

ClimateWorks Australia and Future Climate Australia

Submission to the Vehicle Emissions Discussion Paper

8 April 2016

ClimateWorks Australia, in collaboration with Future Climate Australia, welcomes the opportunity to make this submission in response to the Vehicle Emissions Discussion Paper which is seeking views on measures to achieve the Australian Government's greenhouse gas emissions reduction targets, air quality objectives, and improvements in energy productivity in the context of road vehicles.

ClimateWorks Australia is an independent not-for-profit organisation, established as a partnership between philanthropy and Monash University. Its mission is to catalyse substantial carbon emission reductions in Australia through collaborative action with business and government. Building on its neutrality and strong networks, ClimateWorks will do this by bringing together key partners to deliver specific projects and interventions that drive a cycle of change resulting in significant emission reductions.

Future Climate Australia (FCA) is a not-for-profit environmental organisation that provides strategies for individuals, business and government to address climate change, particularly in the area of transport and mobility.

This submission draws on current evidence, including Global Fuel Economy Initiative (GFEI)¹ and ClimateWorks research that has been developed through a range of projects aimed at identifying opportunities to reduce emissions at an international, national and regional level, and overcoming barriers to their implementation.

¹ GFEI is a partnership of the International Energy Agency (IEA), United Nations Environment Programme (UNEP), International Transport Forum of the OECD (ITF), International Council on Clean Transportation (ICCT), Institute for Transportation Studies at University of California Davis, and the FIA Foundation, which works to secure real improvements in fuel economy, and the maximum deployment of existing fuel economy technologies in vehicles across the world.

Towards Fuel Efficient, Lower Emission Light Vehicles

As a signatory to the Paris Agreement, Australia has now committed to the global transition to net zero emissions, requiring the development of long-term decarbonisation strategies. Australia has proposed an economy-wide target to reduce greenhouse gas emissions by 26 to 28 per cent below 2005 levels by 2030. This includes the investigation of opportunities to improve the efficiency of vehicles, with an estimate of 100 million tonnes (Mt) CO₂e² of emissions reductions between 2020-2030 identified².

The Pathways to Deep Decarbonisation in 2050 research by ClimateWorks and ANU demonstrates that Australia could achieve net zero emissions by 2050 with continued economic growth, and with technologies that are currently available³. ClimateWorks and ANU worked with CSIRO to identify decarbonisation pathways for Australia which focus on meeting Australia's carbon budget optimised for the lowest cost across four pillars; ambitious energy efficiency, low carbon electricity, electrification and fuel switching in transport, industry and buildings and sequestering offsetting non-energy and remaining emissions⁴.

The transport sector is one of the fastest growing sources of emissions within Australia, increasing by 47.5% since 1990⁵, however it also represents the most financially attractive emission reduction opportunity across the Australian economy⁶. The transport sector accounts for 17% or 92 MtCO₂e of Australia's emissions in 2013-14, with Passenger and Light Commercial vehicles contributing 62% of the sector's total emissions⁷. The sector's emissions have been projected to rise by a further 6% to 2020, to reach 97 MtCO₂e, driven primarily by population and income growth for passenger travel and economic growth for freight transport⁸.

As it stands however, Australia is one of the few remaining developed countries without light vehicle CO₂ emission standards in place, with standards covering over 80 per cent of the global automotive market⁹. This has meant that in comparison to our global peers, Australia has scored poorly in the energy efficiency of its land transport sector. The recent American Council for an Energy-Efficient Economy (ACEEE) International Scorecard ranked Australia last out of 16 major OECD countries for the energy efficiency of our transport sector¹⁰.

² CO₂e or carbon dioxide equivalent, used to describe how much global warming a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of carbon dioxide as the reference

³ ClimateWorks Australia (2014)

⁴ ClimateWorks Australia (2014)

⁵ DIICSRTE (2013)

⁶ ClimateWorks Australia (2010)

⁷ DIICSRTE (2013)

⁸ DCCEE (2010)

⁹ International Council on Clean Transportation (2015)

¹⁰ American Council for an Energy-Efficient Economy (ACEEE) (2014)

Australia is set to fall behind the 50 per cent fuel economy improvement that our global peers such as the United States and Canada are targeting with their implemented standards within the next 10 years. Australia cannot afford to rely on the closure of domestic vehicle manufacturing in 2017 to deliver greater efficiencies to our light vehicle fleet. Australian-made vehicles only account for 10 per cent of sales in the current market, so any improvement when we import all of our new vehicles will be minimal at best and far from the efficiencies targeted in leading markets. Australia's current performance indicates that without standards Australia is not currently getting the most efficient vehicles on the market, and could become, or continue to be, a dumping ground for inefficient vehicles in the future. Research already reveals that the current variants of models offered in Australia are often less efficient than the same model sold in other markets, with the most efficient variants of some models available in Australia consuming approximately 20 per cent more fuel on average than the most efficient variant of the same make and model available in the UK¹¹.

Over 1.1 million new light vehicles were sold in Australia in 2014¹², making it the 11th largest vehicle market globally¹³. These new sales were comprised of approximately 80% passenger vehicles and 20% light commercial vehicles¹⁴. Light vehicles include all motor vehicles under 3.5 tonnes gross vehicle mass, including passenger vehicles, sports utility vehicles (SUVs) and light commercial vehicles, but excluding motorcycles¹⁵. A fuel efficient or low emission vehicle is considered to be a vehicle with the lowest possible impact on the environment and in general, can be classified in terms of net CO₂ emissions and tailpipe air-pollutant emissions.

Best practice light vehicle CO₂ emission standards and relevant complementary measures must be designed with a focus on maximising a range of positive outcomes - financial savings for vehicle owners, improved energy security, and least cost emissions reductions. The conditions are now optimal for Australia to set the policy and program framework for the improvement of light vehicle fuel economy and set us on the path towards lower and ultimately zero emissions light vehicles in Australia.

A summary of questions answered in this submission are included in the table below, with corresponding page references.

Options to Reduce Vehicle Emissions	
<u>Implementation of Fuel Efficiency CO₂ Standards for Light Vehicle</u> Questions 7 to 10 in the Vehicle Emissions Discussion Paper	Refer page 5-13

¹¹ Climate Change Authority (CCA) (2014)

¹² Federal Chamber of Automotive Industries (FCAI) 2015

¹³ Bandivadekar (2013)

¹⁴ National Transport Commission (2013)

¹⁵ ClimateWorks Australia (2014)

<u>Implementation of Euro 6/VI Noxious Emissions Standards for Light Vehicles</u> • Question 1 in the Vehicle Emissions Discussion Paper	Refer page 13
<u>Fuel Quality Standards</u> • Question 13 to 16 in the Vehicle Emissions Discussion Paper	Refer page 13-14
Complementary Measures to Support Standards	
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<u>Alternative fuels and electric vehicles</u> • Question 26 to 28 in the Vehicle Emissions Discussion Paper	Refer page 22-23
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Options to Reduce Vehicle Emissions

Implementation of Fuel Efficiency CO₂ Standards for Light Vehicles

Australia is one of the few remaining developed countries without light vehicle CO₂ emission standards in place, with standards covering over 80 per cent of the global automotive market¹⁶ including many developing nations such as China, Brazil, India and Mexico. This has meant that in comparison to our global peers, Australia has scored poorly in the energy efficiency of its land transport sector.

Whilst fuel efficiency standards vary in their ambition and design by country, in general they set average CO₂ emission levels which a manufacturer must meet across its annual fleet of new vehicle sales. Emissions are calculated using a range of vehicle test cycles, and policy design may include exemptions for manufacturers who sell small volumes or credits for certain very low emissions vehicle technologies, such as electric vehicles.

When considering the structure of best practice standards from our global peers, the EU and United States standards include policies that are worth consideration.

In Europe, legislation sets mandatory emission reduction targets for new passenger and light-commercial vehicles with the tightening of targets every five years. Emission limits are set according to the mass of vehicle, using a limit value curve which allows heavier vehicles to have higher emissions than lighter cars. Only the fleet average is regulated, so manufacturers are still able to make vehicles with emissions above the curve provided these are balanced by vehicles below the curve¹⁷. If the average CO₂ emissions of a manufacturer's fleet exceeds the limit value in any year from 2012, the manufacturer is required to pay an excess emissions premium for each additional vehicle registered.

The structure of the legislation also allows additional incentives, known as 'super credits', for manufacturers to produce vehicles with extremely low emissions, below 50 gCO₂/km. Low emission vehicles are counted as 3.5 vehicles in 2012 and 2013, 2.5 in 2014, 1.5 in 2015 and 1 vehicle from 2016 to 2019¹⁸. Super-credits will also apply in the second stage of emission reductions, from 2020 to 2023. During this stage, each low-emitting vehicle will be counted as 2 vehicles in 2020, 1.67 in 2021, 1.33 in 2022 and 1 vehicle from 2023.

Alternatively in the United States, the US Environmental Protection Agency has established a set of fleet-wide average carbon dioxide (CO₂) emission standards to apply to passenger cars, light-duty trucks, and medium-duty passenger vehicles from 2017 through to 2025. The final

¹⁶ International Council on Clean Transportation (2015)

¹⁷ European Commission (2016)

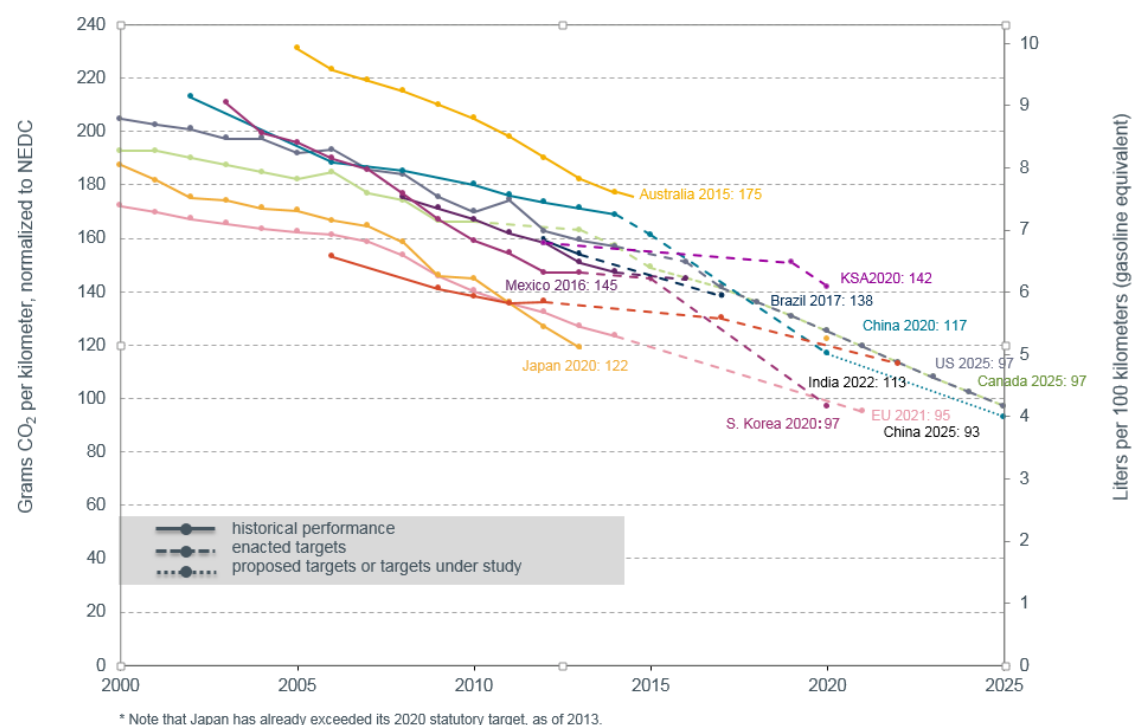
¹⁸ European Commission (2016)

standards have been projected to reduce the average industry fleet-wide level to 163 gCO₂/km in 2025. Light-duty vehicles are currently responsible for nearly 60% of United States transportation-related petroleum use and greenhouse gas emissions¹⁹.

These standards are based on CO₂ emissions-footprint curves, where each vehicle has a different CO₂ emissions compliance target depending on its footprint value. Generally, the larger the vehicle footprint, the higher the corresponding vehicle CO₂ emissions target. As a result, the burden of compliance is distributed across all vehicles and all manufacturers.

It has been projected that manufacturers will comply with the 2017 to 2025 standards by using a wide range of technologies, including continual advances in gasoline engines and transmissions, vehicle weight reduction, lower rolling resistance tyres, vehicle aerodynamics, diesel engines, and more efficient vehicle accessories. The majority of improvements will come from advancements in internal combustion engines, including improved thermal efficiency, although an increase in electrification of the fleet through the expanded production of stop/start, hybrid vehicles, plug-in hybrid electric vehicles, and electric vehicles is also expected²⁰.

Figure 1: Global comparison of CO₂ emission and fuel consumption standards for passenger vehicles

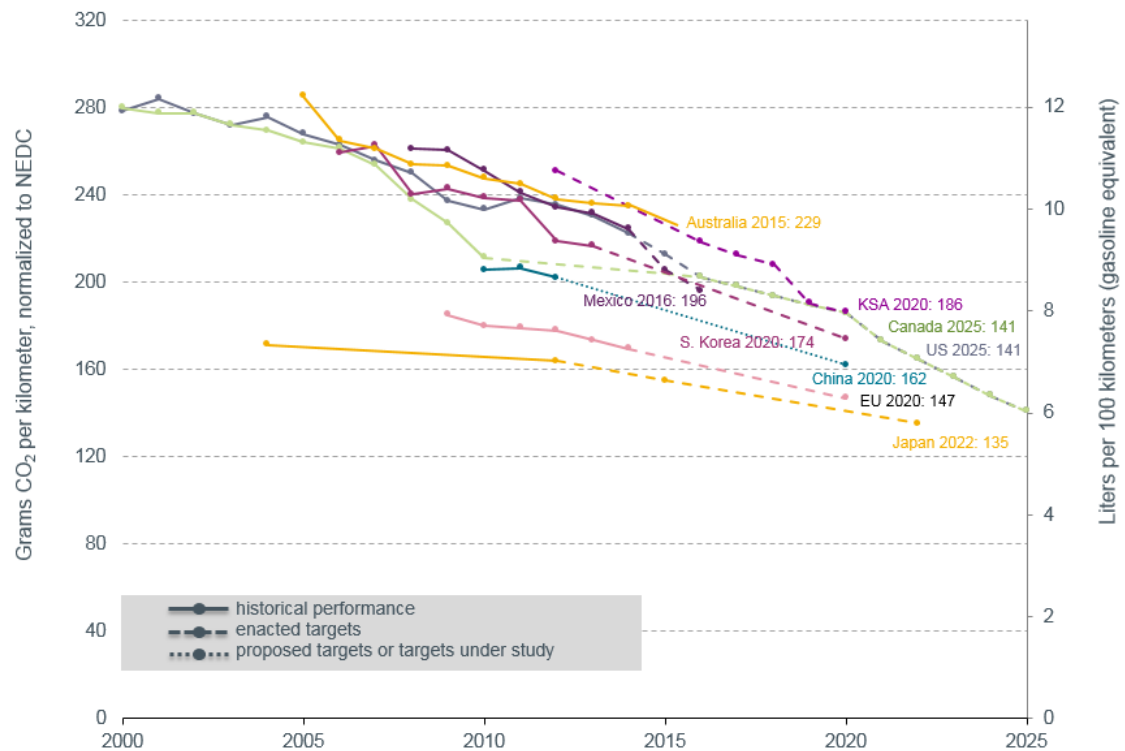


Source: Adapted from ICCT (2016)

¹⁹ United States Environmental Protection Agency (2012)

²⁰ United States Environmental Protection Agency (2012)

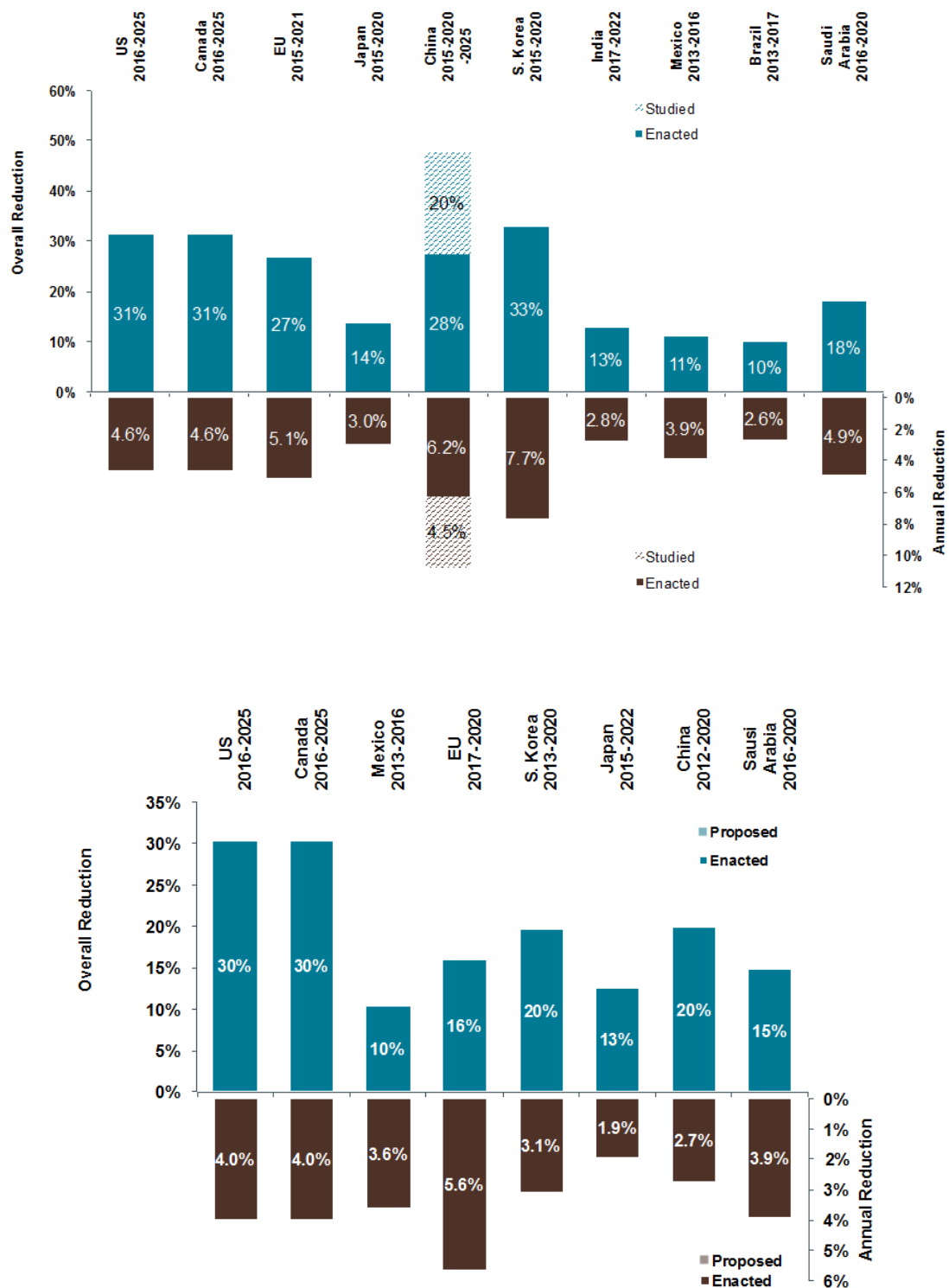
Figure 2: Global comparison of CO₂ emission and fuel consumption standards for light commercial vehicles and light trucks



Source: Adapted from ICCT (2016)

Figure 3 presents an ICCT summary of improvement rates being targeted in other markets for passenger vehicles and light trucks. The United States and Canada expects an annual rate of improvement of 4.6% over the period 2016 to 2025 for passenger vehicles (and 4.0% for LCVs). Europe, which has had strong standards in place for a number of years, is aiming to achieve an annual improvement rate of 5.1% for passenger vehicles for the period 2015 to 2021, and 5.6% per annum for light trucks between 2017 and 2020.

Figure 3: Global comparison of overall and annual CO₂ reduction rates achieved for a) passenger cars (top) and b) light trucks (bottom)



Source: ICCT (2016)

The Australian Government has the opportunity to introduce best practice standards, which if designed well in collaboration with industry and consumer stakeholders, and supported with suitable complementary measures, present a significant opportunity to reduce emissions from the transport sector whilst providing broader benefits for vehicle owners and the economy.

If Australia were to target the same levels of fuel economy improvement achieved in leading markets (approximately 5% per annum), this equates to a 50 per cent improvement over 10 years using 2015 as a baseline, and as a 'technology taker' with an increasingly large proportion of our fleet sourced from markets with standards already in place, Australia, starting from a lower base, can expect to replicate the rate of improvement in a shorter timeframe than previously seen in markets such as the United States and Europe. Conversely, in the continued absence of CO₂ emission standards, Australia runs the risk of becoming the dumping ground for low-specification models and falling further behind international peers, resulting in relatively higher fuel costs for motorists and businesses, and missing out on a simple low-cost climate mitigation opportunity.

If Australia achieves a 50 per cent improvement in fuel economy for new light vehicles (passenger and LCVs) over 10 years equating to approximately 130 gCO₂/km in 2020, and 95 gCO₂/km in 2025, there will be financial benefit to consumers through reduced fuel bills. ClimateWorks' analysis shows that net annual savings of approximately \$350 for average drivers of conventional internal combustion engine vehicles over a five year ownership period could be achieved, and economy wide these fuels savings would total almost \$8 billion per year by 2025²¹.

Meeting this target would also help address broader national issues such as reducing greenhouse gas emissions by almost 4 Mt CO₂ per year by 2020, and 9 Mt CO₂ per year by 2025, resulting in approximate cumulative emission reductions of approximately 40 Mt CO₂ over this 5 year period, and almost 100 Mt CO₂ for the 2020-2030 period if these rates of improvement are continued. The Government has indicated that it is targeting approximately 76 Mt CO₂ over the 2020-2030 period. Going beyond this will deliver further low cost abatement, meaning that 2030 targets can more easily be met or exceeded, at the lowest cost to the economy. Any delay in improving vehicle emissions standards will lead to a level of emissions lock-in – where a larger proportion of vehicles on our roads will be less efficient than they would be with standards in place – reducing the potential by which vehicle emission standards can contribute to Australia's 2030 emission reduction target.

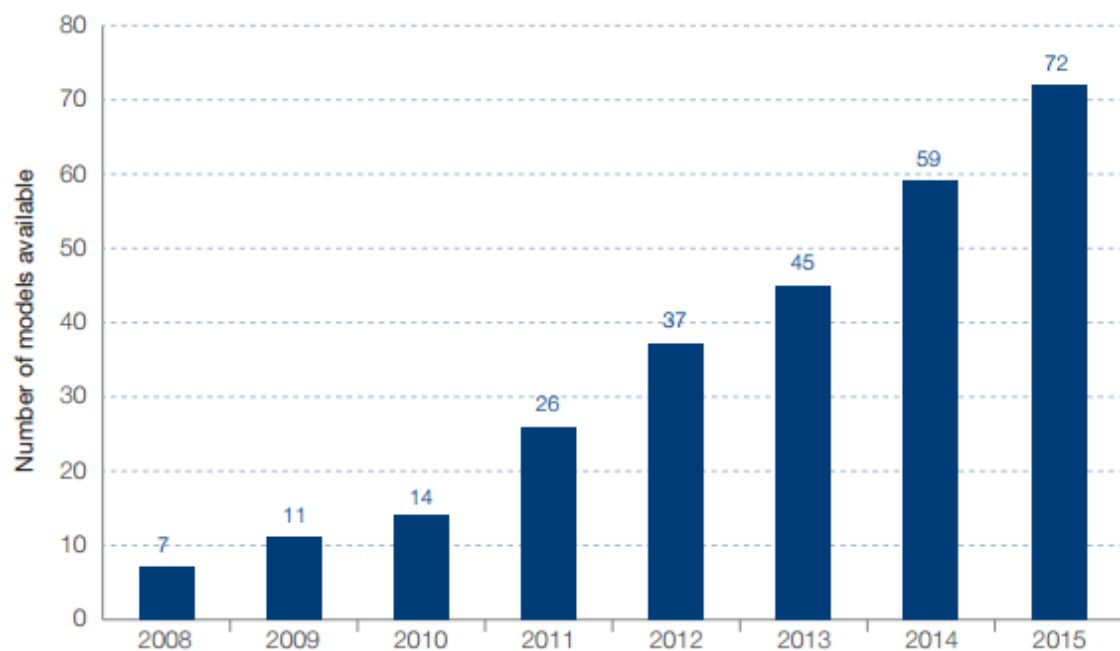
Other benefits of having strong standards include enhanced fuel security by reducing demand by between 40 to 66 million barrels of oil per year. These improvements can help ensure that

²¹ ClimateWorks Australia (2015)

Australia keeps pace with productivity gains in other comparable countries, reduces energy costs to consumers and business and achieve our emission reduction targets at lowest cost.

The implementation of standards would support an increased range of ‘green’ vehicles available in Australia. A ‘green’ vehicle has been defined as a vehicle with a carbon dioxide emissions intensity not exceeding 120 g/km²². In Australia, the proportion of green cars sold in 2015 was 4.7 per cent of total sales, compared with 2.8 per cent in 2014. There were 72 green car models available in Australia in 2015, compared with 59 in 2014. Figure 4 below shows the growth in the number of green vehicle models available for sale between 2008 and 2015²³.

Figure 4: ‘Green’ vehicle model availability 2008–2015



Source: NTC (2016)

If Australia were to implement standards which match targets in other markets (130 gCO₂/km by 2020 and 95 gCO₂/km by 2025), the majority of vehicle segments in the Australian market already have models available to meet these levels. Figure 5 presents a 2015 summary of the range and average of emissions intensity by segment within the Australian market, as well as the sales volumes for each of these segments. As outlined, the segment with the highest sales (small) also has the greatest range of low emission vehicles. The second and third highest segments (SUV medium and SUV large) also currently have vehicles available below the 2025 standard. Together these three segments account for almost 50% of all new light vehicles sold in Australia.

²² NTC (2016)

²³ NTC (2016)

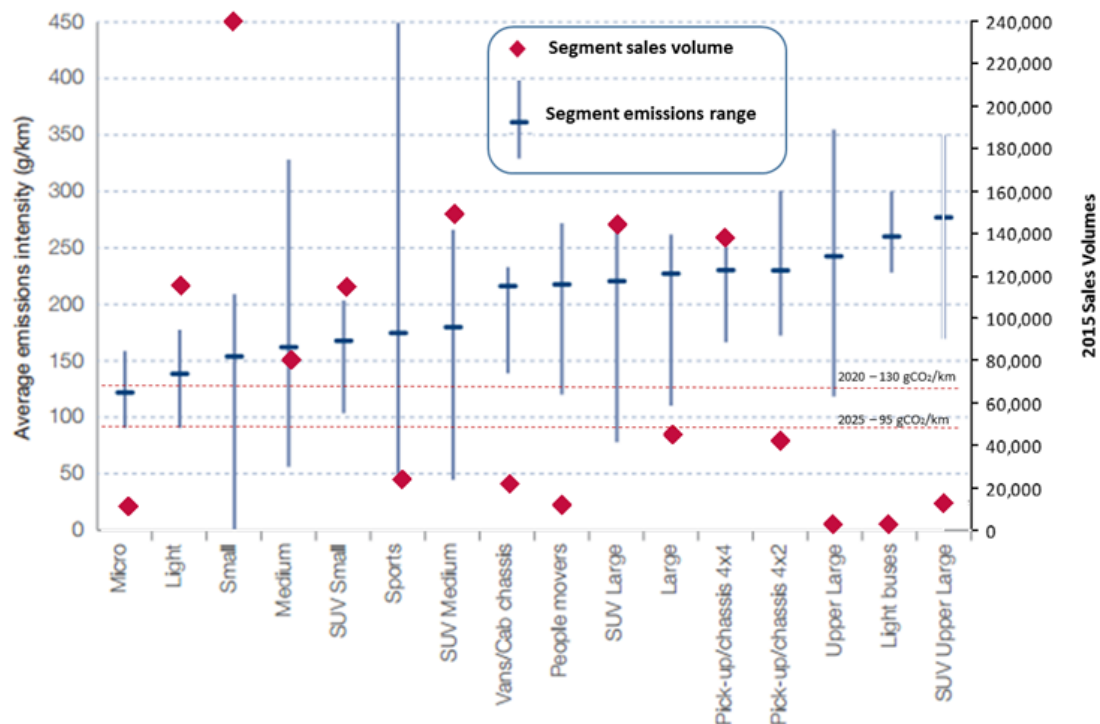
There are a number of segments which do not currently have vehicles available which meet either the proposed 2020 or 20205 target. Of these segments, the Pick-up/chassis 4x4 segment has the highest sales (4th highest selling segment overall) with models including the Toyota Hilux, Ford Ranger, Mitsubishi Triton and Holden Colorado leading sales.

Under a standards regime, manufacturers will have a range of options to ensure they can meet the required fleet wide average standard, including;

- Improving the efficiency of existing models within each of these segments;
- Introducing more efficient models into these segments;
- Introducing more efficient models into other segments; and
- Removing inefficient models from the Australian market.

The choice of options will be driven by a range of factors including consumer preferences and cost. However as the options above demonstrate, the introduction of standards does not necessarily lead to a reduction in consumer choice. Rather, they should increase the availability of more efficient vehicles into the Australian market, providing benefits for consumers, and continuing current trends of increased number of 'green vehicles'. The graph below does not factor in the improvements in emissions intensity which will be gained across these segments in the 5-10 year period under consideration, meaning that these segment emission ranges will drop naturally over time.

Figure 5: Range of emission intensity and sales volumes by segment, 2015

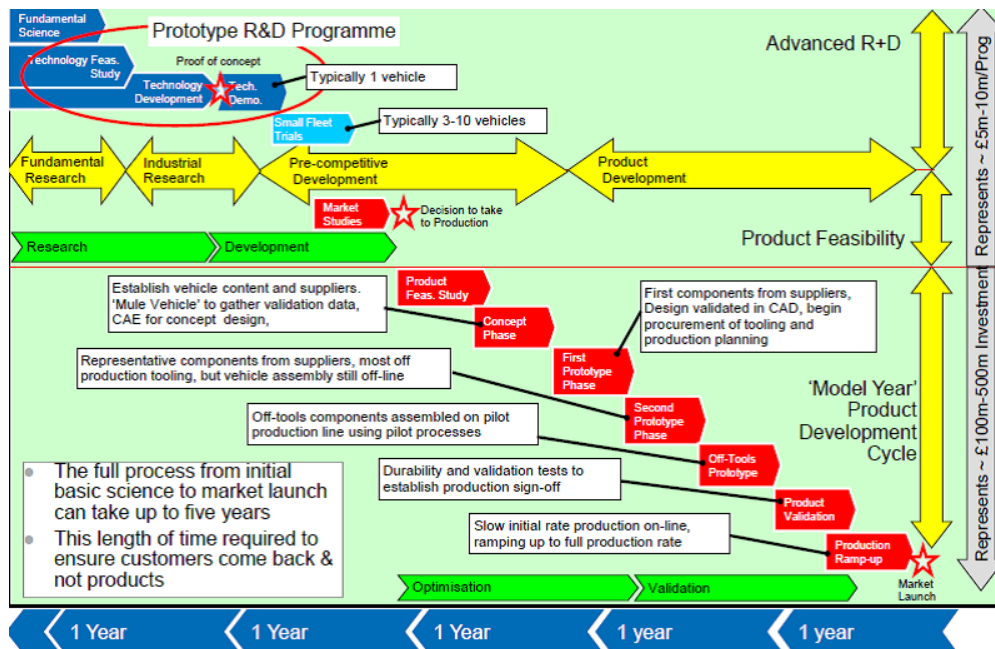


Source: Adapted from NTC (2016)

The adoption of standards requires consideration of an appropriate lead-in time to allow manufacturers to respond. In general, new product development cycles range from two to five years; full model redesigns are still on a five year redesign cycle, however it is becoming common for manufacturers to make substantial improvements during mid-cycle updates that often include major powertrain changes.

Assuming that any standards introduced in Australia will initially lag behind other major markets, the vehicles and powertrain technologies to meet them will already be available in those markets. Manufacturers may need to build up additional production capacity and/or change the countries from which they source certain vehicles. Figure 6 below illustrates typical technology development timelines. The production ramp-up process will be relevant to the introduction of any Australian standards.

Figure 6: Technology Development Timelines



Source: Ricardo (2016)

Figure 6: Accelerating Technology Introduction in the U.S. driven by Fuel Economy Regulation

	GDI	Turbo	VVT	Stop/Start	Hybrid	6 speed	7+ speed	CVT non-hybrid
2004	-	4%	44%	-	0.9%	5%	0.4%	1%
2005	-	2%	49%	-	1.9%	6%	0.4%	1%
2006	-	3%	58%	-	1.5%	12%	2%	1%
2007	-	4%	63%	-	3.2%	16%	2%	7%
2008	3%	4%	63%	-	3.3%	19%	3%	8%
2009	4%	4%	79%	-	2.9%	19%	3%	8%
2010	9%	4%	92%	-	5.6%	33%	3%	8%
2011	18%	8%	95%	-	3.4%	54%	5%	9%
2012	28%	10%	98%	0.9%	4.7%	57%	6%	11%
2013	38%	15%	98%	3.0%	5.4%	60%	7%	14%
2014	43%	18%	98%	6.8%	4.2%	58%	10%	21%
2015	47%	21%	98%	7.4%	4.5%	56%	14%	23%

Source: United States Environmental Protection Agency (2015)

Figure 6 above outlines the rapid uptake of some vehicle technologies in the U.S. market since standards were adopted. The spread of gasoline direct injection (GDI), variable valve timing (VVT) and 6-speed transmissions has been significant.

Overseas experience shows that, while mandatory fuel efficiency standards are key to achieving emissions reductions in passenger and light commercial vehicles, these reductions can be enhanced with a range of complementary measures which are detailed further in subsequent sections.

Requested measures:

- That a 2020 target of 130 gCO₂/km and a 2025 target of 95 gCO₂/km for light vehicles (passenger and light commercial) be adopted, reflecting targeted rates of improvement in other markets.
- That learnings from overseas experiences are incorporated into any light vehicle CO₂ standard, through collaboration with organisations such as the Global Fuel Economy Initiative
- That any Regulatory Impact Statement undertaken adequately considers the broader benefits of improving the fuel efficiency CO₂ standards for light vehicles including emission reductions, air quality, health, fuel security and energy productivity.
- That any Regulatory Impact Statement undertaken consider a range of potential 2020 and 2025 targets and rates of improvement based on those being planned in leading markets, and consider the cost of delaying implementation of these standards.
- That the introduction of the suggested standards by 2020 and 2025 not be delayed by the issue of potential manufacturing lead times.

Implementation of Euro 6/VI Noxious Emissions Standards for Light Vehicles

The focus of this submission is primarily on measures to reduce the CO₂ emissions from Australia's light vehicle fleet. As such, there is limited commentary of measures to reduce noxious emissions, other than to consider the broader benefits which implementation of these standards can provide. A substantial reduction in fuel usage, given the same pollution controls, will of necessity provide air quality improvements.

Requested measures:

- That any Regulatory Impact Statement undertaken adequately considers the broader benefits of improving noxious emission standards for light vehicles including health and air quality.

Fuel Quality Standards

Motor vehicle fuel economy and CO₂ emissions are influenced by fuel quality, and the debate around fuel quality standards in Australia has been ongoing. Starting in the 1970s, standards have been introduced by governments around the world requiring the supply of unleaded gasoline in order to reduce emissions of lead, and more recently, to reduce levels of sulphur in

gasoline and diesel fuel²⁴. Fuels and powertrains work together as a system, and the greatest emissions benefits can be achieved by combining lower sulphur fuels with appropriate powertrain and emission control technologies²⁵. Low-sulphur fuels provide air pollution benefits for vehicles in two ways:

1. the immediate, direct benefit of a reduction in sulphate particle emissions; and
2. an indirect benefit in enabling the incorporation of advanced emission-control technologies that are sensitive to higher levels of sulphur.

Research has indicated that the indirect reduction of emissions enabled by low-sulphur fuel contributes the vast majority of overall air pollution emissions reduction, and for this reason fuel desulfurization needs to be considered as a complement to tailpipe emission standards, the primary policy lever for vehicle emission controls²⁶.

According to the International Council on Clean Transportation, the world-class emission standard for clean low-sulphur fuel is 10 to 15 parts per million sulphur for gasoline/petrol and diesel fuel plus Euro 6/VI, US Tier 2/ HD2010, or equivalent fuel specifications. The quality of fuel in Australia is currently regulated by the Fuel Quality Standards Act 2000 and the Fuel Quality Standards Regulations 2001, which limits sulphur levels in gasoline/ petrol to 50 parts per million²⁷ and in diesel to 10 parts per million²⁸. The ICCT believes that *"the present fuel quality available for road transport across Australia does not present any impediment to reduce vehicle CO₂ emissions at rates comparable to other regions of the world"*²⁹. A memo from the ICCT on this matter is attached to this submission to provide further detail on this matter.

Requested measures:

- That any updates to fuel quality standards in Australia not prevent the immediate introduction of light vehicle CO₂ emission standards to match efficiency gains being targeted in other markets.

²⁴ International Council on Clean Transportation (2015)

²⁵ Global Fuel Economy Initiative (GFEI) (2015)

²⁶ International Council on Clean Transportation (2015)

²⁷ Department of Environment (2001)

²⁸ Department of Environment (2001)

²⁹ International Council on Clean Transportation (2014)

Complementary Measures to Support Standards

As has been consistently shown in other markets, implementing light vehicle CO₂ emission standards should not happen in isolation. Best practice light vehicle CO₂ emission standards and relevant complementary measures must be designed with a focus on maximising a range of positive outcomes - financial savings for vehicle owners, addressing technical and infrastructure issues, improved energy security, and achieving least cost emissions reductions. They must also be designed to support the marketing of low emission vehicles, to assist consumer choice.

Information and Education

Awareness raising and fuel consumption labelling

International research suggests that a majority of prospective consumers are not well informed about the existing policy incentives or the value proposition of replacing their conventional vehicles with fuel efficient vehicles³⁰. Education and awareness activities should include providing information about fuel savings, total cost of ownership and relevant purchasing incentives at dealerships, on consumer labels, websites, and through advertising campaigns.

Providing information to prospective low emission vehicle consumers on total cost of ownership and vehicle fuel-saving benefits on websites and consumer labels is an important basic step. Consumer groups have indicated that there is often feedback on real-world fuel consumption versus the manufacturer's specifications, which indicates that consumers are relying on the labelling system. The Green Vehicle Guide website has been a useful resource, however with the recent update and removal of the star rating guide the information become less accessible for consumers. Consumer groups have indicated that the presentation of data as the actual g/km or L/100 km is more difficult for the average motorist to understand.

The UK Low Carbon Vehicle Partnership (LowCVP), commissioned the design and rollout of an easy-to-read and understand Fuel Economy Label in 2005 to meet the requirements of the Passenger Car (Fuel Consumption and CO₂ Emissions Information) Regulations 2001³¹. The labels include an energy-efficiency style colour coded fuel economy scale for CO₂ emissions, see Figure 6 below. The colour-coded bands use a scale similar to energy-efficiency rating systems used for 'white goods' ranging from green for cars with the lowest CO₂ emissions through the colours of the spectrum to red for the most highly polluting vehicles.

³⁰ International Council on Clean Transportation (2015)

³¹ UK Government (2001)

Other information on the label includes annual fuel costs based on the 'combined' fuel economy figure and a UK average fuel price for petrol, diesel and liquefied petroleum gas (LPG); and a 12-month Vehicle Excise Duty rate. Fuel economy information is also displayed, measured over three cycles: 'urban', 'extra-urban' and 'combined' and is presented in 'mpg' (miles per gallon) and 'litres/100 km' units.

Figure 6: Extract from the UK Fuel economy label (left) and NZ Fuel Economy label (right)



Source: Low Carbon Vehicle Partnership (2012) and International Energy Agency (IEA) (2012)

Public events, including ride-and-drive with expert panels for fleet managers and decision makers and increased placement of low emission vehicles in government fleets, increase awareness of new technologies. Finally, the placement of vehicles in taxi, company, rental, and car-sharing fleets can also help to overcome the basic foundational lack of awareness and acceptance regarding available low emission vehicle models.

There are a number of options available to raise awareness and educate Australian consumers about fuel efficient and lower emission vehicles and their benefits, and to resolve misinformation.

1. Simplifying and mainstreaming fuel economy labelling:

Labels covering both new and used vehicles, combining direct disclosure and comparative ratings:

 - Type: The current Australian fuel consumption labelling system discloses direct fuel consumption and CO₂ emission values. According to the IEA, a label combining direct disclosure and an eye catching comparative rating is the most useful to vehicle purchasers. This combined fuel economy labelling system has been applied in New Zealand³². This displays fuel economy in litres per 100km alongside a star rating, and an estimate of potential financial savings. A number of countries, including New Zealand and the UK, mandate the labelling of fuel economy on new and used vehicles. The current Australian labelling system only mandates labelling of new vehicles.

³² International Energy Agency (2012)

2. Setting up information campaigns and tools:

The former Victorian Fleetwise Program presented a useful model for the structure of an information program. The program engaged with fleet managers through information seminars on how to improve fleet energy efficiency. The program resulted in a reduction of 149 tonnes CO₂e³³.

3. Hosting exposure events:

These could potentially be organised by State and Local governments in partnership with motoring clubs, NGOs and could include tests drive events.

Develop a vision for Australia's light vehicle fleet

An overarching vision for improving the fuel economy of Australia's new light vehicle fleet would be a major driver for supportive policy. The establishment of supportive institutional and policy frameworks consisting of the creation of an agenda setting organisation for lower emission vehicles would ensure a coordinated approach in terms of policies and complementary measures.

An agenda setting organisation could be established as either a stand-alone or as a separate functional area of an existing department or agency. An initial review has revealed that a number of existing organisations could undertake this role, however there is recognition it would need to be well placed, offer appropriate skills and have the ability to effect real change.

An adequately resourced national organisation would be appropriate and valuable to:

- Broadly promote the uptake of low-emission automotive technologies;
- Advise and guide Federal and State Government policy responses; and
- Evaluate the broad economic benefits of low emission vehicles.

In terms of structuring a new organisation, several examples could be applied to Australia. An organisation similar to CALSTART or the UK Low Carbon Vehicle Partnership (LowCVP) would allow for a private, member-based structure that could be less dependent on government funding and shifts in policy direction. Alternatively - and given currently limited advocacy for low emission vehicles in Australia - the structure of the UK Office for Low Emissions Vehicles may be a more pragmatic starting point. State and Territory road agencies could also participate through an inter-jurisdictional transport body, such as Austroads, the association of Australasian road transport and traffic agencies, or the National Transport Commission.

³³ Department of Economic Development, Jobs, Transport and Resources (DEDJTR) (2015)

Requested measures:

- Support the establishment of an agenda setting organisation within Australia to help coordinate consumer engagement activities in partnership with key stakeholders, and develop a consistent, strong media campaign.
- Review fuel economy labelling to provide clear comparative coloured, engaging graphics
- Support local government, consumer groups and industry initiatives to engage the community on low emission vehicles through information sessions, forums and Drive Day events.

Fleet Purchasing Policy

The importance of fleet purchasing policies is crucial in the support and uptake of low and zero emission vehicles. In 2015, approximately 46% of new vehicle purchases in Australia were by fleets³⁴ with fleets typically turning vehicles over in 3 to 5 years, and in doing so providing a significant proportion of vehicles into the second-hand market. Fleet operators also generally have a good understanding of the total cost of ownership, duty cycle and are more understanding of issues stemming from the deployment of new technology. A high proportion of fleet purchases are novated or 'User Chooser' leases where an individual nominates the make and model of car that they wish to obtain. Fleet managers, with their level of knowledge, can potentially be great advocates for efficient vehicles³⁵.

Furthermore for vehicle retailers, fleet sales are often key to achieving corporate sales targets and thereby ensuring that upstream investments in new product development and manufacture can be recouped.

Governments in smaller markets such as Sweden³⁶ and New Zealand³⁷ have been or are considering fleet procurement as a means to aggregate purchase volumes and specifically incentivise electric vehicle model introductions to address local supply constraints.

In contrast, there are limited reports of any low emission vehicles being deployed into the Australian Government's fleet of over 12,000 vehicles. With the pending closure of domestic automotive manufacturing in 2017, fleet policies will of necessity shift from the current Australian-made mandate. The opportunity now exists for the Australian Government to leading by example through fleet policies designed to promote adoption of radically lower emission vehicles.

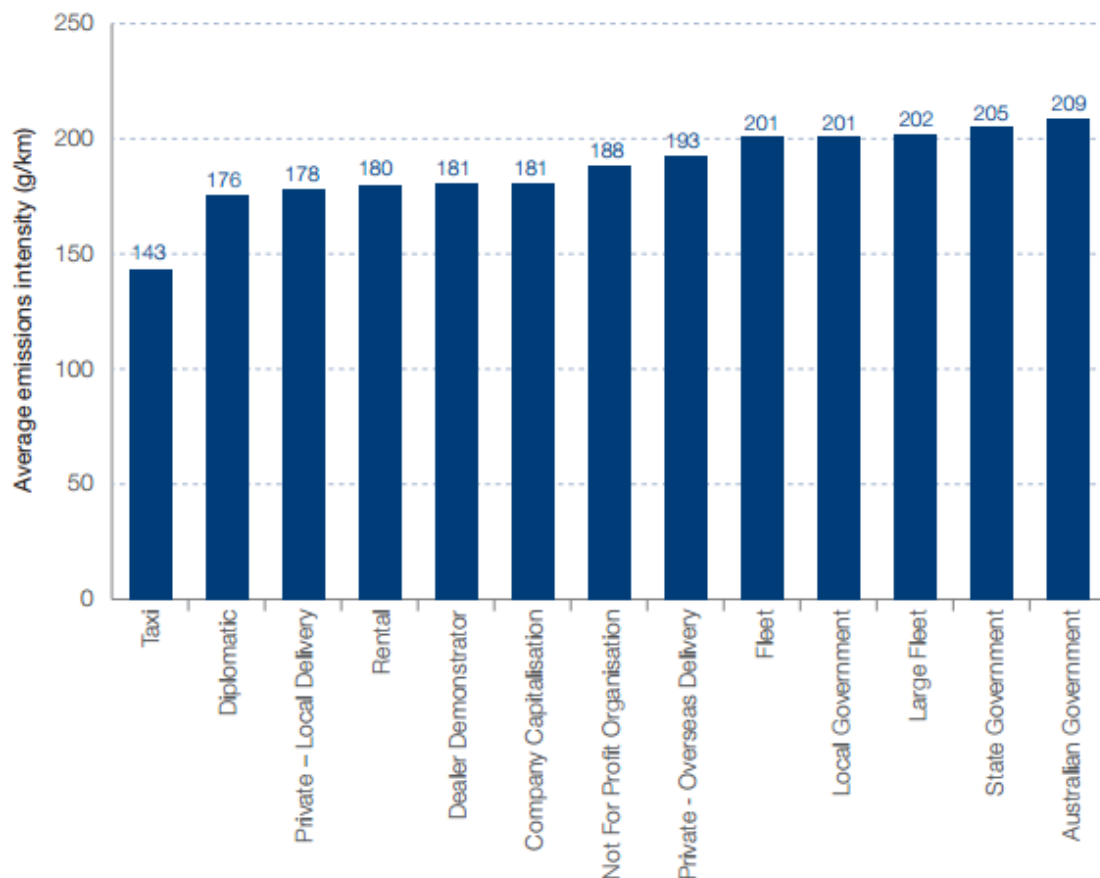
³⁴ FCAI (2015)

³⁵ Wikstrom (2014)

³⁶ Eltis (2015)

³⁷ Smellie (2015)

Figure 7: Average emissions intensity by detailed buyer type 2015



Source: NTC (2016)

Requested measures:

- Government fleets (all levels) should be required to develop a plan to reduce fleet emissions (CO₂, NO_x and PM), and produce an annual public report on progress.
- All levels of government work with manufacturers to help aggregate demand for low emission vehicles, encouraging lower prices and deployment of new models within the Australian market.
- Support early-stage demonstration and deployment of low emission vehicles with both government and business fleet owners.

Taxation and other policy measures

Measures to increase demand and to strengthen current understanding of the value proposition of lower emission vehicles and fuels

There are a number of potential government actions that could assist in increasing market demand and in overcoming the barrier of prospective consumers' knowledge of the value proposition of lower emission vehicles.

Several basic design principles appear important in policy implementation. Consumer interest could be motivated by setting incentives for the purchase of fuel efficient and lower emission vehicles including both financial and nonfinancial mechanisms. Financial incentives could be in the form of annual (including tax rebates, registration and stamp duty reductions, parking fee deductions and vehicle emission taxes) or punctual incentives (including differential road tolls and pricing, free or reduced parking fees, higher fuel prices)³⁸.

These policy options can be illustrated through the example of the California Clean Vehicle Rebate Project. This project offers up to \$5,000 for the purchase or lease of a zero emissions plug-in hybrid or light-duty vehicle, and has helped to put over 100,000 clean vehicles on the roads³⁹. Non-financial incentives can include benefits such as priority lanes and reserved parking spaces. These types of initiatives have been utilised by both State and Local governments in Australia and internationally with varying degrees of success. Currently 10 U.S. States offer unrestricted access to high-occupancy vehicle (HOV) or carpool lanes for electric vehicle drivers⁴⁰, and the Brisbane City Council and City of Sydney offer reduced parking fees for hybrid vehicles when parking specifically in the council-owned car parks.

Research in international markets indicates that reductions in registration charges offered only minor impact in comparison to the overall purchase cost of a new vehicle, but anecdotal evidence from those markets suggests that consumer place a greater value on this beyond the pure financial incentive. The ACT Government currently offers a reduction in stamp duty payable on lower emission vehicles for the registration of a new vehicle and on the transfer of registration. This initiative was established under the Green Vehicle Scheme and sets differential duty costs as an incentive for the purchase of lower emission vehicles and a disincentive against the purchase of vehicles with poor environmental performance⁴¹. The ACT Government is currently reviewing the uptake and impact of this scheme.

³⁸ ClimateWorks Australia (2015)

³⁹ Center for Sustainable Energy (2015)

⁴⁰ Lutsey, N. (2015)

⁴¹ ACT Government (2015)

Table 2: ACT Green Vehicle Scheme performance ratings

Performance rating	CO ₂ emissions: grams emitted per km
A - Environmental leading edge models	0 – 130
B - Models with environmental performance significantly above average	131 – 175
C - Models with average environmental performance	176 – 220
D - Models with below average environmental performance	More than 220

Table 2: Duty amount under the Scheme

Performance rating	Motor vehicles valued at \$45,000 or less	Motor vehicles valued more than \$45,000*
A	\$0	\$0
B	\$1 per \$100 or part thereof	\$450 plus, \$2 per \$100 or part thereof over \$45,000
C	\$3 per \$100 or part thereof	\$1,350 plus, \$5 per \$100 or part thereof over \$45,000
D	\$4 per \$100 or part thereof	\$1,800 plus, \$6 per \$100 or part thereof over \$45,000

Source: ACT Government

Anecdotal evidence suggests that most vehicle owners would prefer a rebate on the cost of a less polluting vehicle. To best calculate the Total Cost of Ownership (TCO) and improve consumer awareness, there needs to be input and coordination with vehicle manufacturers and to change the current fuel and energy consumption labelling system. It is important to recognise however, that there are difficulties in accurately predicting or comparing TCO between different vehicles, due to uncertain resale values and sales volumes driving behaviour as well as the impact of fluctuations in fuel prices.

Consideration could be given to targeting classes or groups of potential purchasers, rather than individual motorists. Low emission fuel efficient vehicles are arguably more suited to high use scenarios, where low running costs are able to pay back higher purchase costs more rapidly. A shorter term policy focus could concentrate on subsidising fuel efficient uptake in taxi, rental car, car share and urban delivery sectors. The rental car and car share schemes could also offer the greatest potential for general consumer exposure to low emissions technologies.

Luxury Car Tax

At present, luxury car tax (LCT) in Australia imposes a tax on cars with a GST-inclusive value above the LCT threshold of \$63,184. There is a higher threshold for fuel efficient cars (with fuel consumption of 7L / 100km or less), of \$75,375⁴². LCT is then imposed on the amount above the threshold at a rate of 33%.

⁴² ATO (2016)

There are a range of low emission vehicles within Australia which currently attract the LCT. Creating a banded threshold for low emission vehicles below the current exemption, could help drive further uptake of these vehicles.

Requested measures:

- Work with other levels of government to investigate other potential financial incentives to drive uptake of low emission vehicles.
- Provide banded threshold exemptions for low emission vehicles from the Luxury Car Tax from 2016-17.

Alternative fuels and electric vehicles

Expansion of infrastructure and supply chains to support alternative fuel vehicles

The deployment of alternative fuelled vehicles requires both the right infrastructure and developed supply chains. In Australia, addressing these requirements is at a standstill, with some arguing that once consumer demand for lower and zero emission vehicles grows, supply chains and appropriate infrastructure will follow, and some argue the opposite.

To develop the right infrastructure for alternative fuels federal, state and local governments could utilise urban planning powers coupled with grant programs towards businesses to stimulate the installation of infrastructure dedicated to lower emission vehicles. An example of this is the EV Infrastructure Rebate Program in Illinois covers 50% of the cost of equipment and installation of EVs charging stations, with a cap based on the type of station. More than \$350,000 was awarded in 2013, funding a total of 130 stations⁴³.

Supply chains for lower emission vehicles can be stimulated by policy intervention in a variety of ways. Government procurement is a powerful policy tool that can be considered at all levels of government. Government procurement could represent a major demand in the lower emission vehicle market, consequently developing supply chains. The NSW Government Cleaner Fleet Initiative 2004- 2011 is a practical example for replication and scale-up, new efficiency targets were set for government fleets and vehicles with V8 engines were removed from government contracts⁴⁴. Federal and State governments could also establish voluntary agreements or set binding targets on manufacturers or suppliers to increase model availability in Australia and contribute to the development of specific supply chains.

⁴³ Jin et al (2014)

⁴⁴ NSW Government StateFleet (2015)

Requested measures:

- Federal Government to provide co-ordination of alternative fuel and electric vehicle infrastructure roll out, potentially through supporting the establishment of an agenda setting organisation within Australia.

Advancement of emerging technologies and practices which can improve efficiency

The broad-scale advancement of new and emerging technologies can bring significant changes in the technologies utilised for personal transportation, and also in moving economies away from petroleum and reducing the environmental footprint of transportation. With standards or targets in place, industry can be incentivised to promote advanced technologies to achieve reductions in CO₂ emissions. An example of this is the Alternative Fuel Vehicle Incentive Program, which was funded by the California Air Resources Board between 2007 to 2009⁴⁵. A total of \$25 million was appropriated to promote the use and production of vehicles capable of running on alternative fuels, including compressed natural gas and electricity via all-electric vehicles and plug-in hybrid electric vehicles.

The development of intelligent transportation systems (ITS) provide advanced and innovative applications relating to different modes of transport and traffic management. If ITS becomes accessible to ten per cent of the Australian fleet, the benefits in terms of improved traffic management and safety would flow on to the entire fleet. In addition, greenlight technologies or traffic signal priority could improve traffic management - however this technology is perhaps best suited to public transport and freight and its advancement will depend on optimal telecommunications and available data capacity.

Requested measures:

- Undertake research to identify the emission and energy productivity impacts of emerging technologies.

⁴⁵ California Environmental Protection Agency (2009)

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October 31, 2014

Henry O'Clery
Future Climate Australia
P.O. Box 44
Koonwarra, VIC 3954

Via email: henry@futureclimate.com.au

Subject: Fuel Quality and CO₂ emission standards for Australia

Dear Henry,

Thank you for your inquiry about fuel quality and CO₂ emissions. The ICCT believes that vehicle and fuel should be treated as a system, but the present quality of fuel available for road transport across Australia does not present any impediment to reduce vehicle CO₂ emissions at rates comparable to the other regions of the world.

If Australia wishes to move towards tighter conventional pollutant emission standards such as U.S. Tier 3 emission standards, then fuel quality -- in particular sulfur content of gasoline -- should be improved. Lack of availability of ultra-low sulfur gasoline should not, however, become an excuse to delay action on light-vehicle CO₂ emission standards.

I'm including a short memo with this letter that clarifies the relationship between fuel quality and CO₂ emissions further. If you have any questions or comments, please do not hesitate to let us know.

Best regards,



Anup Bandivadekar
Passenger Vehicle Program Director
The International Council on Clean Transportation
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cc:
Scott Ferraro (scott.ferraro@climateworksaustralia.org)
Eli Court (eli.court@climateworksaustralia.org)

incl:
Memo on Fuel Quality and Light vehicle CO₂ emission standards for Australia

Fuel Quality and Light vehicle CO₂ emission standards for Australia

In the debate over inclusion of light-vehicle CO₂ standards in Australia Energy White Paper, some stakeholders seem to have made an assertion that the lack of low sulfur and 95 RON gasoline could be an impediment in meeting any future new vehicle CO₂ standards.

Sulfur and vehicle fuel efficiency

It is likely that some of the stakeholders are confused about the fundamental differences between criteria pollutants and CO₂ emissions. Criteria pollutant (NO_x, CO, HC, PM) standards, do have major linkages with gasoline-sulfur content because catalyst aftertreatment systems work better with low sulfur fuel; however, gasoline sulfur content does not present an obstacle for prominent vehicle efficiency technologies for compliance with CO₂ standards.

(1) Gasoline sulfur content does not pose a problem for increasing fuel economy.

- Source: US EPA, 2000
 - The U.S. Environmental Protection Agency implemented Tier 2 vehicle criteria pollutant standards in concert with a regulation for reformulated low-sulfur gasoline. In their regulatory research, they analyzed potential connections with these sulfur/criteria regulations and the fuel economy of vehicles.
 - Summarized that that the regulations had “no significant impacts on either fuel economy or performance of the vehicles”
- Source: Auto/Oil Air Quality Improvement Research Program (AQIRP), 1997
 - A six-year program with emission testing of over 100 vehicles by the 3 automobile and 14 oil companies, conducted to analyze reformulated fuels effect on emissions and fuel economy.
 - The project analyzed vehicle emissions from use of fuel sulfur content that ranged from 450 ppm sulfur (early 1990s levels) to 50 ppm sulfur (federal US Tier 1 levels).
 - Concluded that “Sulfur content had no effect on fuel economy”
- Source: Coordinating Research Council (CRC), 2000.
 - Testing of number of vehicles in 1999-2000 over variety of drive cycle procedures, with gasoline sulfur content of 1, 50, and 100 ppm.
 - No significant impact of sulfur content on fuel economy was found.

(2) Low sulfur fuel is crucial in enabling more stringent criteria pollutant standards for gasoline and diesel vehicles.

- Source: US EPA, 2000
 - Tier 1 and Tier 2 vehicle emission standards required lower sulfur fuel to achieve new more stringent HC, NO_x, CO levels due to the problems associated with the conversion efficiency of catalytic convertors in the presence of sulfur. Sulfur also impedes the functioning of diesel particulate

filters—without ultralow sulfur diesel, Tier 2 standards would be out of reach for diesel vehicles.

(3) Low sulfur fuel might be important for long-term lean-burn combustion technologies that are in development stages.

- Traditional three-way catalysts are only effective at stoichiometry. The extra oxygen in lean-burn engines inhibits NO_x reduction in the three-way catalyst. Lean-NO_x catalysts are highly sensitive to sulfur and, thus, higher sulfur levels can inhibit introduction of lean-burn engines. However, even in countries with low sulfur fuel very few gasoline lean-burn engines have been produced, so this is currently only a theoretical concern.
- There are other ways to gain the efficiency advantages of running with a lean air/fuel ratio, such as using high rates of exhaust gas recirculation or using a fuel with high levels of ethanol (e.g. E30). Thus, the impact of sulfur on lean-burn engines may never become an inhibiting factor.
- Source: US EPA, 2010
 - EPA will continue to assess emissions control performance of more advanced engine efficiency technologies like lean-burn gasoline direct injection which are *not* expected to have significant deployment by 2016 even in countries with low sulfur fuel (p. 6799):

“The EPA staff will continue to assess the emission control potential of vehicles powered by technologies such as lean-burn and/or fuel-efficient technologies, including diesel engines equipped with advanced aftertreatment systems.... In the assessment we will maintain a “systems” perspective, considering the progress of advanced vehicle technologies in the context of the role that sulfur in fuels plays in enabling the introduction of these advanced technologies.”

Gasoline octane rating and vehicle fuel efficiency

Technically, it is accurate to state that higher gasoline octane rating enables greater compression ratios and higher levels of turbocharger boost, and hence lower fuel consumption and CO₂ emissions.

(1) Compression ratios could be increased without necessarily increasing octane rating of fuel.

- Source: U.S. Environmental Protection Agency (EPA) and Department of Transportation (DoT), 2010.
 - While stating the case for US 2012-2016 fuel economy standards, the agencies stated:
 - “Direct injection of the fuel into the cylinder improves cooling of the air/fuel charge within the cylinder, which allows for higher compression ratios and increased thermodynamic efficiency without the onset of combustion knock. ... Use of GDI systems with turbocharged engines and air-to-air charge air cooling also reduces

the fuel octane requirements for knock limited combustion and allows the use of higher compression ratios.”

- The so called cooled EGR technology “reduces knock sensitivity which enables the use of more optimal spark advance or enables compression ratio to be increased for improved thermal efficiency, and increased fuel economy. Currently available turbo, charge air cooler, and EGR cooler technologies are sufficient to demonstrate the feasibility of this concept.”
- In the same document, the US agencies also state that variable valve timing can be used to alter and optimize the effective compression ratio where it is advantageous to do so.

(2) The worldwide fuel charter RON 95 is a wish, not a requirement.

- The worldwide fuel charter (WWFC) makes several excellent points about fuel quality including the need to have lead and manganese free gasoline, as well as low-sulfur fuels. The charter also states that "95 RON will enable manufacturers to optimize powertrain hardware and calibrations for thermal efficiency and CO2 emissions".
- Note that the U.S. gasoline pool has an effective RON rating of about 92, and this has not affected the introduction of high-efficiency downsized turbocharged/gasoline direct injection engines. For example, Mazda's SKYACTIVE-G 2.5-liter direct injection gasoline engine has a compression ratio of 13.0:1, and runs on regular unleaded gasoline.

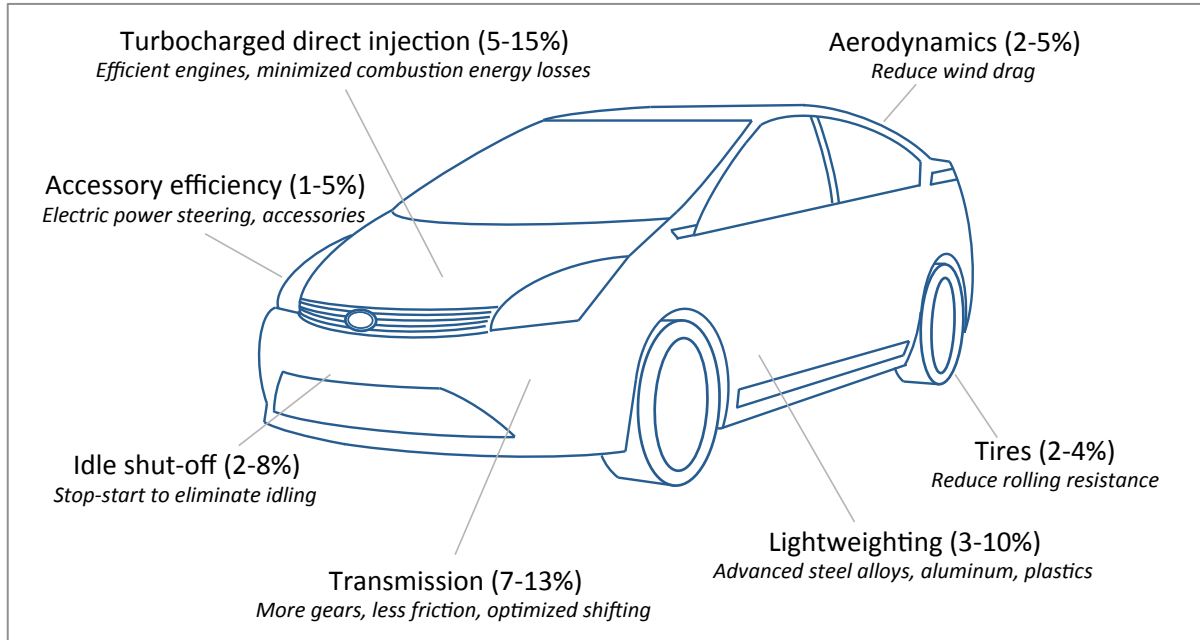
(3) The impact of octane on vehicle fuel economy is not large

- Source: Speth et al (2014)
 - The ratio of compression ratio to octane number is 0.17% to 0.25%, i.e. compression ratio can be raised by one with an octane increase of 4 to 6 RON.
 - The impact of compression ratio on efficiency varies with the baseline compression ratio. For example a unit increase in compression ratio with a 10.0:1 baseline will yield a 2.2% increase in efficiency and with a 11.5:1 baseline will yield a 1.4% increase.
 - The higher compression ratio will also increase performance. Simulations using Argonne National Laboratory's Autonomie model yield an additional 32% increase (x1.32) in efficiency for engine downsizing associated with the performance increase.
 - Speth et al modeling of a 6 RON increase yielded a net fuel consumption reduction of 3.0-4.5% for a naturally aspirated engine and 4.9-7.1% for a turbocharged engine.
 - Thus, increasing octane for regular grade fuel in Australia from 91 to 95 RON would reduce fuel consumption of current generation naturally aspirated engines by 2.0-3.0% and 3.3-4.7% for turbocharged engines.
 - Note that this improvement will decrease in the future as baseline compression ratios rise.

- Note that this reduction in fuel consumption would only occur if engines in Australia were redesigned to take advantage of the higher octane.
- Source: Leone et al 2014
 - Over the EPA test cycles, a turbocharged engine optimized for 11.9:1 compression ratio yielded a 4.8-5.1% improvement in fuel economy compared with a baseline 10.0:1 compression ratio.
 - This increase (4.8-5.1%) is roughly the same as the 4.9% improvement found by Speth et al for turbocharged engines. However, the compression ratio increase is much larger -- 1.9 versus 1.0 for Speth. This suggests that the fuel consumption decreases found by Speth et al may be overstated.

(4) Improving engine compression ratio is just one technology among a multitude of technology pathways available to reduce vehicle CO₂ emissions. The following tables and accompanying figure shows a variety of engine, transmission as well as vehicle level technologies that can be brought to bear on reducing vehicle fuel consumption and CO₂ emissions. Nearly all of these technologies have larger impacts on fuel consumption than raising octane from 91 to 95 RON.

Area	Technology	Fuel economy improvement	Example new vehicle models and technology marketing names
Engine	Advanced variable valvetrains	4-6%	Audi "Valvelift"; Honda "VTEC"; BMW "VANOS"
	Turbochargers	2-5%	Ford "EcoBoost" (Fusion, Escape, Edge F150);
	Gasoline direct injection (GDI)	5-15%	GM "Ecotec"; Mazda "SkyActiv"; Ford "EcoBoost" (Fusion, Escape, F150); VW "TSI"
	Cylinder deactivation	5-6%	Honda "Variable Cylinder Management"; GM "Cylinder on Demand"
	Diesel engines	15-25%	Mercedes "Bluetec"; VW "TDI"
Transmission	6+ speed transmissions	2-8%	Chrysler 200 (8-speed); Audi A3 (7-speed)
	Dual-clutch transmission	9-13%	Ford "PowerShift" (Focus); VW "Direct-Shift Gearbox" (Jetta, Golf)
	Continuously variable transmission (CVT)	8-11%	All Toyota, Nissan, Honda hybrids; Jeep Patriot, Compass; Subaru Impreza
	Stop-start	2-8%	Hyundai "Blue-Drive"; Ford "Auto Stop-Start"
Overall vehicle	Accessory and auxiliary efficiency (e.g., electric power steering, efficient air-conditioning)	1-5%	(all manufacturers)
	Low rolling resistance tires	2-4%	(all manufacturers)
	Aerodynamic features (lower clearance, underbody panels)	2-5%	(all manufacturers)
	Lightweight advanced materials (aluminum, plastic, carbon fiber)	3-10%	(all manufacturers)
	Hybrid gasoline-electric vehicle	5-50%	Toyota Prius; Honda Civic hybrid
	Plug-in electric vehicle	50-100%	GM Volt; Nissan LEAF;



Note also the following examples of actual vehicles sold in the U.S. market that have improved efficiency by using many of the technologies mentioned above:

Vehicle model	Vehicle class	Original fuel economy (km/L)	New fuel economy (km/L)	Change	Low-carbon/efficiency technologies
Ford Focus	Compact car	11.9	13.6	14%	Direct injection, 6-speed dual-clutch transmission, electric power steering
Subaru Impreza	Station wagon	9.4	12.8	36%	Continuously variable transmission, 160-lb mass reduction, lower rolling-resistance tires, electric power steering
Hyundai Sonata	Midsize sedan	9.4	11.1	18%	Variable valve timing, direct injection, 6-speed, aerodynamics, mass reduction
Nissan Altima	Midsize sedan	11.1	13.2	19%	Intake/exhaust valve timing, continuously variable transmission, taller gear ratio, mass reduction, aerodynamics
Mazda CX-5	Small sport utility vehicle	9.8	11.9	22%	Direct injection, 6-speed transmission, mass reduction, aerodynamics, friction reduction, high compression Atkinson engine
Ford Explorer	Large sport utility vehicle	6.8	9.8	44%	Turbocharging, direct injection, 6-speed transmission, mass reduction, aerodynamics
Ford F150	Large pickup truck	6.0	7.7	29%	Turbocharging, direct injection, 6-speed transmission, mass reduction, aerodynamics

In conclusion, there is no direct relationship between fuel sulfur content and vehicle CO₂ emissions, and Australia's current fuel quality does not present any impediment to delivering CO₂ emission reduction at rates comparable with other regions of the world.

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IMPROVING AUSTRALIA'S LIGHT VEHICLE FUEL EFFICIENCY



Briefing Paper
February 2014

Executive summary

Improving the fuel efficiency of Australia's light vehicle fleet can deliver substantial environmental and broader economic benefits.

This briefing paper builds on the significant amount of work already undertaken on this issue over the past decade by government, industry, consumer groups and others.

Despite these efforts, Australia lags behind most other developed economies in introducing regulated vehicle fuel efficiency standards, commonly referred to as CO₂ emission standards because of the direct correlation between reducing fuel use and reducing CO₂ emissions.

International experience shows that in order to capture the broad range of benefits from improved fuel efficiency, a suite of measures needs to be developed and implemented in collaboration with all stakeholders.

Best practice light vehicle CO₂ emission standards and relevant complementary measures must be designed with a focus on maximising a range of positive outcomes – financial savings for vehicle owners, improved energy security, and least cost emissions reductions. Best Practice standards could see the fuel efficiency of Australia's new light vehicle fleet improved by over 50% within 10 years.

ClimateWorks Australia is calling on the Federal Government within the next two years to work with industry and consumer groups to design and introduce best practice light vehicle CO₂ emission standards and supporting complementary measures that maximise the economic and environmental benefits available.

This Briefing Paper highlights that:

- > Australian new light vehicles have improved in efficiency by 20% since 2002. However, at an average of 199 gCO₂/km our cars and light commercial vehicles are still far less efficient than those in most developed economies.
- > Three-quarters of all new cars sold globally each year are regulated under some form of CO₂ emissions standard, and without standards in place, Australia will fall further behind other developed economies.

- > The financial benefit to light vehicle owners of introducing best practice standards is significant. If efforts in the European Union are targeted with a 4 year lag, by 2020 an average driver could pay up to \$170 per year less for fuel than they do today, and within 10 years they would pay up to \$410 less than they pay today, even factoring in rising fuel prices.
- > While improving fuel efficiency means higher upfront costs for car buyers, with a conservative estimate of \$2,500 per vehicle for a 50% efficiency gain in 2024, our analysis indicates that average car owners would recover these additional costs within 3 years through fuel savings, well within the average length of vehicle ownership of about 5 years. This results in net annual savings of \$352 for average drivers over this 5 year ownership period.
- > The broader economic benefits are also tangible. Within 10 years, we could save up to \$7.9 billion per year across our economy through reduced fuel use.
- > Further, fuel efficiency helps to enhance Australia's fuel security, with fuel demand reducing under best practice standards by between 40 and 66 million barrels per annum in 2024, equivalent to 30%-50% of all automotive fuel used in Australia in 2012.
- > Of all the opportunities identified in ClimateWorks' *Low Carbon Growth Plan for Australia*, reducing emissions from cars and light commercial vehicles through improved fuel efficiency presents the lowest cost opportunity to reduce emissions across our economy, and could deliver reductions of 4 Mt CO₂e in 2020 and 8.7 Mt CO₂e in 2024, equivalent to taking 2.2 million cars off the road in 2024.
- > A partnership approach is required to ensure a robust solution is developed that delivers the optimal benefits to consumers and the environment, and current inertia can be overcome.

Improving Australia's vehicle fuel efficiency

How adopting light vehicle CO₂ emission standards can cut fuel use and save households and businesses money

There is a direct correlation between improving fuel efficiency and reducing carbon (CO₂) emissions. Australia currently lags behind most of the developed world in introducing light vehicle CO₂ emissions standards, with ¾ of all new cars sold globally covered by standards.

OUR CURRENT/PROJECTED PERFORMANCE & OPPORTUNITY

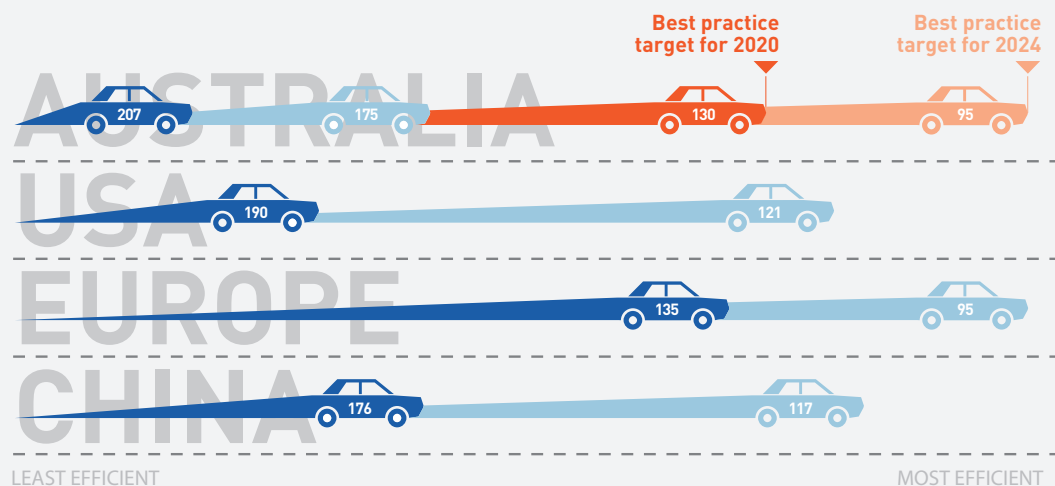
Without standards in place, Australia will fall further behind other developed economies, at substantial cost to consumers.

Introducing standards that adopt international best practice will address this gap.

130 gCO₂/km emissions level

● 2011

● 2020 business-as-usual



Our modelling shows that introducing best practice targets for 2020 (130gCO₂/km) and 2024 (95gCO₂/km) would deliver significant benefits across the Australian economy. Achieving this standard is technologically feasible and cost effective.

THE BENEFITS ACHIEVED IN 10 YEARS



\$7.9 billion p.a
fuel savings across
Australian economy



Take \$850 per year
off the average
driver's fuel bill
and achieve minimal
annual net savings of \$350



Reduce CO₂e
emissions
by 8.7 Mt
equivalent to taking
2.2 million cars off
the road



Eliminate up to
66 million barrels
of imported oil
equivalent to 50% of all
automotive fuel used
in Australia in 2012

Each year we delay the implementation of best practice standards is another year we miss out on these benefits and the task to catch up becomes harder. The time to act is now.

THE ROADMAP: HOW WE GET THERE

Work with industry and consumer groups to design and implement best practice standards that maximises consumer and environmental benefit

Introduce complementary measures to drive consumer demand for the most efficient vehicles

Develop partnership approach to overcome inertia and ensure effective outcomes

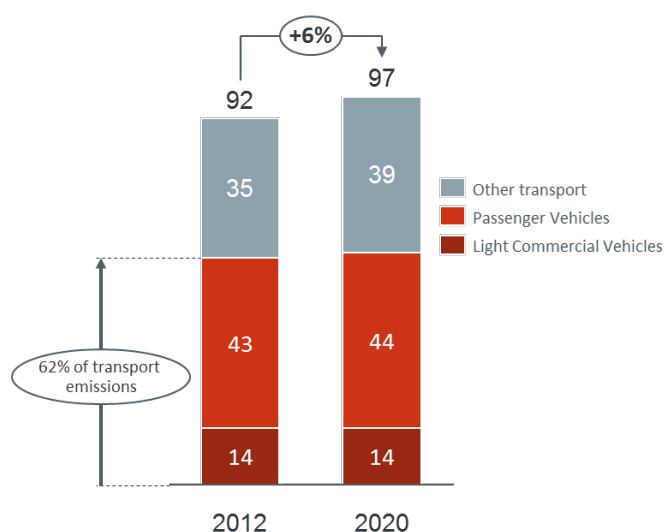
Australia's transport emissions are continuing to grow, with passenger and light commercial vehicles contributing the largest overall share

The transport sector accounts for 17% (92 MtCO₂e) of Australia's emissions, with Passenger and Light Commercial vehicles contributing 62% of the sector's emissions (DIICCS RTE, 2013).

The transport sector is one of the fastest growing sources of emissions within Australia, increasing by 47.5% since 1990 (DIICCS RTE, 2013).

The sector's emissions are projected to rise by a further 6% to 2020, to reach 97 MtCO₂e (DCCEE, 2010). This continued increase in emissions is driven primarily by population and income growth for passenger travel and economic growth for freight transport (DCCEE, 2010).

Exhibit 1 - Australia's transport emissions 2012 and 2020 (MtCO₂e)



Source: DIICCS RTE (2013); DCCEE (2010)

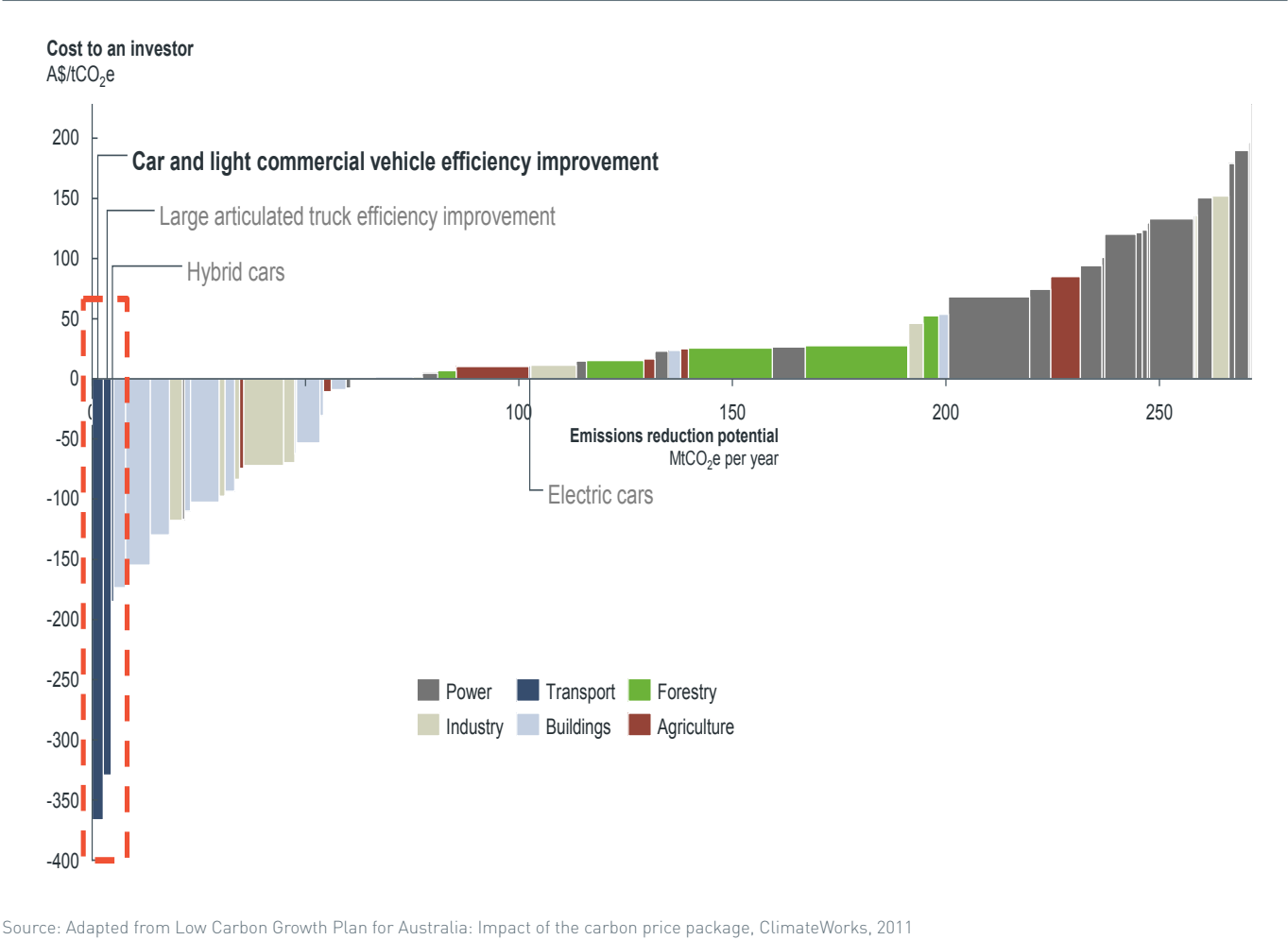
The Low Carbon Growth Plan for Australia showed that cars and light commercial vehicles can deliver the lowest cost emissions reductions across the Australian economy

The *Low Carbon Growth Plan for Australia* (ClimateWorks Australia, 2010), identified that the transport sector could contribute the most financially attractive opportunity identified across the economy through improving the fuel efficiency of conventional internal combustion engine (ICE) light vehicles; the cars, sports utility vehicles (SUVs), utes and vans most commonly seen on our roads.

As part of this previous analysis, a range of policy approaches were compared, which showed that mandatory fuel efficiency standards (also known as CO₂ emission standards because of the direct correlation between improved fuel efficiency and reduced CO₂ emissions) had the largest impact on reducing emissions, even after taking account of the increase in kilometres driven when fuel savings are achieved (known as the 'rebound effect').

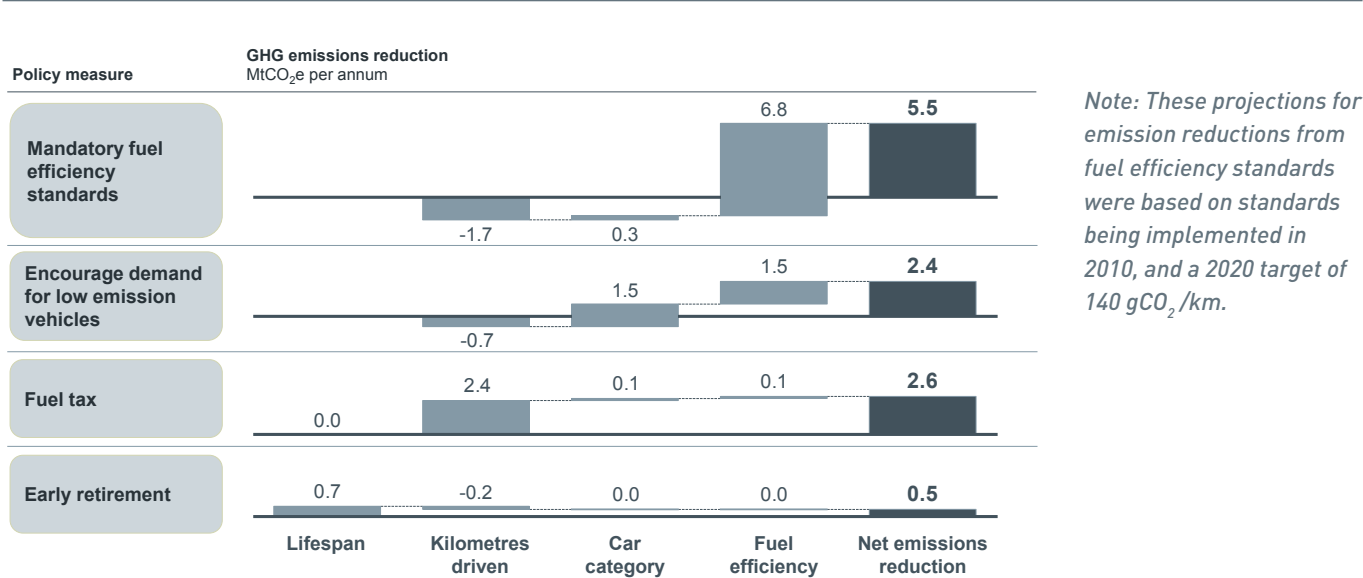
Mandatory standards set the average acceptable emissions across the new vehicle fleet. Each vehicle manufacturer would be required to meet these standards, averaged across the mix of vehicles they sell in the Australian market. This ensures that the same variety of vehicles Australians currently enjoy would still be available, but overall they would be more fuel efficient.

Exhibit 2 – Opportunities to reduce emissions in Australia in 2020



Source: Adapted from Low Carbon Growth Plan for Australia: Impact of the carbon price package, ClimateWorks, 2011

Exhibit 3 – Comparison of policy measures to reduce emisisions in cars and light commercial vehicles



Source: Low Carbon Growth Plan for Australia, ClimateWorks, 2010

Australia has the 11th largest new car market globally, with over 1 million new vehicles sold annually

Over 1 million new vehicles were sold in Australia in 2012 (NTC, 2013), making ours the 11th largest vehicle market globally (Bandivadekar, 2013).

Over the last decade, there has been a 40% increase in the total number of cars sold in Australia (from approximately 750,000 in 2001 to over 1,000,000 in 2012). These new sales are comprised of approximately 80% passenger vehicles (e.g. cars, people movers and SUVs), and 20% light commercial vehicles (e.g. utes and vans) (NTC, 2013).

As seen in Exhibit 4, over this same period there has been an overall decline in sales from local vehicle manufacturers, driven by the high Australian dollar (which has both reduced export demand and made imported vehicles cheaper), reduced import tariffs (which has increased the range of brands and models available), and a shift in consumer preferences towards smaller vehicles and SUVs (sports utility vehicles), which has also benefited the import market.

These factors have resulted in a significant increase in imported vehicles and a decline in local vehicle manufacturing, culminating in recent announcements from Ford, General Motors Holden and Toyota to cease manufacturing vehicles in Australia post 2017.

Whilst fuel efficiency from Australia's new light vehicle fleet has been improving, we continue to lag behind most of the developed world, providing an opportunity for significant efficiency gains

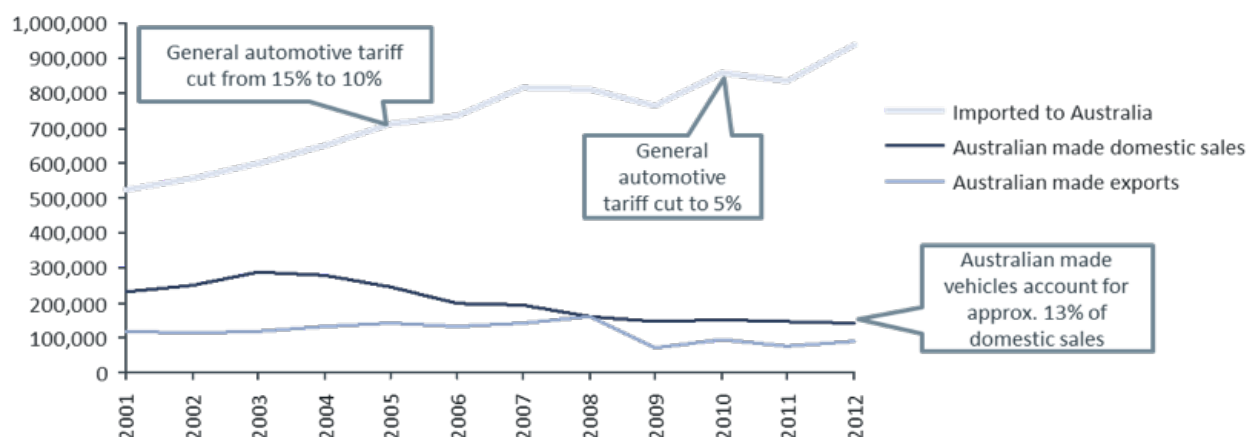
Reducing emissions in vehicles is typically achieved through technology improvements that also reduce fuel use. The less petrol, diesel or natural gas consumed per kilometre driven, the less emissions produced, while also delivering a decrease in vehicle operating costs. There is in fact a direct correlation between a reduction in fuel use and a reduction in emissions and 'fuel efficiency standards' are often also referred to as 'vehicle CO₂ emissions standards'.

Between 2002 and 2012, average CO₂ emissions for new passenger and light commercial vehicles in Australia reduced by over 20% (NTC, 2013). In 2012 alone, average CO₂ emissions reduced by almost 4%, to reach 199 gCO₂/km (NTC, 2013). Breaking this down further, the NTC (2013) reports that passenger vehicles averaged 190 gCO₂/km (a 4% improvement on 2011), while light commercial vehicles averaged 238 gCO₂/km (a 2.7% improvement on 2011).

This progress, which has occurred without any Australian regulatory driver, has been driven by improved vehicle technology, an increase in the share of more efficient imported vehicles, and shifting consumer preferences towards smaller vehicles and compact SUVs (Rare, 2012).

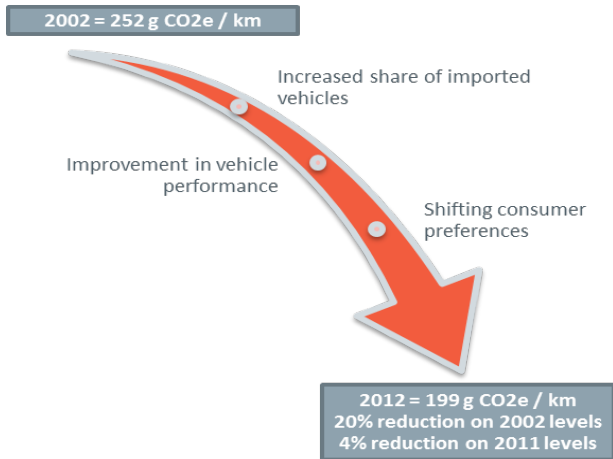
Without standards in place, business as usual (BAU) projections for Australia's light vehicle fleet (including both passenger and light commercial vehicles) estimate average emissions of approximately 175 gCO₂/km in 2020, and 165 gCO₂/km in 2024 (Rare, 2013).

Exhibit 4 – Breakdown of domestic sales and exports 2001-2012



Source: DoI, 2012

Exhibit 5 – Australian fleet average emissions 2012 and 2020



Source: NTC, 2013

Exhibit 6 compares the historic and business as usual (BAU) performance of Australia's light vehicle fleet, comprising passenger vehicles (approximately 80% of new light vehicle sales) and light commercial vehicles (approximately 20% of new light vehicle sales)

Despite these efficiency gains, Australia still lags behind a number of other developed nations in terms of the average fuel efficiency (and therefore the CO₂ emissions performance) of the vehicles we drive, and the required regulatory structure to drive further efficiency improvements.

In fact, three quarters of all new cars sold globally each year are regulated under some form of CO₂ emissions standard (ICCT, 2012). For example, the US has committed to achieving the equivalent of 121 gCO₂/km by 2020 and 93 gCO₂/km by 2025 for passenger vehicles.

On a like for like comparison (excluding the various credits available in the US system and normalization of the testing methods), this equates to US cars being up to 30% more fuel efficient than the average Australian car by 2020, and even further ahead by 2025.

The United States expects an annual rate of improvement of 4.6% over the period 2012–2020 for passenger vehicles (and 4.4% for LCVs), and 5.1% per annum from 2020–2025 for passenger vehicles (and 5.5% for LCVs) with current standards in place, leading to an overall gain of 47% for passenger vehicles and LCVs out to 2025.

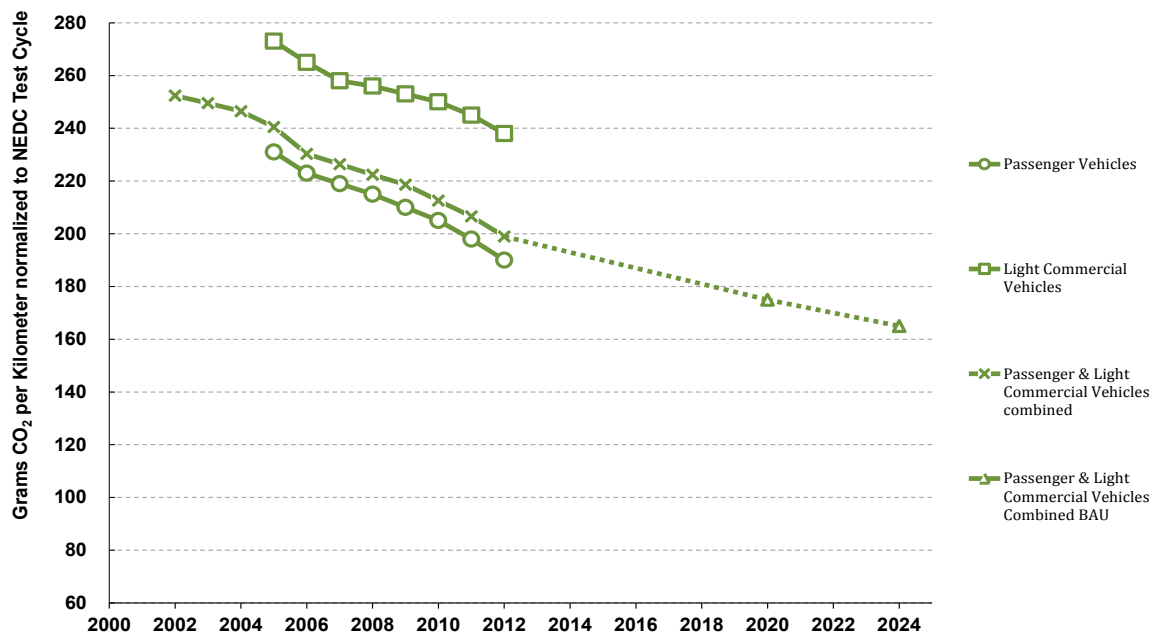
The EU, which has had strong standards in place for a number of years, is aiming to achieve a passenger vehicle target of 95 gCO₂/km by 2020 and approximately 73 gCO₂/km by 2025 (standards for 2025 are currently being debated in the EU) – over 40% more fuel efficient than the average car sold in Australia by 2020, and even further ahead by 2025.

In Europe, new passenger vehicle standards target a 3.8% improvement per annum from 2011–2020 (and 2.2% for LCVs), and a further 5.1% annual improvement between 2020–2025 (and 5.2% for LCVs), for an overall gain of 46% (and 37% for LCVs).

China is currently considering an ambitious 6.2% per annum improvement in passenger vehicles between 2015–2020, to improve their overall performance by 27% over this 5 year period (and is yet to set standards out to 2025).

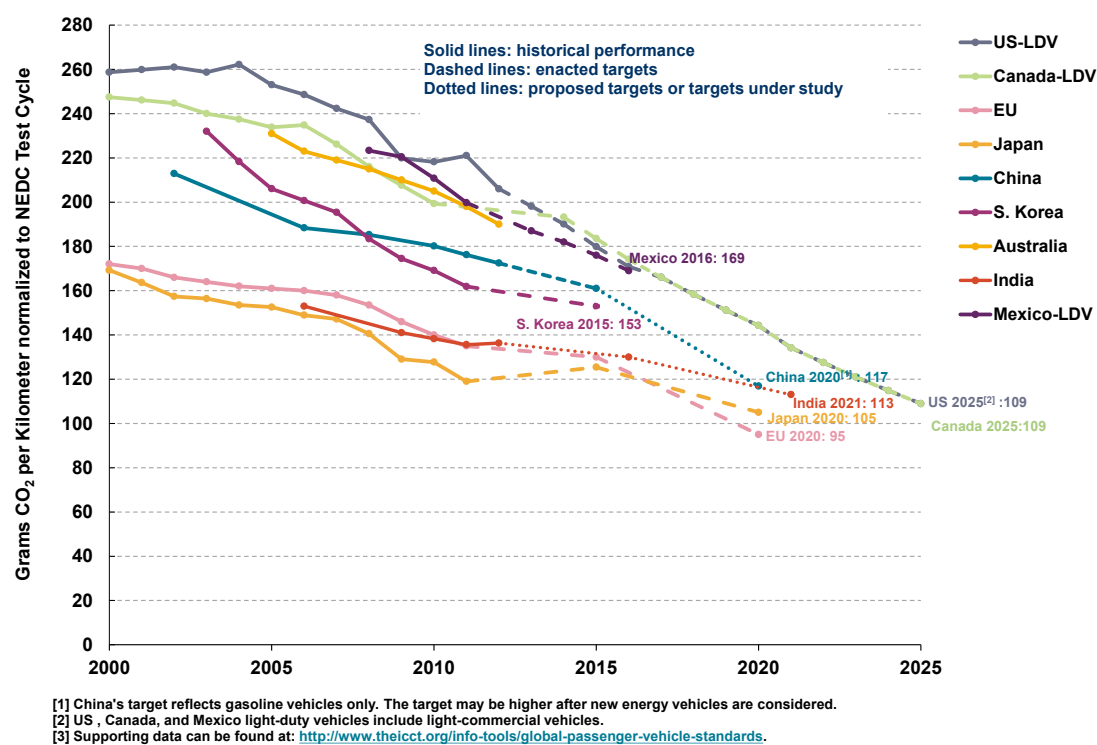
It also demonstrates that for Australia, there is potential to achieve significant efficiency gains above BAU through the adoption of technologies that are already available in international markets.

Exhibit 6 - Historic and projected performance of average emissions of Australian light vehicle fleet



Source: NTC, 2013 and Rare, 2013

Exhibit 7 - International comparison of average emissions of vehicle fleets targets to 2025, normalised to New European Driving Cycle (NEDC)



Source: International Council on Clean Transportation, 2013

The time is right for Australia to match international efforts and further encourage the adoption of the latest technologies

Light vehicle fuel efficiency standards have been proposed in Australia previously, but due to a number of factors have stalled in their introduction.

The current Government has the opportunity to introduce best practice standards, which if designed well in collaboration with industry and consumer stakeholders, and supported with suitable complementary measures, present a significant opportunity to reduce emissions from the transport sector whilst providing broader benefits for vehicle owners and the economy.

Rather than rely on higher fuel prices to encourage new vehicle buyers to choose more fuel-efficient vehicles (with evidence suggesting a high degree of price inelasticity, therefore requiring significant fuel price increases to drive a shift in consumer preferences), most countries have used a combination of regulatory standards, voluntary targets, financial incentives and consumer information to achieve fuel efficiency improvements.

Whilst fuel efficiency standards vary in their ambition and design by country, in general they set average CO₂ emission levels (in gCO₂/km or equivalent) which a manufacturer must meet across its annual fleet of new

vehicle sales (see Appendix A for various elements of standard design).

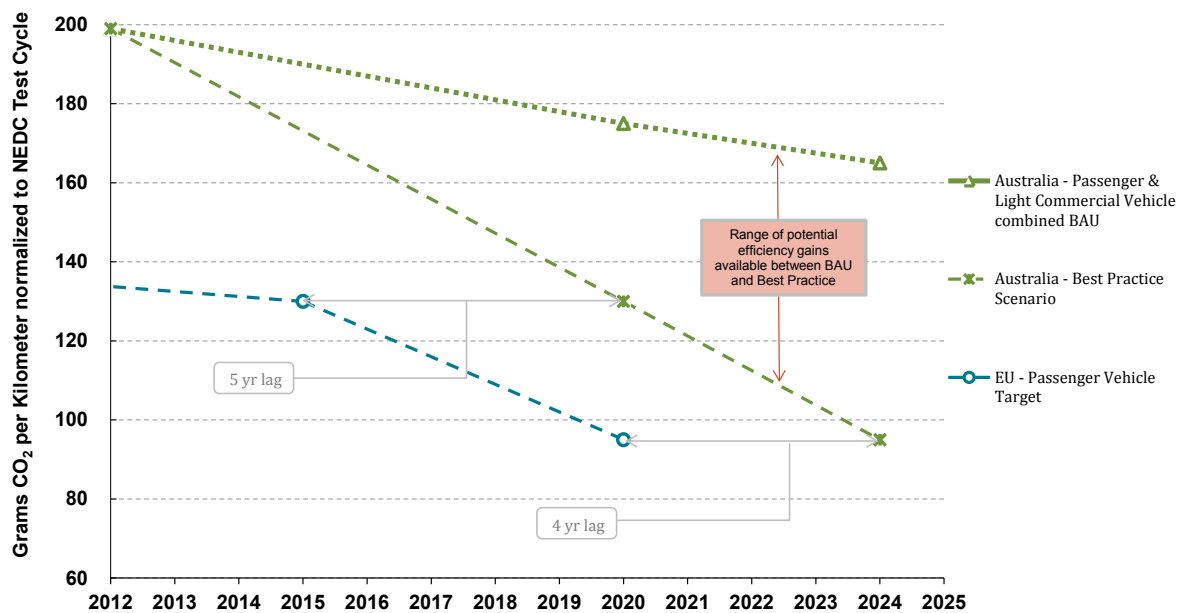
Emissions are calculated using a range of vehicle test cycles (i.e. vehicle running patterns to mimic actual driver behaviour), and policy design may include exemptions for manufacturers who sell small volumes, and credits for certain very low emissions vehicle technologies, such as electric vehicles. If a manufacturer does not achieve the standard, they may be penalised.

It is important to note that consumers influence the average CO₂ for a manufacturer, based on their vehicle purchase choice, and hence the need for complementary measures to inform consumer decision making. ClimateWorks Australia and Rare Consulting (a division of pitt&sherry) collaborated to model the costs and benefits of various scenarios for emissions standards based on international best practice.

Our analysis shows that if Australia were to adopt new light vehicle emission standards up to the best practice passenger vehicle standards adopted in the EU, with a four year delay - 130 gCO₂/km in 2020, and 95 gCO₂/km in 2024, we could potentially achieve significant savings on emissions and fuel use.

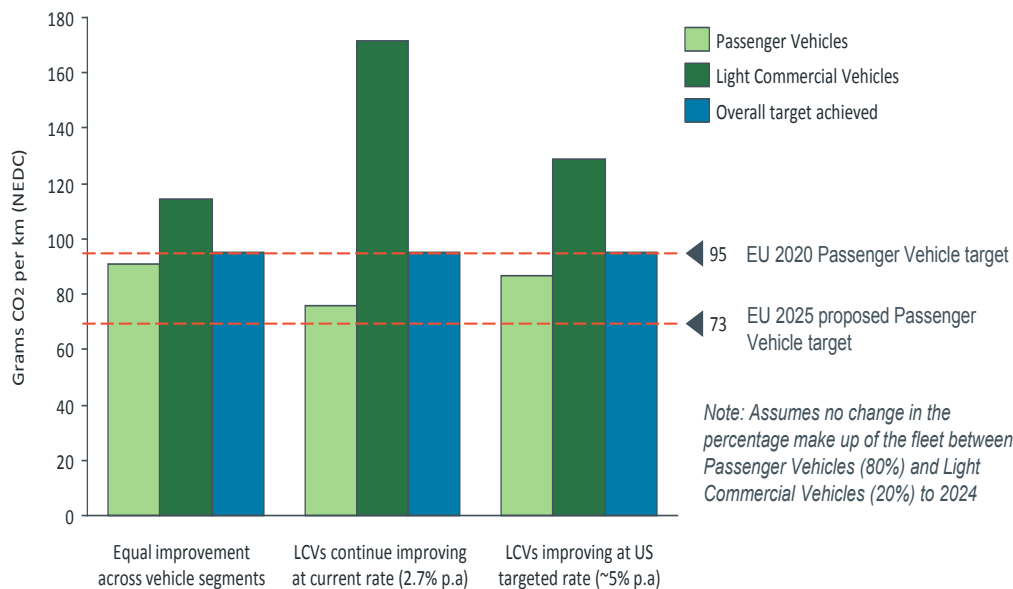
The degree of these savings will depend on the emission level targeted over and above BAU. Details on the appropriate target, whether they are combined for the entire fleet or separated based on vehicle

Exhibit 8 - Potential Australian light vehicle emission standard range compared to EU passenger vehicle targets



Source: Rare, 2013 and ClimateWorks analysis

Exhibit 9 – Breakdown of required performance of vehicle segments under Best Practice scenario in 2024



Source: Rare, 2013 and ClimateWorks analysis

segments (passenger and LCVs), and other such technical issues, should be worked through by Government with relevant industry and consumer groups to ensure an effective outcome that delivers the broadest benefits to the Australian economy and environment.

Achieving the targets up to those in the Best Practice Scenario, which covers both passenger vehicles and light commercial vehicles, is considered realistic because it acknowledges three important issues in relation to the difference between the Australian and other markets:

1. An easier starting point (low hanging fruit) in the Australian fleet;

2. The potential to adopt vehicle technologies that have already been developed and commercialised in other markets; and

3. The changing preferences of Australian buyers (adopting more small, diesel and European vehicles).

Overall, such a best practice scenario would require up to a 52% improvement in the performance of Australia's light vehicle fleet to 2024. Breaking the required performance of the passenger vehicle and light commercial vehicle segments of the fleet out under such a scenario reveals that there are a variety of ranges for improvement between these two segments out to 2024, as shown in Exhibit 9.

This analysis assumes the new vehicle fleet is comprised of a constant mix of passenger vehicles (80%) and LCVs (20%), based on today's current mix ratios.

As can be seen, if an equal rate of annual improvement is assumed across passenger vehicles and LCVs to achieve a target of 95 gCO₂/km by 2024, this would require passenger vehicles to average 91 gCO₂/km, and LCVs to average 114 gCO₂/km.

For passenger vehicles, this level is still well above the 73 gCO₂/km proposed for the EU in 2025, whilst for LCVs it is significantly below present day levels and may restrict the types of LCVs that can be offered, which is not desirable.

Alternatively, if LCVs were to continue to achieve their current 2.7% p.a. rate of improvement, this would mean that passenger vehicles would need to average 76 gCO₂/km by 2024, which is in line with the level targeted in the EU.

The final scenario shows that if LCVs were to improve at the rate targeted in the US (~5% p.a.), this would mean they achieve a 2024 level of 129 gCO₂/km, requiring passenger vehicles to average 87 gCO₂/km, still above the 73gCO₂/km targeted in the EU.

Being a technology taker and with a large proportion of our fleet sourced from markets with standards already in place, Australia can expect to achieve more rapid rates of improvement than markets such as the EU and US, and our Best Practice Scenario reflects this, delivering these benefits to Australian consumers in a realistic timeframe.

Best practice standards can deliver a range of economy-wide benefits

Our research found that emission standards can provide benefits to consumers and the broader economy by reducing emissions, providing financial savings for businesses and households, and increasing energy security.

However, there are also costs associated with implementing standards such as program administration, reduced taxation revenue through decreased fuel use, and additional upfront costs for more efficient vehicles.

The International Energy Agency estimates that within the EU, achieving a 50% improvement in fuel efficiency will cost in the range of \$2,500 per vehicle by 2020 in today's dollars, with costs decreasing further over time (IEA, 2012).

Other assessments estimate that the additional vehicle technology required to achieve the EU's 2020 target, compared to the average 2010 manufactured car, is approximately \$1,500-\$1,660 (€1,000-€1,100) (Ricardo-AEA, 2013).

In the EU and other leading markets, technological innovation and commercialisation is required in order to achieve new standards in these countries, and this has been factored into the \$2,500 additional cost estimate.

In the interests of taking a conservative approach to estimating potential financial benefits in our modelling, we have applied this cost to the implementation of our Best Practice Scenario in the Australian market in 2024 – even though we can expect that the actual costs will be lower, given that these technologies will be fully commercialised approximately four years prior to the time they are applied to the Australian market.



Emission Reductions - Best Practice Scenario vs BAU

- Reduce emissions by up to 4 Mt CO₂e in 2020, and up to 8.7 Mt CO₂e in 2024



Fuel Cost Savings in 2024 - Best Practice Scenario vs BAU

- Fuel savings of up to \$7.9 billion per year in 2024
- Fuel savings of up to \$852 per year off the average vehicle (14,000 km/yr) fuel bill in 2024, which would see drivers pay up to \$410 less for fuel than they pay today, and pay off the additional \$2,500 upfront cost in approximately 3 years
- Fuel savings of up to \$1,218 per year off an average fleet vehicle (~20,000 km/yr) fuel bill in 2024, which would see businesses pay up to \$585 less for fuel per vehicle than they pay today, and pay off the additional \$2,500 upfront cost in approximately 2 years



Increased Energy Security - Best Practice Scenario vs BAU

- Up to 3.7 billion litres of fuel saved per year by 2024
- Reduce demand for imported oil by up to 66 million barrels per year by 2024

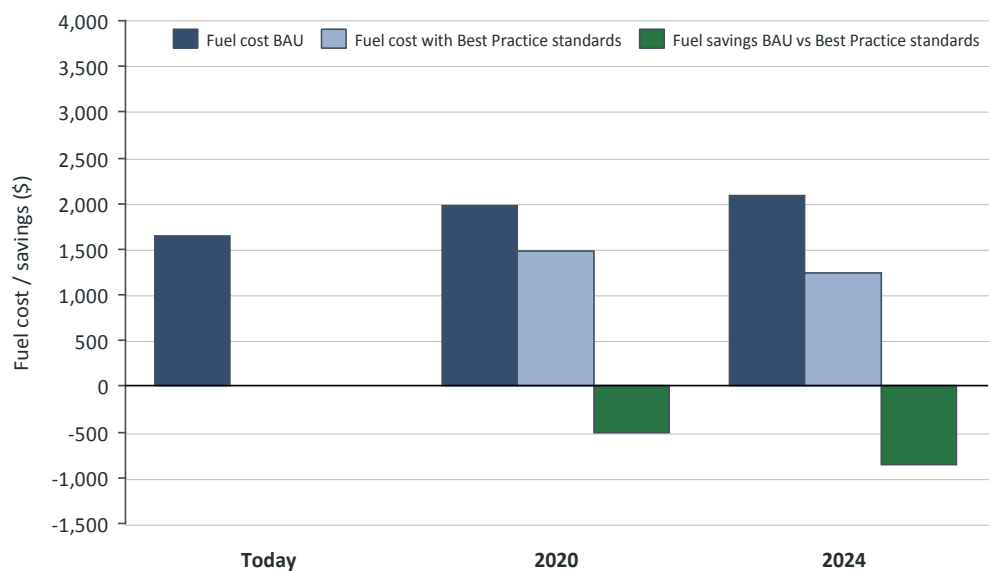
Further, a decline in the upfront cost of new vehicles over this period has not been factored in, even though new vehicle purchase costs have declined by 11% over the past decade, driven by an increase in the number of imported vehicles available in the market, and increased competitiveness (DIISRTE, 2011).

As shown in Exhibit 10, our analysis found that best practice efficiency gains can provide significant fuel cost savings to consumers compared to a BAU scenario. Under our Best Practice Scenario versus BAU, for a vehicle driving average kilometres (14,000 km/yr) (ABS, 2012), annual fuel savings of \$500 per year could be achieved in 2020, and over \$852¹ per year in 2024.

In 2020 a vehicle owner travelling average kilometres could be paying \$170 less per year for fuel than they do today, and as much as \$410 less per year for fuel in 2024, even driving the same distances and with increasing fuel prices.

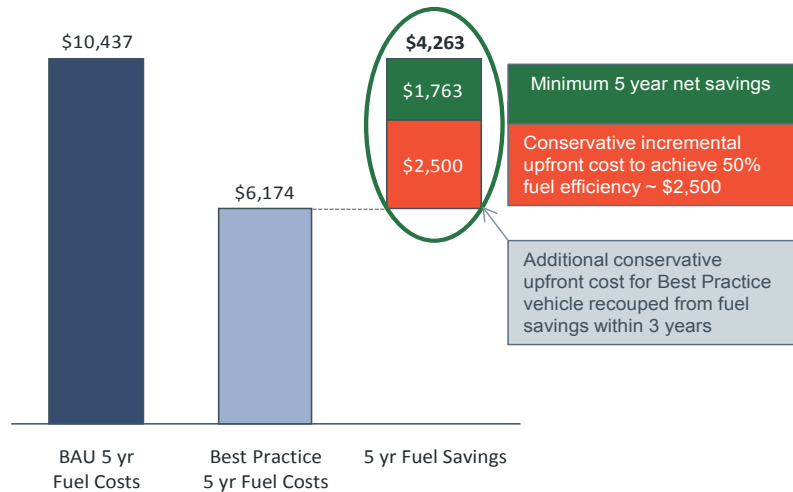
Exhibit 11 shows that for an average vehicle owner driving 14,000 km/yr fuel savings over the 5 year ownership period would total \$4,263, which means that even our conservative estimate of additional upfront costs would still be recouped within 3 years, well within the 10 year average age of a vehicle (ABS, 2013) and the 5 year average ownership period. This results in a minimum savings of \$1,763 over this 5 year period, or \$352 minimum net annual savings.

Exhibit 10 – Annual fuel costs and savings: Best Practice Scenario compared to BAU for an average vehicle (14,000km/yr)



Source: Rare, 2013 and ClimateWorks analysis

Exhibit 11 – 5 year fuel costs and savings: Best Practice Scenario compared to BAU for an average vehicle (14,000km/yr)



Source: Rare, 2013 and ClimateWorks analysis

¹ Assumes fuel price of \$2.10/litre in 2024

As shown in Exhibit 12, the fuel savings could be even greater for fleet owners with higher annual kilometres (for example 20,000 km/yr), with fuel savings of over \$710 per year in 2020 and \$1,218¹ in 2024 compared with BAU.

Exhibit 13 shows that for a fleet vehicle owner driving 20,000 km/yr fuel savings over the 3 year ownership period would total \$3,654, which means that even our conservative estimate of additional upfront costs would still be recouped within 2 years, within the 3 year average ownership period.

This results in a minimum savings of \$1,154 over this 3 year period, or \$384 minimum net annual savings.

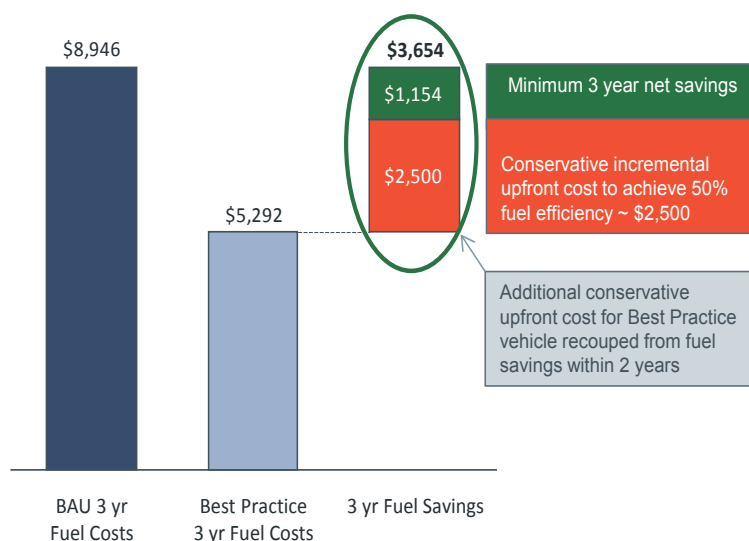
Given that upfront costs could be significantly less than the \$2,500 conservative estimate adopted, due to the 4 year lag in adoption of technologies from overseas markets and the trend in decreasing costs for vehicles, it is expected that savings would be greater over both the ownership periods analysed above than the minimum presented.

Exhibit 12 – Annual fuel costs and savings: Best Practice Scenario compared to BAU for a fleet vehicle (20,000km/yr)



Source: Rare, 2013 and ClimateWorks analysis

Exhibit 13 – 3 year fuel costs and savings: Best Practice Scenario compared to BAU for a fleet vehicle (20,000km/yr)



Source: Rare, 2013 and ClimateWorks analysis

With best practice standards in place, in 2024 average drivers could recoup the additional upfront costs within 3 years, and be paying 25% less per year for fuel than they do today, even in the face of increasing fuel prices

Comparing these savings to projected average household electricity bills in 2020, our analysis shows that with best practice standards, the fuel savings achieved for an average driver (14,000 km/yr) could offset one third of the average household electricity bill².

This shows that there are significant financial savings available that can help relieve cost of living pressures for Australian consumers, and also increase business competitiveness.

Assuming a 2% growth in new vehicle sales, the additional upfront costs of new vehicles purchased in 2024 will total approximately \$3.2 billion. This is in comparison to the potential annual fuel savings of over \$1 billion for these vehicles, showing again that economy wide this upfront investment could be paid off from fuel savings in less than 3 years.

Our analysis shows that avoided fuel use (which will ultimately depend on the fuel mix), could total around 3.7 billion litres of fuel (worth \$7.9 billion) every year by 2024 from implementation of these best practice standards.

Given the short pay back period on these efficiency upgrades, and as fuel prices continue to rise, without best practice vehicle emissions standards in place, Australian light vehicle owners will continue to spend substantially more on fuel than they could be, adding to cost of living pressures.

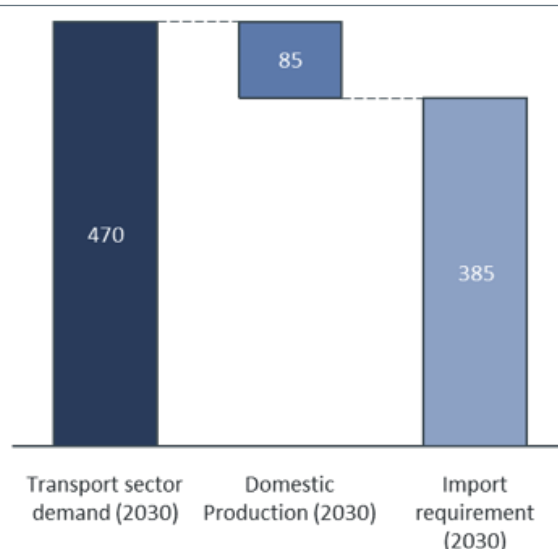
There are several key risks that Australia faces if it does not take advantage of this opportunity

Energy security

Australia's oil self-sufficiency has been declining rapidly over the past decade and is expected to continue to decline over the next 20 years, increasing reliance on imported oil for transport fuels.

Projections suggest that Australia's annual demand for transport energy could rise by as much as 35% by 2030 to 470 million barrels of oil equivalent (ACIL Tasman, 2008). This prediction coincides with a projected fall in Australian crude oil production to less than 85 million barrels of oil equivalent by 2030, as seen in Exhibit 14.

Exhibit 14 – Transport sector oil demand compared to supply (millions barrels oil equivalent)



Source: ACIL Tasman, 2008, ACIL Tasman et al 2009

As vehicle ownership in emerging economies continues to explode over the next decade and beyond, this will have implications for the cost and availability of transport fuels in the global market, and for Australia's ongoing energy security.

However by 2024, the impact of best practice emissions standards could reduce oil imports by between 40 and 66 million barrels per annum, equivalent to between 30-50% of Australia's 2012 domestic demand for automotive fuels (BREE, 2012).

Lock-in of higher levels of emissions

The average age of vehicles on Australian roads is 10 years (ABS, 2013), which is higher than the global average. Exhibit 15 shows that in 2024, 30% of all cars and light commercial vehicle kilometres will be from vehicles built prior to 2014. As a result, new vehicles

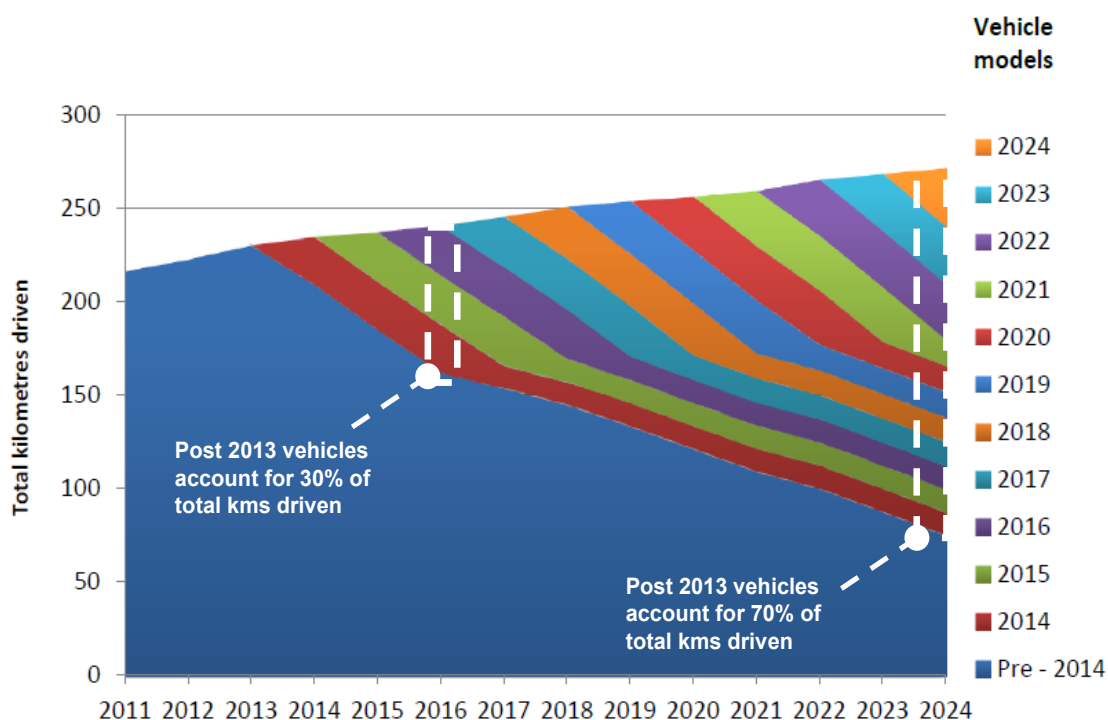
² 2020 annual household electricity costs of \$1,416 based on an average household demand of 5.9MWh (ClimateWorks team analysis) and forecast retail electricity price of \$240/MWh (SKM MMA 2012)

introduced after 2013 would account for over 30% of all kilometres driven by 2016 and over 70% in 2024.

This means that any delay in improving vehicle emissions standards will lead to a level of emissions lock-in – where a larger proportion of vehicles on our roads will be less efficient than they would be with standards in place – reducing the potential by which vehicle emission standards can contribute to Australia’s 2020 emission reduction target.

By setting a 2020 target, this will encourage the gradual improvement (beyond BAU) of average fleet emissions in the lead up to 2020, as demonstrated in international markets which have implemented standards. As the lowest cost opportunity to reduce emissions available in Australia, missing this potential would increase the cost of ‘catching up’ through other emissions reduction opportunities in the future.

Exhibit 15 - Proportion of new light vehicles by total vehicle kilometres driven (2011-2024)



Source: Rare, 2013

The technology already exists to achieve significant efficiency improvements in the vehicles we drive

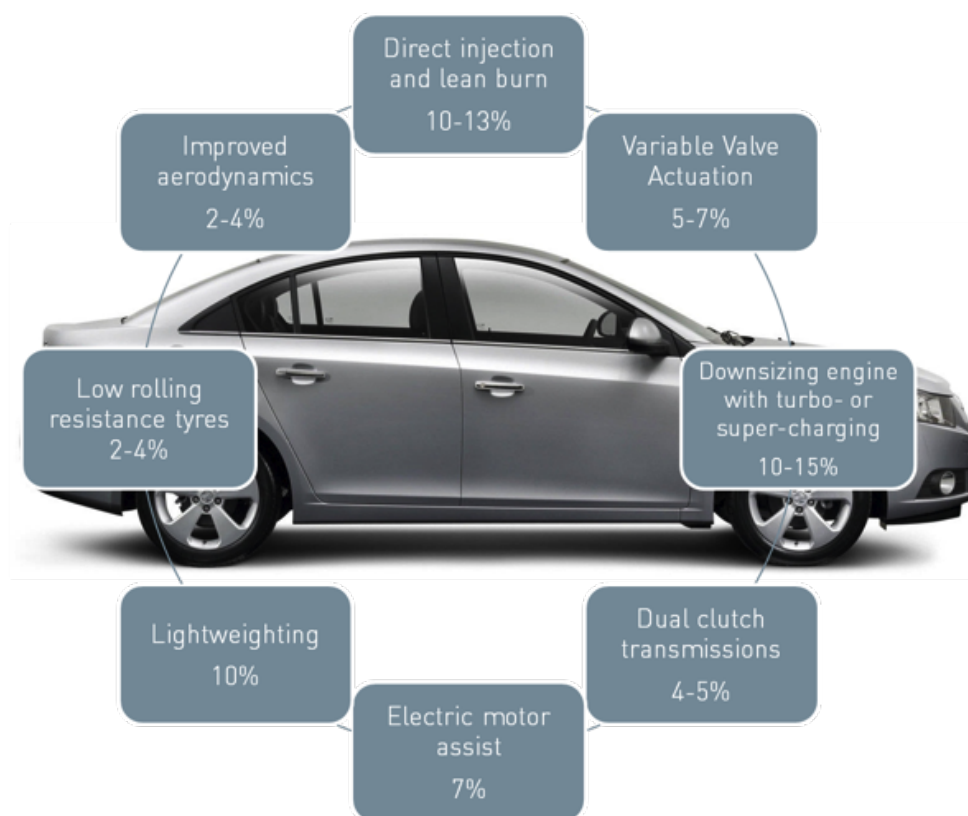
There are a range of current and emerging technologies that can be, and some which already have been, implemented to improve vehicle efficiency. The majority of these technologies have been developed in response to existing and forthcoming legislative requirements in international markets.

For Australia, this means that we can adopt these technologies at lower cost and faster rates, and importers can sell more efficient vehicles into our market that they already manufacture for other markets. In many cases, less efficient versions of these cars are already sold in Australia.

In addition to technology improvements to traditional internal combustion engines, savings could also be achieved through a range of alternative fuels (e.g. biofuels) and technologies (e.g. electric or hybrid vehicles) that can also reduce emissions from the light vehicle sector.

Widespread penetration of these fuels and technologies will depend on a variety of factors, including the time required to optimise production scales, build fleet operator confidence, and cost.

Exhibit 16 – Available technology to improve vehicle emissions



Source: DIT, 2011

A range of complementary measures are available to improve light vehicle fuel efficiency

Overseas experience shows that, while mandatory fuel efficiency standards are key to achieving emissions reductions in passenger and light commercial vehicles, they can be enhanced with a range of complementary measures.

These may include information measures and incentives to build consumer awareness and drive demand and other measures to minimise the 'rebound effect'. The 'rebound effect' refers to the phenomenon where energy savings from increased efficiency can result in rebounding energy consumption.

For the transport sector, the rebound effect comes into play where savings from reduced fuel consumption are utilised to travel additional kilometres.

Complementary measures are required in addition to standards to ensure that the rebound effect can be minimised if not eliminated. In particular, economic signals that provide clear financial incentives to vehicle owners have been found to work in international markets (ICCT, 2012). These include road access pricing and fuel and vehicle fees.

All countries that have enacted standards have supported them with complementary measures. A range of example complementary measures are discussed below.

Table 1 - Range and examples of complementary measures introduced in other countries

Complementary Measure	Example
Consumer education Labelling, promoting eco-driving, low emissions vehicle demonstrations, car share etc.	The UK Fuel Economy Label shows car buyers the running costs and fuel efficiency of new cars, clearly demonstrating that choosing a car with lower CO ₂ emissions means lower running costs (UKLCVP, 2013).
Fuel Quality A review of Australian fuel quality standards with a view to mandating fuels compatible with the Euro 5/6 emissions standards.	Australia may require a tightening of petrol standards as many European vehicles require 10 ppm sulphur content to meet air quality standards. Without harmonisation of fuel quality standards there may be some impediment for importing fuel-efficient vehicles or transferring engine technology. Further investigation is required.
Road access pricing Users charged based on distance travelled on certain roadways to reduce the number of 'low value' kilometers driven.	Congestion plays a significant role in increasing vehicle carbon emissions, while also contributing to health costs. Road access pricing strategies could significantly reduce (or even eliminate) congestion on urban freeways (and reduce congestion elsewhere), which would provide an additional benefit in reducing vehicle carbon emissions. Such measures have been implemented in Singapore and in parts of the EU and US, at the city and national scale.
Fuel and vehicle fees Fees encourage consumers to buy the most efficient models available and drive automakers to go beyond compliance of the minimum mandated levels. Alone they do not guarantee improvement, and consumers can discount fuel savings when purchasing a vehicle. 'Feebates', which combine fees on high-emitting vehicles with rebates for buyers of low-emissions vehicles, can address this market failure (ICCT, 2012)	Annual registration fees based on CO ₂ emissions have been adopted in France, Germany and the UK. The US has had a 'gas-guzzler' tax on cars with a fuel economy rating below 22.5 mpg (280 gCO ₂ /km) since 1991. Research has found that these fuel fees have significantly more impact on fuel economy than purchase-registration fees (ICCT, 2012) The UK has found that progressive CO ₂ taxation of company cars has been very powerful in driving consumer choice (UKLCVP, 2013) Linking fuel and vehicle fees to emissions rather than attributes such as weight allows for application across a range of technologies (ICCT, 2012)

Appendix 1 – Elements of best practice standard design

Element	Suggested design for discussion
Coverage of standards	There are pros and cons of having a single standard for all light vehicles versus separate standards for passenger cars and light commercial vehicles. A single standard allows manufacturers more flexibility in meeting targets by changing their model mix, it avoids the complexity of separate standards, and minimises leakage of passenger models into a less stringent light commercial vehicle standard. This approach may advantage manufacturers who only sell passenger cars, but this bias could be offset through the application of attribute weightings (e.g. mass, footprint).
Attribute based targets	Vehicle footprint (size) is the preferred attribute for its greater fairness and its recognition of light weighting opportunities as opposed to vehicle mass (weight) which may unintentionally incentivise a shift to larger vehicles.
Test cycle	New vehicles are tested in laboratory conditions using a representative test cycle that aims to simulate real-world driving. Different countries use different cycles. It is suggested that the New European Driving Cycle should continue to be used as the fuel consumption test drive cycle. This test cycle is also supported by key countries where many of Australia's new vehicles originate (e.g. European Union and China).
Banking	Permitting the transfer of credits between years encourages early effort and allows manufacturers to meet their targets if their sales mix does not meet the target (due to consumer preferences).
Trading	Transfer between manufacturers of large brands enables advanced technologies to be provided by the manufacturer with least cost (e.g. Toyota hybrid drivetrain development).
Super credits	Multiplication factors for electric vehicles and alternative fuels are not recommended beyond a short transition period because these can undermine the total emissions benefit achievable. They may also unnaturally favour more expensive technologies and increase the cost of meeting standards.
Penalties	Penalties should be high enough so that manufacturers invest in improving fuel economy rather than pay a fine, but reasonable enough to not make the Australian market an unattractive place to sell vehicles.
Target setting	At least a 10-year outlook is necessary. This is consistent with longer term targets established in other markets (United States) and provides a lead time for model planning and technology transfer.
Eco-innovations	These are non-engine technologies that can still contribute to fuel savings (e.g. low-resistance tyres, gear shift messages). Their effect can be difficult to measure and can have a higher administrative cost. It may be better to support case studies that show the impact of additional fuel saving features to encourage purchase of vehicles that adopt these technologies.
Exemptions for low volumes	In the European Union, manufacturers registering fewer than 22,000 new vehicles a year can apply for an exemption. A lower threshold is required for Australia because the European threshold would exempt all but the top 15 car brands in Australia.

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Glossary

BAU	Business as usual
CAFE	Corporate Average Fuel Economy
EU	European Union
ICCT	International Council on Clean Transportation
LCV	Light Commercial Vehicle
NEDC	New European Driving Cycle
SUV	Sports utility vehicle
US	United States of America

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ClimateWorks Australia is an independent non-profit organisation whose mission is to facilitate substantial emissions reductions in the next five years in Australia by working with government, business, industry groups and the community via a collaborative research and action-based approach.

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