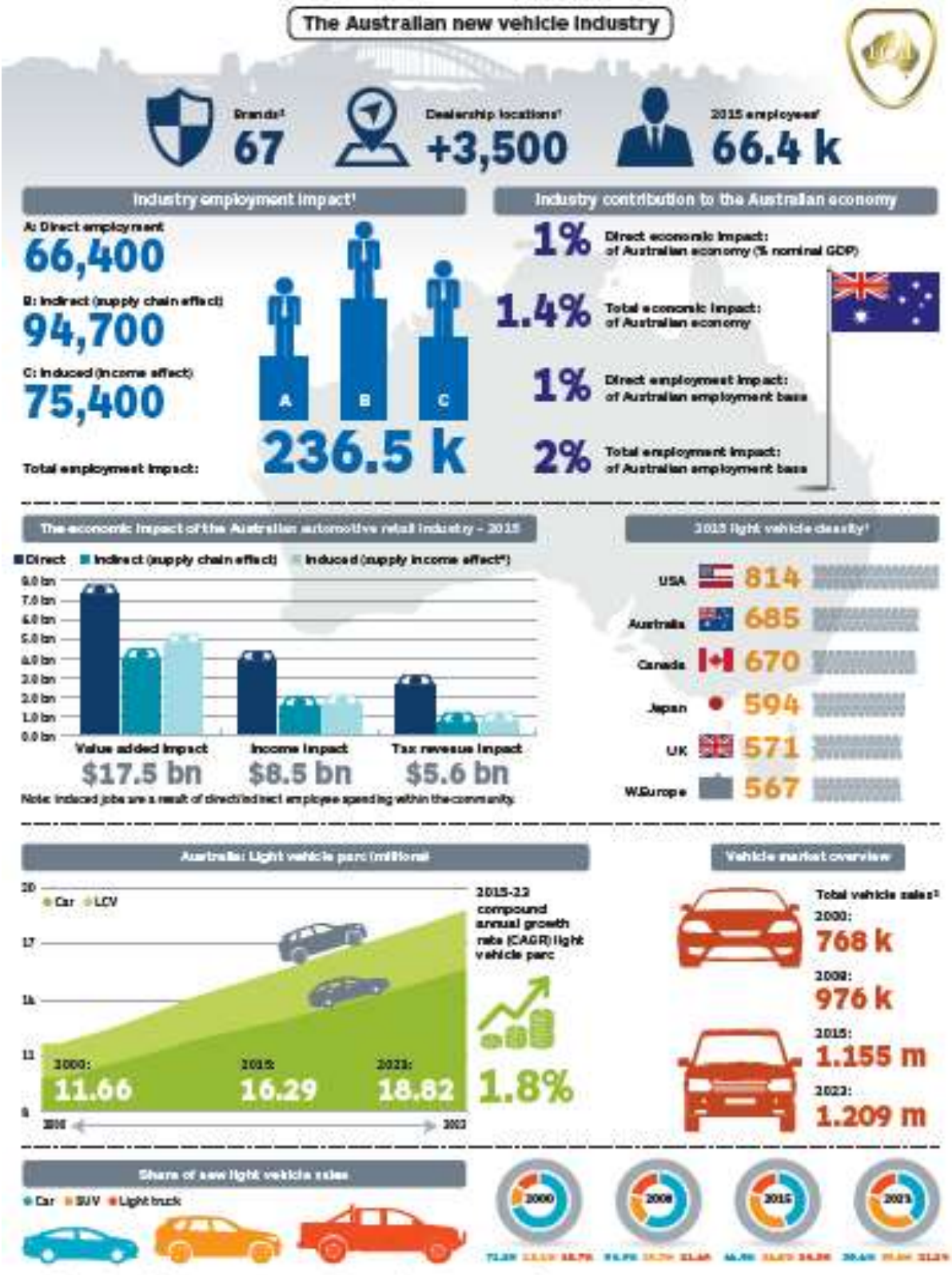
Introduction of improved fuel quality standards will deliver environmental and health benefits from both new vehicles (meeting Euro 6 level pollution emission standards) and substantial parts of the 16.8 million in-service light vehicle fleet.

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 CO2 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 $CO_2$ 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.

# APPENDIX A THE AUSTRALIAN AUTOMOTIVE INDUSTRY



# APPENDIX B INTEGRATED APPROACH

## B1.0 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 – 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.

### *B1.1 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).

### *B1.2 Fuel Quality Standards.*

To deliver the expected $CO_2$ and pollutant emission reductions, compatible market fuel must be available. 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.

The other 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. [51]

In contrast, the diesel fuel quality standard has specified a maximum of 10 ppm sulphur since 2009.[52] Diesel fuel refined in Australia meets this standard.

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

The high sulphur 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 10 ppm sulphur petrol is a pre-requisite to mandating Euro 6.

### *B1.3 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[53]:

- 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:[54]

- 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.
- 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.

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

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 RMB3,000 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.

### *B1.4 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[55] 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.

### *B1.5 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[56].

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-

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

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.

### *B1.6 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.[57]

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).

### *B1.7 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.[58]

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.

[57] 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.

[58] 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 STANARDS 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 widely recognised throughout the world.

## *C.1 US EPA*

The US EPA stated in their Tier 3 Motor Vehicle Emission and Fuel Standards:[59]

> *"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:[60]

> *"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[61]" the EC state:

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

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[59] 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

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

[61] 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*[62] 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[63] (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:[64]

> *"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[65] states:

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

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[62] 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.
[63] ACEA, Auto Alliance, EMA and JAMA, World Wide Fuel Charter, September 2013, 5th Edition, www.acea.be [accessed 9 October 2010]
[64] WWFC 5th Edition, p.17
[65] 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…"*

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

The maximum sulphur level for both Category 4 and Category 5 gasoline is 10 ppm and Category 5 gasoline specifies a minimum of 95 RON (refer pages 6 and 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:

- A report prepared by Orbital Australia in 2013, "Review of Sulphur Limits in Petrol." [66]
- A 2014 report by Hart Energy, International Fuel Quality Standards and Their Implications for Australian Standards.[67]

[66] 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.

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

Orbital Australia reviewed existing standards and research on the impacts of sulphur levels in petrol and similar conclusions to the WWFC 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."*

(Note: in their 2015/16 rulemaking process to introduce Euro 6 vehicle pollutant emission standards, the Indian Government has recognised that availability of 10 ppm sulphur petrol is necessary.[68]

### *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[69] 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.

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.

[68] Shakun & Company (Services) Private Limited, Copy of Notification, Motor Vehicles Act, G.S.R 18(E), (published in the Gazette of India on 22nd Febuary 2016).
[69] Australian Government Climate Change Authority (CCA), Light Vehicle Emission Standards for Australia: Research Report, June 2014

### *C.7 Australian Institute of Petroleum*

In their 2013 publication, *Downstream Petroleum 2013*,[70] 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 10 ppm sulphur petrol as the test fuel.

If the Government wants to introduce light vehicle $CO_2$ standards as the next step in light vehicle pollutant emissions standards (i.e. Euro 6), compatible market fuel must be available, otherwise the benefits estimated using the results of the regulation certification laboratory testing will not be delivered on the road.

While 95 RON is available as Premium Unleaded Petrol (PULP) the Australian fuel quality standard allows up to 50 ppm sulphur in premium (95 or 98 RON). For correct operation of vehicles with advanced pollution emission equipment (i.e. meeting Euro 6b and Euro 6c) PULP with a maximum 10 ppm sulphur is required in the market.

The diesel fuel quality standard has specified a maximum of 10 ppm sulphur since 2009. Diesel fuel refined in Australia meets this standard.

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

# APPENDIX D EURO 6

**Summary of Euro 6 for Petrol Engine Light Vehicles in both EU and UN Regulation (ver 3)**

**Table 1: Euro 6 as introduced into the EU[a]**

| Euro 6 Level[f] | | 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 (No/km) | $6.0 \times 10^{12}$ | $6.0 \times 10^{11}$ | $6.0 \times 10^{11}$ | $6.0 \times 10^{11}$ |
| 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.[iii] & monitoring phase | Final C.F.[iii] |

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

| Euro 6 Level[k] | | 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] (No/km) | $6.0 \times 10^{12}$ | $6.0 \times 10^{11}$ | | |
| 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:**

| | |
|---|---|
| | Not part of regulation/standard |
| | Temporary or alternative standard/limit |
| | 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.

[f] Commission Regulation (EU) 2016/427 of 10 March 2016
[g] Delphi, 2016/2017 Worldwide Emissions Standards, Passenger Cars and Light Duty
[a] 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
[b] Unknown if emission limits and OBD thresholds will be revised with introduction of WLTP
[v] PN (particulate number) only apply to GDI engines
[iii] Temporary conformity factor: NOx limit x 2.1 (incl. measurement tolerance)
[iii] 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.
[vi] Date of entry into force:22 January 2015
[k] 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

## APPENDIX E ABMARC REPORT

(Supplied as separate file)