Australian Government

Department of Infrastructure, Transport, Regional Development and Communications

Light Vehicle Emission Standards for Cleaner Air

Draft Regulation Impact Statement

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Acronyms and abbreviations

ABS	Australian Bureau of Statistics
ADR	Australian Design Rule
ANCAP	Australasian New Car Assessment Program
BCR	Benefit-cost ratio
BITRE	Bureau of Infrastructure, Transport and Regional Economics
CO	Carbon monoxide
CO_2	Carbon dioxide
Department	Department of Infrastructure, Transport, Regional Development and Communications
EU	European Union
Euro NCAP	European New Car Assessment Program
FCAI	Federal Chamber of Automotive Industries
GDI	Gasoline (Petrol) Direct Injection
Global NCAP	Global New Car Assessment Program
GRPE	UN Working Party on Pollution and Energy
GVM	Gross vehicle mass
HC	Hydrocarbons
ICCT	International Council on Clean Transportation
MVEm	Motor Vehicle Emission suite
NEPM	National Environment Protection (Ambient Air Quality) Measure
NCAA	National Clean Air Agreement
NCAP	New Car Assessment Program
NOx	Nitrogen oxides
OBPR	Office of Best Practice Regulation
PM	Particulate matter
$PM_{2.5}$	Particulate matter 2.5 micrometres or less in diameter
PM_{10}	Particulate matter 10 micrometres or less in diameter
ppm	Parts per million
PULP	Premium unleaded petrol
RDE	Real Driving Emissions

RIS	Regulation Impact Statement
RVSA	*Road Vehicle Standards Act 2018*
SUV	Sports Utility Vehicle
SVSEG	Strategic Vehicle Safety and Environment Group
ULP	Unleaded petrol
UN	United Nations
US EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres travelled
VOC	Volatile organic compound
WLTP	Worldwide harmonized Light vehicle Test Procedure
WP.29	United Nations World Forum for the Harmonization of Vehicle Regulations
WTO	World Trade Organisation

Executive summary

Australia currently mandates the Euro 5 noxious emissions standards for newly approved models first manufactured from 1 November 2013, and for all light vehicles manufactured from 1 November 2016. This Early Assessment Regulation Impact Statement (draft RIS) evaluates whether the Australian Government should mandate more stringent standards to reduce noxious emissions from light road vehicles.

After analysing several options, this draft RIS has found that there were significant benefits for the Australian community by mandating the latest noxious emissions standards for light vehicles, known as Euro 6, under the *Road Vehicle Standards Act 2018*[a] (RVSA). These benefits would not otherwise be realised under the existing Euro 5 noxious emissions standards currently mandated by Australia. They would also not be realised from implementing other non-regulatory options such as introducing alternative Government fleet purchasing policies or industry introducing its own, more stringent, voluntary standards.

Our analysis of mandating the Euro 6 standard for light vehicles in Australia was based on introducing the Euro 6d requirements, as this stage will have the greatest health benefits when compared with the earlier stages of Euro 6. We also assumed that, if Australia was to mandate Euro 6d, it would do so from 1 July 2027 for new light vehicle models and from 1 July 2028 for all new light vehicles, to align with the transition to better quality petrol announced by the Government on 25 February 2019.

If Euro 6d was mandated for all newly approved models manufactured from 1 July 2027 and for all new vehicles manufactured from 1 July 2028, the benefit-cost analysis suggested that its adoption would result in avoided health costs of $6.4 billion and increased capital costs to manufacturers of $1.1 billion over the period to 2050. The net benefits over this same period are estimated to be $5.3 billion and a benefit-cost ratio of 5.79.

As diesel fuel quality in Australia is already of a high standard and can support Euro 6 vehicles, the department seeks further stakeholder feedback on whether the proposed timeframe for the introduction of Euro 6 for light diesel vehicles should remain aligned with petrol vehicles or if it should be implemented sooner. The department also seeks feedback on whether Euro 6b should be adopted as an interim step for light petrol vehicles before mandating Euro 6d from 1 July 2027. If there is a strong justification for doing so, the department will consider modelling the costs and benefits of alternative implementation timeframes in the final RIS, before a decision is made by the Government.

Consultation

The draft RIS is being released for further targeted consultation with key stakeholders. It does not represent a Government decision nor formal Government policy.

The Department of Infrastructure, Transport, Regional Development and Communications (the department) is separately progressing a draft RIS to consider the case for mandating more stringent Euro VI emission standards for heavy vehicles in Australia.

Comments on this draft RIS are requested by 26 February 2021 and should be submitted by email as a separate Word or PDF document to vemissions@infrastructure.gov.au.

a Set to replace the Motor Vehicle Standards Act 1989 by 1 July 2021.

What is the problem?

An estimated 620 Australians died because of transport-related air pollution in Australia in 2015, which cost our economy approximately $9.2 billion[1]. This is equivalent to over half the national road toll from accidents that year. Noxious emissions from road vehicles are a particularly harmful source of pollution as people generally have a higher level of exposure to these than most other sources[2].

To mitigate this, Australia has had noxious emissions standards in place for light petrol vehicles since the early 1970s and light diesel vehicles since the mid-1990s. Australia currently mandates the Euro 5 noxious emissions standards for newly approved models first manufactured from 1 November 2013, and for all light vehicles manufactured from 1 November 2016.

While Euro 5 has, and is continuing to, reduce noxious emissions from new light vehicles entering the Australian fleet, many other countries have introduced increasingly stringent vehicle emissions standards. The more stringent Euro 6 emissions standards for light vehicles commenced in the European Union (EU) from September 2014. Equivalent standards already apply in most other developed countries including the United States (US), China and Japan.

The key changes under Euro 6 when compared to Euro 5 are:

- a 55 per cent reduction in the emission limits for oxides of nitrogen (NOx) for light diesel vehicles;
- a particle number limit to reduce fine particle emissions from direct injection petrol vehicles; and
- tighter thresholds for on-board diagnostic systems that monitor the performance of emission control systems.

The latest stage of the Euro 6 standards, known as 'Euro 6d', which is being progressively implemented in the EU, introduces further changes to improve the integrity of the vehicle testing regime. A key change is the replacement of the current drive cycle testing regime with the new Worldwide harmonised Light vehicle Test Procedure (WLTP) along with the introduction of an on-road Real Driving Emissions (RDE) test.

In combination with the introduction of other more stringent safety and emissions standards, this has forced vehicle manufacturers to develop new engine technologies that are increasingly being fitted as standard to light vehicles across the global market.

This raises the question of whether, and when, Australia should adopt more stringent noxious emissions standards. This is not only to achieve a reduction in transport-related air pollution but to make sure that the Australian vehicle market keeps pace with technological developments in other countries.

Emission standards in the global vehicle market

Noxious emissions from light passenger and commercial vehicles are currently regulated through the Australian Design Rules (ADRs). These are the national standards for road vehicles made under the *Road Vehicle Standards Act 2018*. All new road vehicles in Australia, whether they are manufactured locally or imported from overseas, are required to comply with the ADRs before they can be supplied to the market for use in transport. The ADRs set minimum requirements for vehicle safety, environmental performance and anti-theft protection.

When developing national vehicle standards, the Australian Government has committed to adopting the United Nations (UN) regulations where possible. Harmonisation with the UN regulations facilitates international trade and minimises compliance costs, while ensuring a high level of safety and environmental performance. The current UN regulation for light vehicle noxious emissions adopts 'Euro 6b' as its minimum. An updated UN Regulation based on the final stage of Euro 6 adopted in the EU, known as 'Euro 6d', is expected to take effect from 2021.

Over 95 million new light vehicles were sold globally in 2018 and approximately 17.7 million of these were in right hand drive markets such as Australia[3]. Around 1.1 million new cars are sold in Australia each year across approximately 60 light vehicle brands and over 400 models. This makes Australia one of the most open, competitive and deregulated car markets in the world. It is also means that, for vehicle manufacturers, the Australian market has lower profit margins than many others.

The globalisation of the motor vehicle industry and the relatively small size of the vehicle market in Australia (1.2 per cent of global new vehicle sales) makes the development of unique Australian standards, and the manufacture of cars tailored specifically for our market, undesirable. This is not just from a regulatory perspective but because, as outlined below, it has the potential to affect consumer choice. This is particularly relevant now there is no longer any significant domestic light vehicle manufacturing in Australia.

Globally, manufacturers are being required to develop vehicles and engine technologies that can meet increasingly stringent vehicle emissions standards. This includes turbocharged petrol engines with advanced direct injection fuelling systems, catalytic converters, particle filters and electrified powertrains. Euro 6 or equivalent noxious emissions standards have been adopted in the US, Canada, the EU, United Kingdom, Japan, China, Korea and India. These countries, which account for over 80 per cent of global new vehicle sales and supply the majority of passenger vehicles sold in Australia, also require manufacturers to meet fuel efficiency standards. This means that the latest vehicles models meeting the Euro 6 are likely to be cleaner and more fuel efficient than equivalent Euro 5 models currently available in Australia.

As manufacturers focus on developing vehicles for deployment in markets that have increasingly stringent standards, there is a significant risk that the range of vehicles that can be allocated to the Australian market will be affected. Manufacturers have already expressed concerns that our vehicle emissions standards are making it increasingly difficult to convince their global parent companies that next generation engine technologies, such as hybrids and plug-in hybrids or vehicles fitted with advanced driver-assistance systems (ADAS) and intelligent transport systems (ITS), should be allocated to the Australian market. This risk will increase in time.

There is also a technical barrier that is increasingly affecting the range of vehicles that can be allocated to our market - the quality of petrol in Australia. The composition of fuels can directly affect the level of noxious emissions and greenhouse gas emissions from road vehicles. The current regulated limit for sulfur in petrol in Australia is 150 parts per million (ppm) for 'regular' unleaded petrol (91RON) and 50 ppm for 'premium' unleaded petrol (95RON or 98RON). By comparison, sulfur in petrol in the EU, China and the US is limited to 10 ppm. The current regulated limit for aromatics in petrol in Australia is 45 per cent (by volume). Most other countries that regulate this parameter set a 35 per cent limit. Australia is the lowest ranked of the 36 OECD member countries based on regulated sulfur content, and equal lowest, with New Zealand, based on regulated aromatics content[4].

Many manufacturers specify that the quality of petrol in Australia must be improved (lowering sulfur and aromatics limits) before they can be expected to meet more stringent emissions standards such as

Euro 6. This is to avoid vehicle operability issues for consumers[5] as high sulfur levels can contaminate catalytic converters in vehicles, limiting their ability to convert noxious emissions into less harmful substances. Due to the effect of sulfur on emission control systems, high-sulfur fuels also restrict access to some new engine and emission control technologies that need lower sulfur fuel to operate effectively. This includes some hybrid and plug-in hybrid engines. A high content of aromatic substances (benzene and its derivatives) in petrol can form combustion chamber deposits in engines and increase particulate and other carcinogenic emissions from vehicles. Lowering aromatics would improve engine operability, and reduce noxious exhaust emissions. Diesel in Australia is already of a high standard (with a sulfur limit of 10 ppm) and can support Euro 6 vehicles.

The Euro 6 noxious emissions standards have been progressively introduced in the EU through increasingly stringent stages. While many Euro 6 light petrol vehicles are currently on sale in Australia, most of these meet an earlier stage of the Euro 6 standard known as 'Euro 6b'. They are often premium or high performance models, and, often require 'premium' unleaded petrol (95RON or 98RON). But manufacturers are now developing vehicles fitted with updated emissions reduction and fuel saving technologies to meet the final stage of Euro 6, known as 'Euro 6d', as well as increasingly stringent fuel efficiency standards in these markets.

Euro 6d first commenced in the EU from September 2017 and introduced more stringent requirements for fine particle emissions from direct injection petrol vehicles and improvements to the integrity of the testing regime of vehicles. The requirements of the final iteration of the Euro 6d[b] standard requires the majority of direct injection petrol vehicles to fit a petrol particulate filter. Petrol particulate filters often cannot be used with even 'premium' unleaded petrols (95RON or 98RON) that are available in Australia, and typically require higher quality fuel that is equivalent to that available in the EU, China and the US. Very few manufacturers have publicly stated that the petrol particulate filters fitted to their vehicles can accommodate the current quality of any fuel available on the Australian market.

Many vehicle manufacturers have indicated that they are reluctant to invest in significant research and development on engine platforms that were designed to meet older emissions standards such as Euro 5 or to design light petrol vehicles that are compatible with Australian fuel standards. It can take 12-18 months to conduct specific durability testing on a vehicle to make sure it is compatible with the quality of fuel available in the Australian market. This is not commercially viable for model variants that are only likely to sell in low volumes (typically less than 500 units per year).

As manufacturers will often only allocate the most cost effective vehicle to a market, and given that over 60 per cent of vehicle models sell less than 1,000 units per year in Australia, manufacturers may choose to withdraw vehicle models and variants from the market rather than add new safety, connected or autonomous systems on to older technology platforms. This is especially true of price sensitive segments in the market, typically smaller, cheaper vehicles, or with more specialised models and variants. There are early indications that some of these models are already being phased out or scaled back.

Vehicle manufacturers will also incrementally develop and optimise new engine platforms over a period of time. If at any stage in the development process those newer engine platforms cannot be offered in Australia, due to the quality of Australian fuel or other factors, then they will revert to offering vehicles fitted with an older generation engine platform instead. Data from the Green Vehicle Guide suggests that many new vehicle models released in Australia are less efficient when compared

[b] Euro 6d-Temp commenced in the EU in September 2017. Full Euro 6d commenced in the EU in January 2020.

to a previous generation of the same model. For example, a previous generation of one vehicle model sold in the Australian market was fitted with an idle stop-start system, the current model offered by the manufacturer is not. Because of this, Australians risk foregoing the fuel efficiency and emissions reduction benefits offered by newer engine platforms.

To address these concerns, the Australian Government announced changes to the petrol quality standards in 2019 to align with international practice. This set limits of 10 ppm for sulfur for all petrol grades from 2027, and set a pool average of 35 per cent aromatics (down from 42 per cent currently) for all petrol grades from 2022. The Australian Government further agreed to a review of aromatics by 2022 to allow for a full assessment of the case for a 35 per cent limit and to examine alternative solutions to be in place by 2027.

The new fuel quality standards being phased in from 2019 to 2027 will increase vehicle choice for motorists and maintain our air quality while giving Australia's refineries the necessary lead time for scheduled refinery upgrades. This lead time is also important to provide refineries with certainty for major investment decisions and allows them to plan workplace arrangements.

But changes to fuel quality standards alone, while removing a significant technical barrier to the introduction of the latest petrol engine technologies from 2027, will not guarantee that manufacturers will choose to supply them to the Australian market. Without corresponding changes to our noxious emissions standards, large numbers of Euro 5 vehicles are still likely to be allocated to the Australian market by manufacturers for commercial reasons. For example, New Zealand, which also mandates the Euro 5 standard and is a small vehicle market that imports all of its vehicles, has regulated a sulfur limit of 10 ppm in its petrol since 2018. But there are still no significant differences between the Euro 5 and Euro 6 vehicle models or variants offered in New Zealand when compared to Australia.

This is because, due to the emissions reduction and fuel saving technologies fitted to them, Euro 6 vehicles cost more to produce than their Euro 5 equivalents. Catalytic converters and particulate filters incur additional capital costs for manufacturers (as outlined later in this draft RIS). If it is cost effective for a manufacturer to avoid fitting them to a vehicle, then they will not. Where it is unavoidable, because that manufacturer has transitioned all of its global production lines to newer engine platforms, then that manufacturer will be placed at a competitive disadvantage against other manufacturers that continue to produce Euro 5 vehicles.

In the premium and high performance segments of the market, with higher margins and less price sensitivity, these costs can be absorbed and it is likely that Euro 6 models will be introduced in increasing numbers in the Australian market from 2027. But again in more cost sensitive segments it may not be commercially viable to introduce Euro 6 models in direct competition to Euro 5 vehicles. This is currently the case in the light commercial vehicle segment in Australia. Over 93 per cent of new light commercial vehicles that entered the Australian fleet in 2019 were diesel vehicles. Of all the available utility vehicles in the Australian market, which accounted for 89 per cent of light commercial vehicle sales, only one model has offered a Euro 6 option, despite diesel fuel having a sulfur limit of 10ppm since 2009.

The risk is that once the UN Regulations for Euro 6d take effect and other countries that currently support Euro 5 (such as Thailand[6]) adopt more stringent standards, the size of the market for vehicles using older emissions technologies will reduce. If international emissions standards are tightened further as predicted in the mid-2020s, very few manufacturers will continue to develop technologies specifically for the Australian market. The further Australian standards diverge from UN regulations

and those prevalent across the global vehicle market, the harder it will be to attract new models and variants of vehicles.

Air quality in Australia's urban environment

The issue of air quality and air pollution has gained national and international prominence recently due to the bushfire smoke that blanketed many parts of South Eastern Australia. But every day, noxious emissions from road vehicles, such as particulate matter (PM), oxides of nitrogen (NOx), volatile organic compounds (VOC) and carbon monoxide (CO), are a major source of air pollution.

The health effects of exposure to air pollution include reduced lung function, ischemic heart disease, stroke, respiratory illnesses and cancer[7]. Individuals with pre-existing respiratory conditions, such as asthma and allergies, are especially vulnerable. Children are susceptible to a range of additional effects, low birth weight[8], long-term effects on lung function[9], childhood leukaemia[10,11], and childhood brain tumours[12].

Living close to major roads and highways increases your risk of dying early[13] and has been linked to a higher incidence of dementia in the elderly[14]. High levels of benzene, a known carcinogen, have been discovered near major roads, particularly when traffic is congested[15].

The two main air pollutants of greatest concern to health experts are fine particles[c], commonly referred to as $PM_{2.5}$, and ground-level ozone. Noxious emissions produced by road vehicles are a significant contributor to both, particularly in major cities.

Scientific evidence links long term exposure to $PM_{2.5}$ with ischemic heart disease, cerebrovascular disease (ischemic stroke and haemorrhagic stroke), lung cancer, chronic obstructive pulmonary disease (COPD), and lower-respiratory infections, in particular, pneumonia. There is also mounting evidence that $PM_{2.5}$ exposure can contribute to the incidence of Type 2 diabetes[16]. A study into the public risk of exposure to air pollutants from 2013 found that long-term population exposure to $PM_{2.5}$ alone was attributable to nine per cent of all deaths from ischemic heart disease in Australia's four largest cities[17].

Health experts agree that there is no safe level of exposure to particulates and that any reduction in particle concentrations would improve population health outcomes[18,19,20,21]. In June 2012, the International Agency for Research on Cancer, in the World Health Organisation, declared that diesel exhaust is a 'known carcinogen' with a special emphasis on particulate emissions produced by diesel engines[22]. The same report also declared that PM itself is a carcinogenic substance.

Ozone is a secondary pollutant formed from chemical reactions of NOx emissions with VOCs in hot and sunny weather conditions. Short-term health effects attributed to ozone include the irritation of the eyes and airways, exacerbation of asthma symptoms in susceptible people, increased susceptibility to infection, and acute respiratory symptoms such as coughing. Long-term exposure is associated with COPD[23]. As with particulates, there is no safe threshold for exposure to ozone and individuals can experience adverse health effects even when exposed to very low concentrations[24].

The impact of noxious vehicle emissions will get worse over time. More and more Australians are being exposed to them as our population grows and our population density and vehicle use increases, particularly in our major cities.

c Airborne particulate matter measuring less than 2.5 micrometres in aerodynamic diameter.

While Australia generally has good air quality by global standards, many areas of Australia experience periods of poor air quality. Some pollutants, particularly ground level ozone and PM, occasionally exceed the air quality standards agreed by governments[d], especially in urban areas with high volumes of traffic. Since 2006, the air quality index in most major urban regions of Australia[e] has improved on average. However of these regions, the air quality index in the Sydney, Illawarra, Lower Hunter, Melbourne and South East Queensland regions have all deteriorated since 2011[25].

Our growing population is contributing to higher levels of ambient air pollution in Australian cities. Almost 71 per cent of Australians now live in a major city, with another 18 per cent living in inner regional areas[26]. Increased urbanisation is also a factor. In 2017, 17.7 million Australians lived in a major city, compared to 14.6 million in 2007. This is projected to increase to over 21 million by 2027[27]. Over 80 per cent of Australia's population growth over the period to 2027 is expected to occur in major cities.

An ageing population that is more susceptible to the health impacts of air pollutants is exacerbating this problem. The proportion of the Australian population aged over 65 is expected to more than double over the next 40 years[28]. This may lead to, as seen in Japan, an increase in the mortality rate attributed to air pollution despite reductions in ambient air pollution[29].

While our average level of exposure to $PM_{2.5}$ is declining, in part due to reductions in exhaust emissions from new road vehicles, our exposure to ozone is increasing. Furthermore, although our average level of exposure to ozone is lower than many other developed countries, our exposure to ozone is increasing at a faster rate than many other developed countries, most of which have adopted more stringent noxious emission standards[30].

[d] Ozone and PM are included in the National Environment Protection (Ambient Air Quality) Measure standards set by National Environment Protection Council under the National Environment Protection Council Act 1994 and complementary state and territory legislation.

[e] Sydney, Illawarra, Lower Hunter, Melbourne, South East Queensland, Adelaide and Perth.

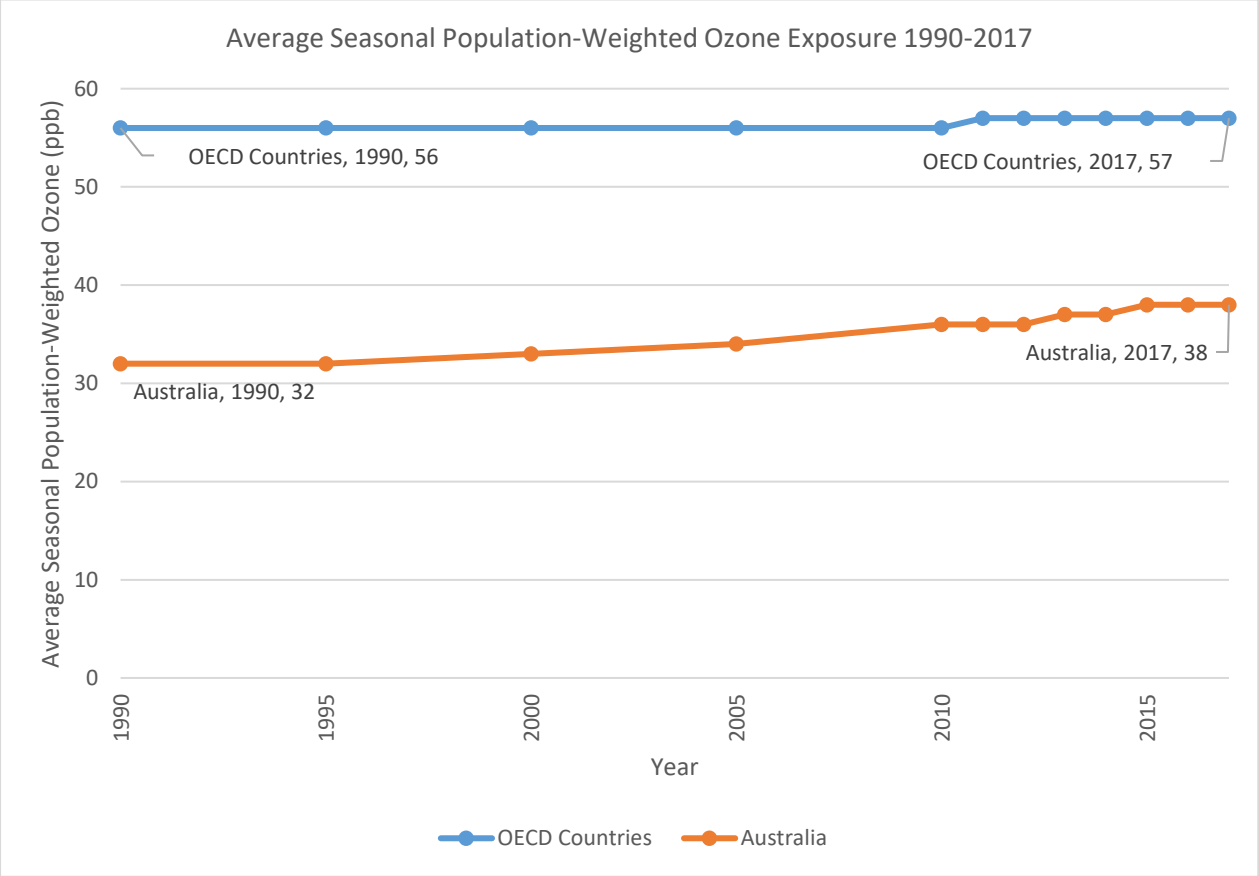

Figure 1 Average seasonal population weighted exposure to ozone in Australia and OECD countries[31]

The most current and comprehensive data available on road vehicle emissions in Australia, from New South Wales, shows that road vehicles account for over 55 per cent of emissions of oxides of nitrogen (NOx), 43 per cent of CO emissions, and 13 per cent of VOC emissions and 13 per cent of $PM_{2.5}$ emissions in the Sydney region[32]. Data from New South Wales (Figure 1.2) also shows that total NOx emissions from light duty diesel vehicles has increased as a result of a significant increase in the proportion of diesel vehicles in the light duty fleet and consequent increase in vehicle kilometres travelled[33]. Since 2003, NOx emissions from light diesel vehicles have decreased by around a third per kilometre, approximately half the decrease demonstrated by petrol passenger vehicles[34].

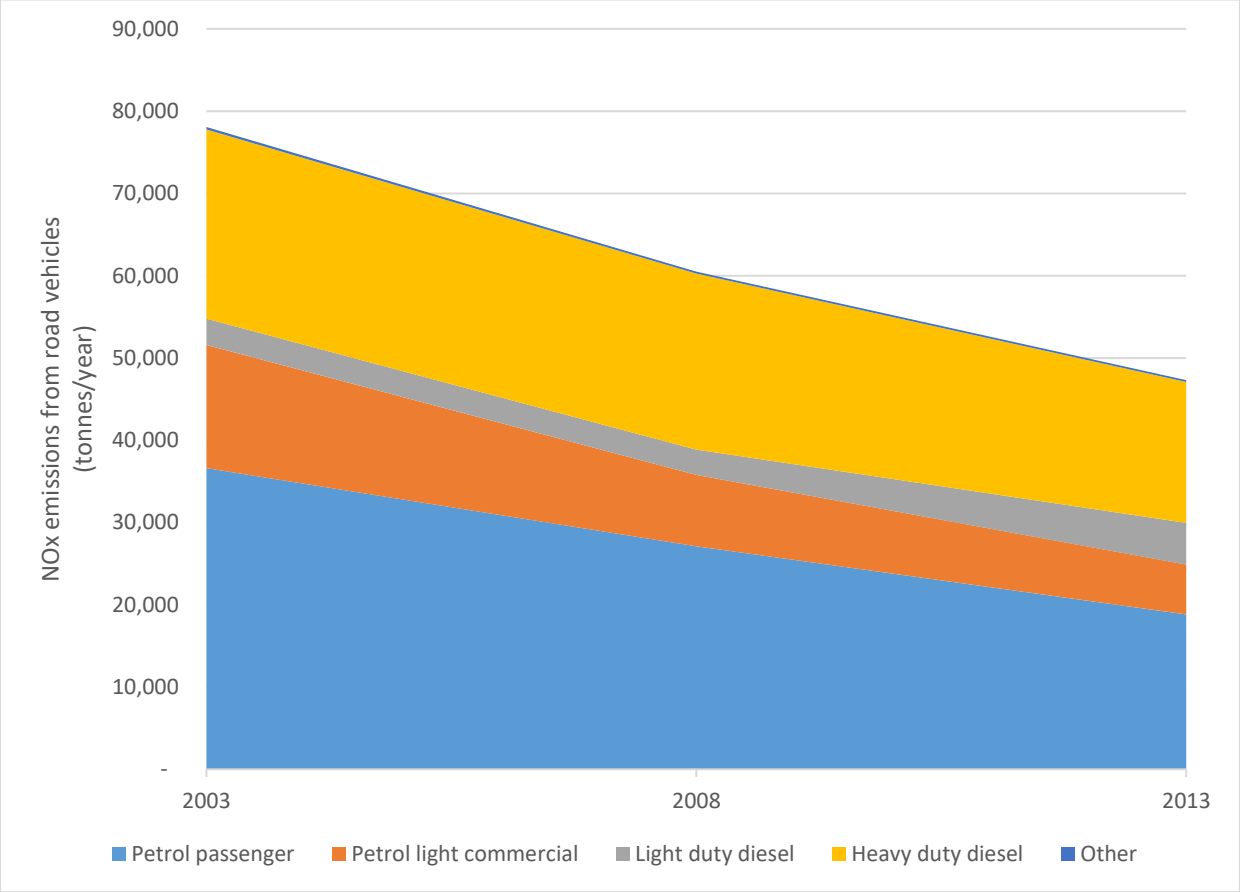

Figure 2 Changes in NOx emissions from road vehicles by vehicle type in the NSW Greater Metropolitan region[35]

Light[f] passenger vehicles (cars and sport utility vehicles), account for 74 per cent of vehicles on the road. They also account for 70 per cent of kilometres travelled (VKT) and 57 per cent of fuel consumed by road vehicles in Australia. Our increasing demand for transport services is exposing more Australians to ambient air pollution. Between 2014 and 2019, the light vehicle fleet in Australia grew by 10 per cent, making vehicles a growing source of air pollution[36].

Light vehicle use is steadily increasing, with total light vehicle travel predicted to grow by 66 per cent between 2016 and 2040[37]. This growth in vehicle use may start to outweigh reductions in noxious emissions from newer vehicles replacing older vehicles meeting less stringent standards.

While road vehicles are not the only source of particulate emissions, exhaust emissions, particularly from diesel vehicles, can contribute up to 30 per cent of the overall particulate load in urban areas[38]. Particulate levels tend to be highest near busy roads and dense urban areas. Data from New South Wales shows that diesel vehicles are the main source of exhaust particulate emissions from light vehicles[39].

[f] Consistent with the UN regulations, the Australian Design Rules for light vehicle emissions apply to passenger (M category) or goods carrying (N category) vehicles with a gross vehicle mass up to 3.5 tonnes.

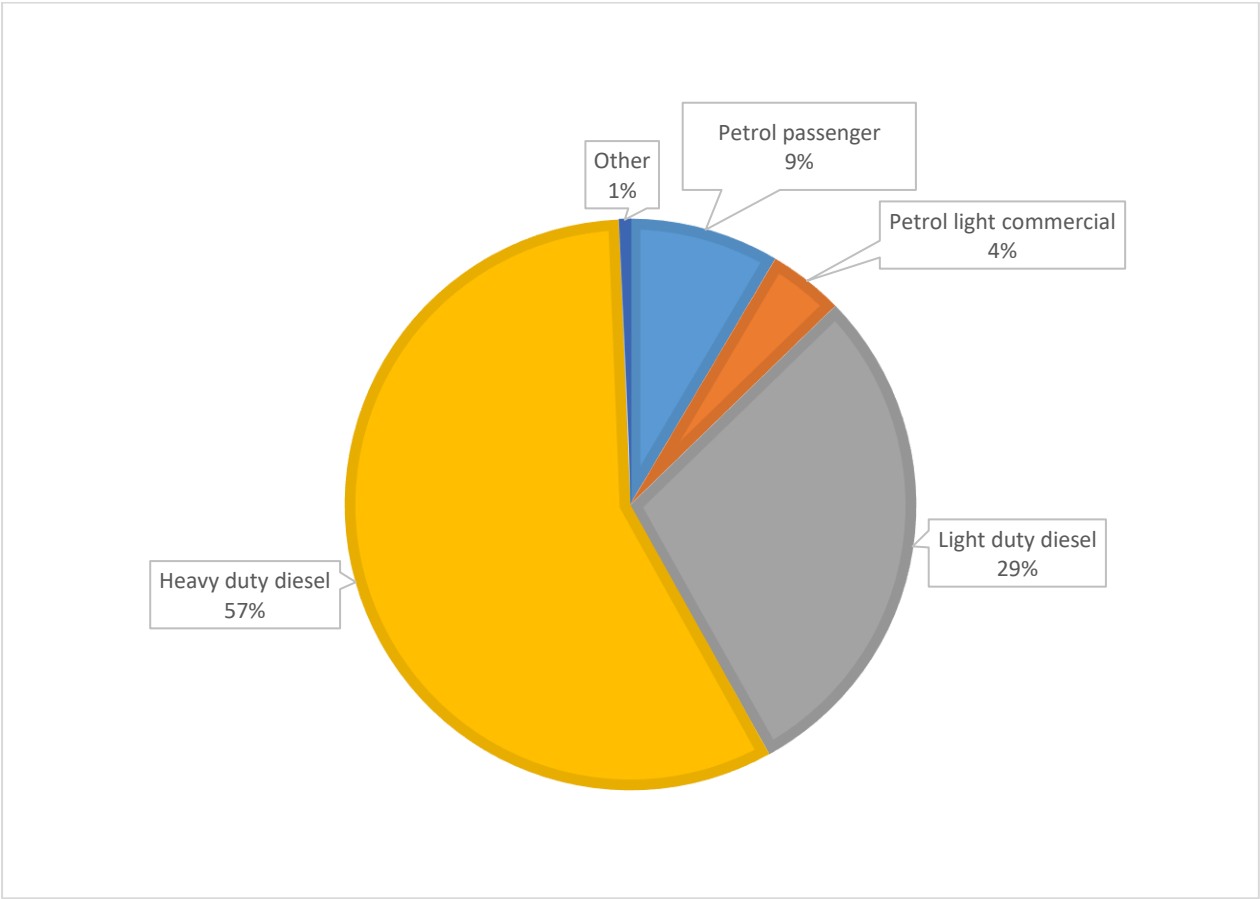

Figure 3 $PM_{2.5}$ exhaust emissions from road vehicles in the NSW Greater Metropolitan region[40]

Diesel engines, which emit higher levels of NOx and particulate emissions than petrol vehicles (and are permitted to do so under current standards), now dominate the light commercial segment of the light vehicle market in Australia. Over 93 per cent of new light commercial vehicles that entered the Australian fleet in 2019 were diesel vehicles, compared with only 41 per cent in 2005[41]. Between 2014 and 2019, the number of diesel light commercial vehicles grew by over 50 per cent[42].

There has also been a sizeable increase in the uptake of light petrol vehicles fitted with gasoline direct injection (GDI) fuelling systems in Australia and globally over the past five years and this is expected to continue to grow[43]. GDI engines improve light vehicle fuel efficiency but tend to emit more hazardous fine particles than traditional petrol engines[44].

While Australia generally has very clean air, there is still work to do to make sure that it remains this way as our population and vehicle fleet grows. Battery electric and hydrogen fuel cell electric vehicles, which produce no tailpipe emissions, will become increasingly common on Australian roads as they achieve price and total cost of ownership parity with petrol and diesel vehicles. BITRE estimates that 8 per cent of all new light vehicle sales will be electrified by 2025 and 27 per cent by 2030[45].

However, while the wider adoption of zero emissions vehicles will help reduce noxious emissions, BITRE also estimates that petrol and diesel vehicles will account for the majority of new light vehicle sales until 2035 and the majority of light vehicles on the road until 2050. Limiting the impact of exposure to noxious emissions from petrol and diesel vehicles on human health will be an issue for some time to come.

Why is further Government action needed?

Australian governments are already taking action to improve air quality. Australia has mandated the Euro 5 noxious emissions standards for light petrol and diesel vehicles for all newly approved models first manufactured from 1 November 2013 and all light vehicles manufactured from 1 November 2016. But Australia has had noxious emissions standards in place for light petrol vehicles since the early 1970s and light diesel vehicles since the mid-1990s. These have been progressively strengthened in response to:

- vehicle technology advances and availability of suitable fuels
- increasing international concern over air pollution problems, as greater scientific knowledge has highlighted their impact on human health
- increases in the size of and make-up of vehicle fleets as well as vehicle use patterns, particularly in urban areas.

The BITRE estimates that, since 1990, light vehicle noxious emissions standards have reduced carbon monoxide and hydrocarbon emissions by over 85 per cent, nitrogen oxide emissions by almost 50 per cent and particulate mass emissions by approximately 45 per cent. These improvements have occurred despite the fact there are almost twice as many vehicles on the road and total vehicle kilometres travelled have increased by over 60 per cent over the same period.

More broadly, in December 2015, Australia's Environment Ministers established the National Clean Air Agreement to ensure that Australians continue to enjoy clean air and to address the impacts of air pollution on human health and the environment. It sets out a framework to help governments identify and agree future actions to ensure Australia can respond to current and emerging air quality priorities.

The National Clean Air Agreement (NCAA) provides scope for a wide range of actions to be formulated over time across four strategic approaches, including reviewing and strengthening air quality monitoring and reporting standards, targeted measures to reduce emissions from key sources of air pollution, improving access to air quality information for communities, and fostering partnerships with industry. The Agreement is designed to incorporate a range of existing, new and complementary measures to improve Australia's air quality[46].

The National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM)[47] establishes a national framework to monitor and report against six criteria pollutants – particulate matter ($PM_{2.5}$ and PM_{10}), sulfur dioxide, nitrogen dioxide, ground-level ozone, carbon monoxide and lead. States and territories have primary responsibility for implementing the NEPM, and implementing strategies towards meeting standards set in the NEPM for these pollutants. Increasing the number of vehicles meeting more stringent vehicle standards would complement the actions under the NEPM and the NCAA in improving air quality.

While Australian governments have committed to improving air quality, market forces alone are not adequately addressing the problem of noxious emissions from road vehicles. This is because, without government action, manufacturers may still find it more cost effective to continue supplying vehicles with older emissions technology to the Australian market.

Most developed countries have now adopted noxious emissions standards for light vehicles based on, or equivalent to, Euro 6. But this does not guarantee that all vehicles in other markets, such as Australia, will be manufactured to comply with these standards in the future. Although all light vehicles supplied to the Australian market are imported, the number of vehicles meeting a particular

international standard can vary considerably from one market to another. This depends on several factors including whether that standard is mandated in domestic regulations, whether there are non-regulatory approaches such as government and private sector fleet purchasing policies, and consumer preferences. If it is cost effective to do so, manufacturers will tailor vehicles to meet the minimum requirements demanded by consumers and regulators in that market.

As an example of market variation in vehicle design, the Global New Car Assessment Program (Global NCAP) undertook a research project in 2013 on the passive safety performance of popular light vehicle models sold in India. One of the vehicles Global NCAP tested as part of this project, the Hyundai i10 (a small passenger car), is also sold in Europe and had previously been tested by the European New Car Assessment Program (Euro NCAP). Global NCAP undertook a frontal impact test on the Hyundai i10. At the time, the vehicles sold to the Indian market were not required to meet UN frontal or side impact crash test regulations. The vehicle was not equipped with any frontal airbags and scored zero per cent for adult occupant protection[48].

In comparison, the Hyundai i10 tested by Euro NCAP was equipped with driver and passenger frontal airbags and scored 79 per cent for adult occupant protection for the same test[49]. In Europe, light passenger vehicles such as the Hyundai i10 are required to meet UN regulations for frontal and side impact protection.

If Australian regulation does not keep pace with international standards that are prevalent across the global vehicle market, then we run the risk of foregoing the benefits of technology available in other countries. Manufacturers may still find it more cost effective to continue supplying older technology to the Australian market, affecting the range and choice of models available to Australian consumers. Several stakeholders advised the department that fuel saving technologies are often packaged with engines meeting Euro 6 or equivalent standards in larger markets. However, it still may not be commercially viable (or even possible) for manufacturers to offer these technologies on older Euro 5 engines for the Australian market. Manufacturers have also expressed concerns that our older vehicle emissions standards are making it increasingly difficult to convince their global parent companies that next generation engine technologies should be allocated to the Australian market.

While the number of vehicles meeting more stringent noxious emissions standards will increase in Australia, by virtue of its adoption in other markets that supply vehicles to Australia, the Government cannot guarantee that all vehicles supplied to the Australian market will eventually meet these standards.

What can be done to further reduce noxious emissions from light duty road vehicles?

The options considered to reduce noxious emissions from new light road vehicles are:

- **Option 1:** Business as usual - allow the existing Euro 5 noxious emissions standards and market forces to provide a solution.
- **Option 2:** Fleet purchasing policies – maintain Euro 5 noxious emissions standards but seek to influence vehicle purchasing decisions by adopting minimum noxious emissions performance requirements in the Australian Government fleet.
- **Option 3:** Voluntary standards - maintain Euro 5 noxious emissions standards but encourage vehicle manufacturers, through peak industry groups, to enter into an agreement with the Australian Government to meet increased minimum noxious emissions performance requirements.
- **Option 4:** Increased mandatory standards - mandate Euro 6 for light vehicles under the *Road Vehicle Standards Act 2018* (RVSA).

Discussion of options

Option 1: Business as usual

The Australian Government requires all Regulation Impact Statements to include an analysis of a business as usual option to act as a benchmark. The benefit-cost analysis for any remaining options are then calculated relative to this, so that what would have happened anyway in the market is not attributed to any proposed intervention.

Under a business as usual option, the Australian Government would not intervene further and instead rely on the existing Euro 5 noxious emissions standards, coupled with market forces, to deliver lower emissions and improvements in air quality.

Existing noxious emissions standards have already delivered air quality benefits and will continue to do so as new vehicles meeting the Euro 5 noxious emissions standards replace older vehicles that do not. A growing proportion of vehicles entering the Australian market may even meet Euro 6 standards, reflecting the implementation of these standards in overseas markets, and join the number of Euro 6 compliant vehicles already available in Australia[50].

However, while the Euro 5 noxious emissions standards will continue to deliver some air quality benefits, their effect is diminishing and they are unlikely to continue delivering significant reductions in NOx and PM emissions in the longer term. The difference in emissions between vehicles entering and exiting the fleet is diminishing and the number of vehicles and vehicle kilometres travelled by the light vehicle fleet is increasing (as well as a greater uptake of diesel and GDI technology).

Projections by the BITRE (Figure 4) show that under current policy settings, emissions of oxides of nitrogen (NOx) from light vehicles are expected to decline at a slower rate than previous years and will remain relatively stable until the late 2020s, when electric vehicles are expected to become cost competitive with petrol and diesel vehicles and their uptake is expected to increase.

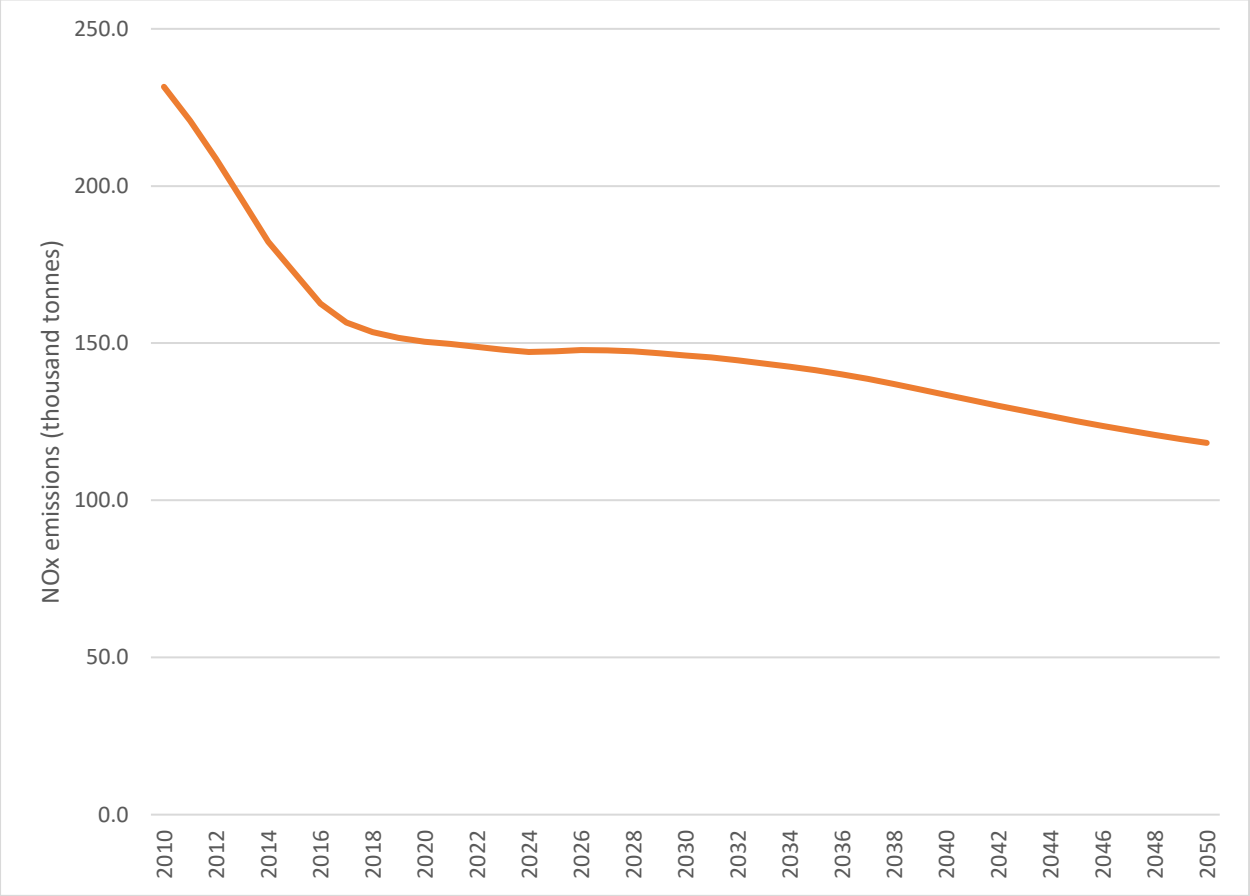

Figure 4 Projected impact of existing noxious emissions standards (Euro 5) on NOx emissions from the light vehicle fleet (2010–2050)[51]

BITRE projections (Figure 5) also show that under current policy settings, fine particulate emissions from light vehicles will decline until the mid-2020s, then increase slowly, due to growth in the number of direct injection petrol vehicles on the road and increased particulate emissions from tyre and road wear.

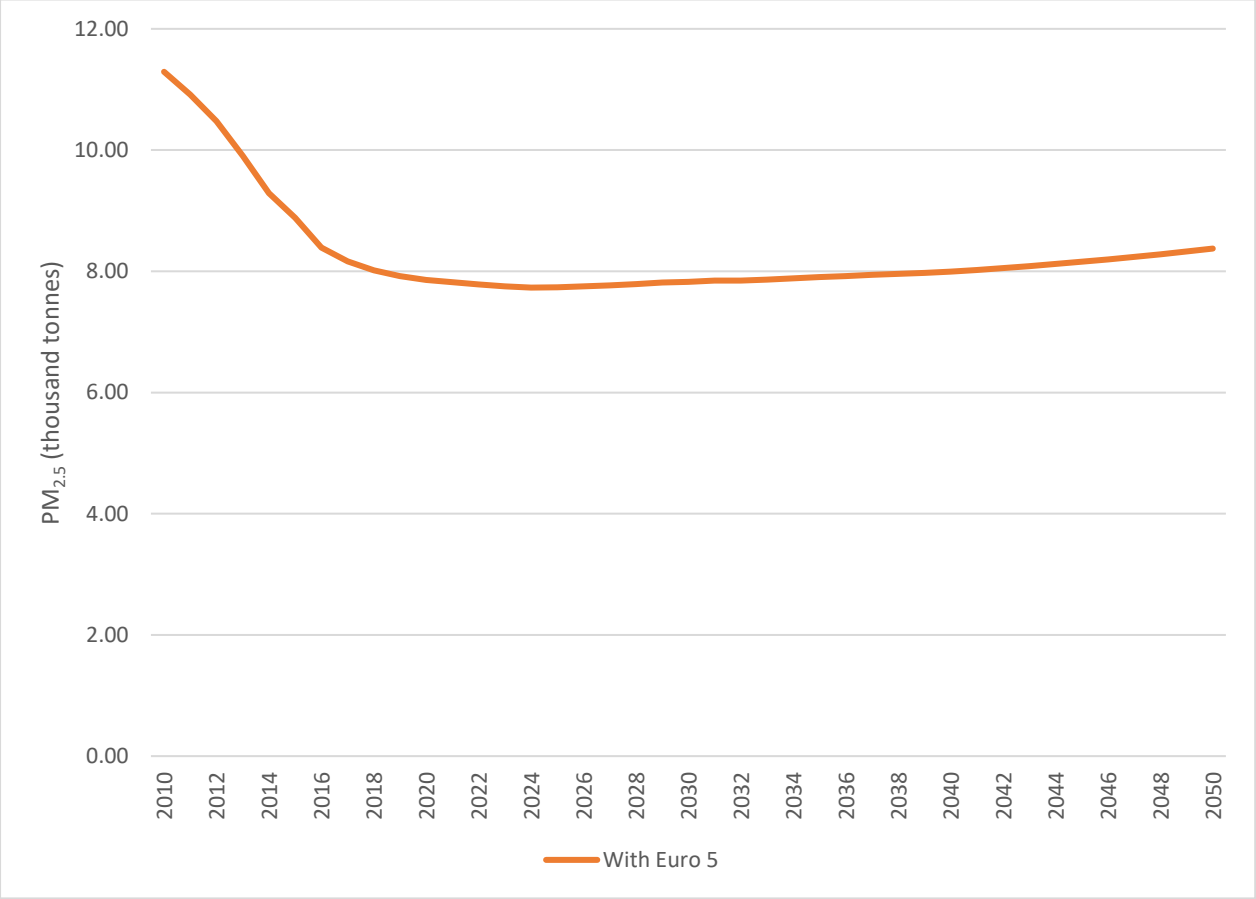

Figure 5 Projected impact of existing noxious emissions standards (Euro 5) on $PM_{2.5}$ emissions from the light vehicle fleet (2010–2050)[52]

In the absence of more stringent mandatory standards, some manufacturers will choose to continue supplying vehicles meeting current standards where it is cost effective to do so. The Second National In-Service Emissions Study which examined vehicles manufactured between 1986 through 2007 found that many vehicles sold in Australia only met the minimum requirements applicable at the time despite the wide availability of more advanced technologies in other markets[53].

Because of this there is no guarantee under a business as usual option that, once improved petrol quality standards are introduced in 2027, large numbers of Euro 6 and other next generation vehicles will be allocated by manufacturers to the Australian market. This is likely to continue until Euro 6 vehicles cost less to produce than their Euro 5 equivalents. It will also not resolve the issue raised by manufacturers that our older vehicle emissions standards make it increasingly difficult to convince their global parent companies that next generation engine technologies, such as hybrids and plug-in hybrids or vehicles fitted with advanced driver-assistance systems (ADAS) and intelligent transport systems (ITS), should be allocated to the Australian market.

There are no benefits or costs associated with this option as there are no proposed changes to existing policy. However, this does not necessarily mean that the costs of complying with existing standards or the health impacts of noxious emissions from light vehicles will not increase from existing levels in the future. The best possible outcome under this option would be that the health impacts and number of premature deaths resulting from traffic-related pollution would remain relatively constant over the next decade.

Option 2: Fleet purchasing policies

The Australian Government could intervene by permitting only light vehicles fitted with Euro 6 emission systems to be purchased or leased in its light vehicle fleet. This would create an incentive for manufacturers to fit these systems to models that are otherwise compatible with government requirements.

The advantages of targeted fleet purchasing are:

- ex-fleet vehicles are often sold after two to three years, giving the public the opportunity to buy a near new vehicle at a large discount; and
- fleet vehicles are on average driven twice as far annually as household vehicles, thus maximising the use of any technology benefits[54].

However, as the Australian Government fleet accounts for less than 0.3 per cent of new vehicle sales, the capacity of the Australian Government alone to influence the supply of Euro 6 vehicles through fleet purchasing would be small. While these requirements could encourage other government, business and rental fleets, which account for roughly half of new vehicle sales in Australia, to adopt similar policies, this cannot be guaranteed (especially in segments where there are very few Euro 6 options available in Australia such as light commercial utility vehicles).

The costs of adopting this option would be largely associated with the cost of developing a new fleet purchasing policy. There would also be some opportunity costs for the fleet in foregoing a higher emitting vehicle that may otherwise be better placed to meet operational requirements.

It is not possible to provide a reliable estimate of the costs and benefits of adopting this approach as they are highly dependent on voluntary action by other government and private fleets. For these reasons this option will not appropriately address the problem of noxious emissions from road vehicles and no further analysis has been undertaken as part of this draft RIS.

Option 3: Voluntary standards

Compared with legislated requirements, voluntary standards usually involve a high degree of industry participation, as well as a greater responsiveness to change when needed. For a voluntary standard to succeed, the relationship between business, government and consumer representatives should be collaborative so that all parties have ownership of, and commitment to, the arrangements.

A voluntary standard could include an agreement by industry to fit emission control systems meeting Euro 6 standards to light vehicles over and above the current mandated Euro 5 standard. However, a voluntary standard of this kind would only be effective if complying with tighter noxious emissions standards is in the commercial interest of light vehicle manufacturers and/or their customers. If there is no incentive to supply light vehicles meeting more stringent noxious emissions standards to the market, either because it is not cost effective to do so or there is relatively little consumer demand for such technologies, then manufacturers are less likely to commit to, or comply with, a voluntary standard.

The health costs of air pollution from heavy vehicles are not borne directly by vehicle manufacturers or consumers but shared by the whole community. When buying a new vehicle, a consumer is much more likely to be attracted to a vehicle with improved fuel efficiency, safety or comfort features. These features directly benefit consumers in a way that improved noxious emissions performance does not.

Because of this, manufacturers have no clear market incentive to supply vehicles with the latest noxious emissions technology.

Unlike mandatory standards, where mandatory recall provisions and fines for non-compliance can be enforced under law, there are limited avenues for consumers or governments to force manufacturers to fix non-compliant vehicles under a voluntary standard. Given the sophistication of emissions systems for light vehicles, detecting any breach of a voluntary standard could be difficult. It is not easy for consumers to obtain independent information and gain the understanding required to evaluate environmental performance. For example, a consumer may research the technologies fitted to a vehicle, but cannot be expected to know if the technology will control noxious emissions effectively. Such breaches would usually only be revealed after the vehicle has entered the Australian vehicle fleet through continual failures in the field or through independent testing and reporting by governments and third party experts.

Any possible reduction in compliance costs from a voluntary standard would also need to be balanced against the consequences of such failures. In the case of emission control systems for light vehicles, non-compliance by a large number of vehicles could result in higher than anticipated health impacts from road vehicle emissions, particularly in densely populated areas along major roads.

In its consideration of the case for Euro 5 and Euro 6 noxious emissions standards, the European Commission (EC) stated that 'self-regulation would imply a significant departure from an approach that is well established all over the world and has proven its effectiveness in the past'. The EC noted that to measure compliance under a voluntary approach, governments and manufacturers would need to establish processes, which would essentially duplicate those which already operate for mandatory standards, increasing costs and complexity[55]. This would diminish any compliance costs savings from a voluntary standard, in lieu of a mandatory standard.

The issue of how to monitor compliance with voluntary standards and how to take action against non-compliance is not new. In 1961, the US Federal Government reached a voluntary agreement with the light vehicle industry to fit emission control devices to vehicles sold in the US. The agreement was made to avoid a threat to extend the then Californian and New York requirement for emission control devices to become a national requirement. However, it was subsequently reported that by 1964, one major manufacturer had ceased fitting these devices due to 'operational and maintenance difficulties' in all states other than the two where it was regulated. The US Government only became aware of this situation through a report on automotive pollution commissioned by the US Department of Health, rather than the manufacturer concerned.

As compliance with a voluntary noxious emissions standard would be strongly dependent on the commercial interests of light vehicle manufacturers and their customers, and governments could incur a high cost to monitor, detect and respond to breaches, this option was not considered to be a viable option to reduce noxious emissions from road vehicles. For these reasons, no further analysis, including any analysis of benefits or costs, has been undertaken as part of this draft RIS.

Option 4: Increased mandatory standards

Under this option, the Australian Government would mandate improved noxious emissions performance for new light vehicles, by determining a new ADR adopting Euro 6 requirements under the RVSA. The current proposal would be to mandate Euro 6 in Australia for new light vehicle models from 1 July 2027 and from 1 July 2028 for all new light vehicles. Other options to implement Euro 6 in Australia are also discussed below.

Under the ADRs, vehicles are approved on a model (or vehicle type) basis known as type approval. This is where the Australian Government approves the design of a vehicle type based on test and other information supplied by the manufacturer. Compliance of vehicles built under that approval is ensured by the regular audit of the manufacturer's production processes. The ADRs apply equally to new imported vehicles and new vehicles manufactured in Australia. No distinction is made based on country of origin or manufacture and this has been the case since the introduction of motor vehicle standards legislation. As of 2018, all light vehicles supplied to Australia are imported.

Vehicle emissions standards both in Australia and internationally have proven to be a cost-effective measure to reduce urban air pollution from the road transport sector. For example, the NSW EPA estimates that the average NOx emissions produced by light petrol passenger vehicles are 71 per cent lower per kilometre than in 2003. NOx emissions from light diesel vehicles are 36 per cent lower per kilometre than in 2003, while particulate emissions are 89 per cent lower per kilometre[56]. The department's analysis of the 2016-17 on-road emissions testing study conducted by the Australian Automobile Association[57] (Figure 6) also suggests that NOx emission from Euro 6 diesel passenger vehicles are substantially lower than Euro 4 and Euro 5 diesel passenger vehicles.

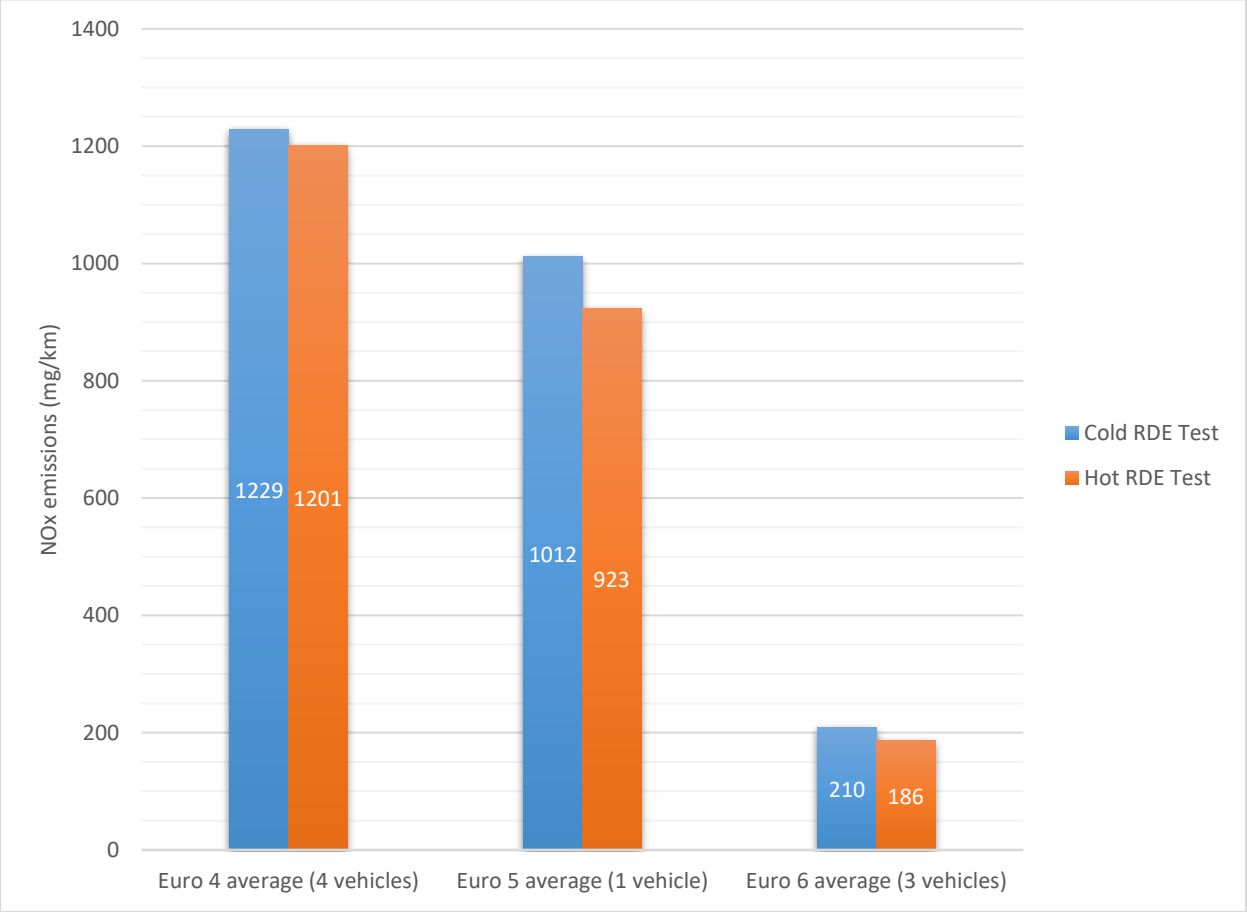

Figure 6 On-road NOx emissions from diesel passenger vehicles tested by the Australian Automobile Association

Similarly, the department's analysis (Figure 7) also found that particulate emissions from Euro 5 and Euro 6 diesel passenger vehicles are also substantially lower than Euro 4 diesel passenger vehicles.

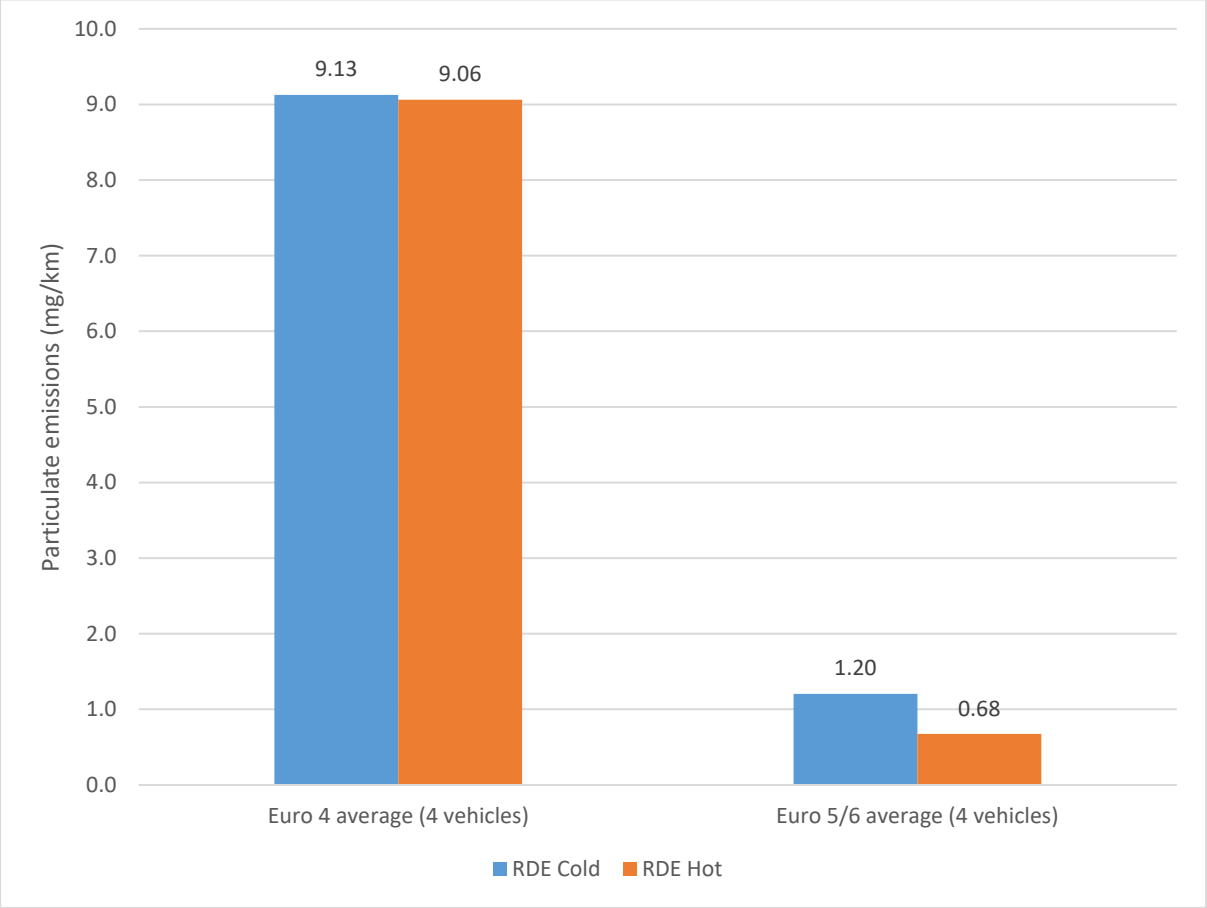

Figure 7 On-road particulate emissions from diesel passenger vehicles tested by the Australian Automobile Association

The adoption of Euro 6 would deliver the following key benefits for new vehicles entering the light vehicle fleet:

- for light diesel vehicles, a 55 per cent reduction in the emissions limits for NOx
- for petrol vehicles with direct injection fuelling systems, the introduction of a limit on the number of particles to control fine particle emissions
- more stringent requirements for on-board diagnostic systems that monitor the emission control systems, including a reduction in the thresholds at which a malfunction warning is detected and an increased frequency of monitoring (in-use performance ratio).

The changes in emissions limits from Euro 5 to Euro 6 are detailed in tables 1 and 2.

Table 1: Euro 5 and Euro 6 light passenger vehicle emissions limits

Pollutant	Euro 5		Euro 6	
	Petrol/LPG	Diesel	Petrol/LPG	Diesel
Oxides of nitrogen	60 mg/km	180 mg/km	60 mg/km	80 mg/km
Particulate matter	4.5 mg/km (for direct injection)	4.5 mg/km	4.5 mg/km (for direct injection)	4.5 mg/km
Particle number limit	No limit	$6x10^{11}$/km	$6x10^{11}$/km (for direct injection)	$6x10^{11}$/km

Table 2: Euro 5 and Euro 6 light commercial vehicle emissions limits

Pollutant	Euro 5		Euro 6	
	Petrol/LPG	Diesel	Petrol/LPG	Diesel
Oxides of nitrogen	82 mg/km	280 mg/km	82 mg/km	125 mg/km
Particulate matter	4.5 mg/km (for direct injection)	4.5 mg/km	4.5 mg/km (for direct injection)	4.5 mg/km
Particle number limit	No limit	$6x10^{11}$/km	$6x10^{11}$/km (for direct injection)	$6x10^{11}$/km

Stages of Euro 6

In the EU, Euro 6 was implemented over several stages to allow time for technology to develop and mature. The first mandatory stage of Euro 6 in the EU, known as Euro 6b, commenced in 2014. This stage introduced the lower NOx emission limits for diesel vehicles, tighter monitoring thresholds for on-board diagnostics and an interim particle number limit for direct injection petrol vehicles.

The second mandatory stage of Euro 6 in the EU, known as Euro 6d, commenced in the EU in 2017. This stage introduced a tighter particle number limit for direct petrol vehicles and even tighter monitoring thresholds for on-board diagnotics. In addition to these changes, Euro 6d also adopts measures to improve the integrity of emissions testing through:

- a new laboratory test (known as the Worldwide harmonised Light vehicles Test Procedure or WLTP) that is more representative of real world driving to determine compliance with emissions requirements; and
- a new on-road Real Driving Emissions (RDE) test to improve the correlation between laboratory tested and on-road emissions levels.

These improvements aim to address the deficiencies highlighted by the 'dieselgate' scandal in 2015, where the Volkswagen Group was alleged to have fitted defeat devices (which changes how a vehicle operates when it is being tested) to its diesel engines to pass more stringent emissions standards[58].

Proposed approach

Any proposed timeframe for the introduction of Euro 6 needs to strike a balance between the earliest possible introduction, which would maximise health benefits, and a delayed introduction, that allows vehicle manufacturers sufficient time to develop and source products designed to meet new emissions standards.

In addition, a key issue raised during previous stakeholder consultation was that better quality petrol (lower sulfur and aromatics limits) in Australia was necessary to avoid vehicle operability issues for consumers.

> The Australian Government regulates fuel quality under the *Fuel Quality Standards Act 2000*, which is administered by the Department of Industry, Science, Energy and Resources.
>
> On 25 February 2019, the Australian Government agreed changes to the petrol quality standards to set limits of 10 ppm for sulfur for all petrol grades from 2027, and set a pool average of 35 per cent aromatics (down from 42 per cent currently) for all petrol grades from 2022. The Australian Government further agreed to a review of aromatics by 2022 to allow for a full assessment of the case for a 35 per cent limit and to examine alternative solutions to be in place by 2027.

For these reasons, the analysis in this draft RIS has assumed that, if Australia was to mandate Euro 6, it would do so from 1 July 2027 for new light vehicle models and from 1 July 2028 for all new light vehicles. This would align with the timeframe for the transition to better quality petrol.

The analysis also assumes that if Australia was to mandate Euro 6 from these dates it would adopt the latest stage of Euro 6 (known as 'Euro 6d') without adopting Euro 6b as an interim step. By 1 July 2027, Euro 6d will have been in force in the EU for nearly ten years. If adopted in Australia from this date, then global vehicle manufacturers will have a clear understanding of the requirements needed to meet these standards.

Alternative timeframes

Diesel fuel quality in Australia is already of a high standard and can support Euro 6 vehicles. The department seeks views on whether the proposed timeframe for the introduction of Euro 6 for light diesel vehicles should remain aligned with petrol vehicles or if it should be implemented sooner. This could include adopting Euro 6b as an interim step for light diesel vehicles before mandating full Euro 6d from 1 July 2027. Similarly, many Euro 6b light petrol vehicles are currently on sale in Australia and can tolerate the 'premium' unleaded petrol (95RON and 98RON) that is currently widely available here. We also seek your feedback on whether Euro 6b should be adopted as an interim step for light petrol vehicles before mandating Euro 6d from 1 July 2027.

While adopting Euro 6b as an interim step would still mean that Australian standards would diverge from those prevalent across the global vehicle market, there could still be benefits for the Australian community in avoided health costs from adopting this stage of Euro 6 as soon as possible. If there is a strong justification for doing so, the department will consider modelling the costs and benefits of alternative implementation timeframes in the final RIS, before a decision is made by the Government.

Alternative standards

Traditionally, the ADRs for light vehicle emissions have only recognised equivalent UN Regulations as an alternative standard. However, to reduce the regulatory burden and increase the range of vehicles manufacturers could offer without compromising the policy objectives of the proposed standards, the department seeks feedback on whether Australia should recognise any other national or regional emissions standards as alternatives.

To be recognised as an equivalent alternative standard, the department usually specifies that any national or regional standard should have comparable test procedures and emission limits to Euro 6d (for both laboratory and on-road testing) and durability requirements of no less than 160,000km.

Alignment of standards with the global vehicle market

Mandating Euro 6d for light vehicles will also bring Australia's vehicle standards into closer alignment with international standards adopted by other major vehicle markets. These markets also supply the overwhelming majority of vehicles to Australia. Reducing any technical or commercial barriers to the importation of vehicles meeting Euro 6d or equivalent standards would increase consumer choice and improve Australians access to the latest vehicles fitted with the latest safety and fuel saving technologies. It will also help Australian vehicle distributors covince their global parent companies to offer their latest generation engine technologies, such as hybrids and plug-in hybrids or vehicles fitted with advanced driver-assistance systems (ADAS) and intelligent transport systems (ITS) to the Australian market.

By improving access to more advanced vehicle models, fitted with the latest technologies, mandating Euro 6d for all new light vehicles sold in Australia, would indirectly improve the safety and fuel efficiency of the Australian light vehicle fleet. This would further reduce the burden on the public health system and reduce Australia's dependence on imported liquid fuels. However, as there is no methodology to estimate these benefits reliably, these benefits could not be quantified or included in the benefit-cost analysis. The estimated benefits in the benefit-cost analysis are therefore likely to be conservative.

Impact on emissions

Projections by the BITRE (Figure 8) show that should Euro 6d be introduced, NOx emissions from light vehicles are expected to decline at an accelerated rate from the mid-2020s (to approximately 43,000 tonnes or over 64 per cent lower than under business as usual).

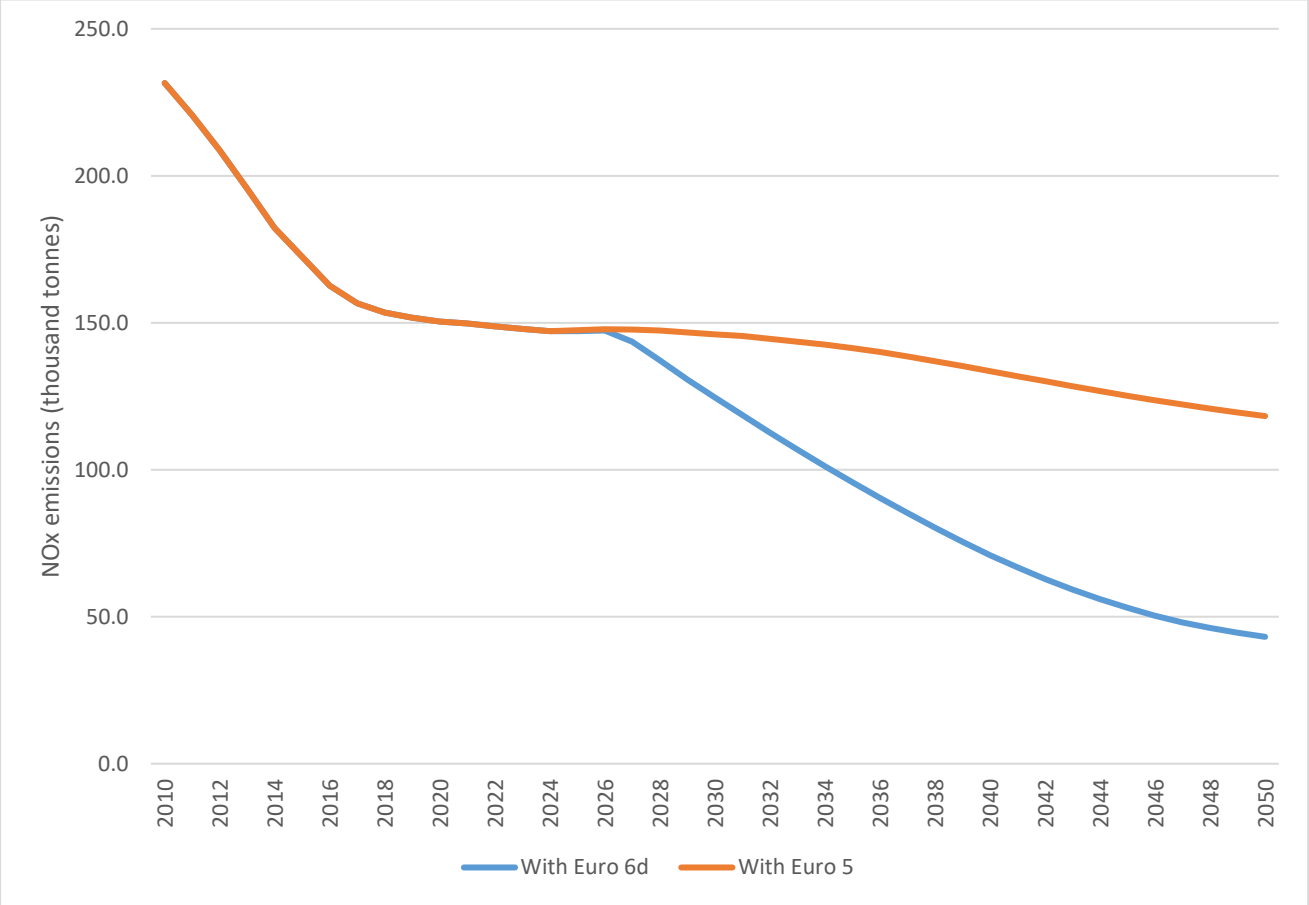

Figure 8 Projected impact of proposed noxious emissions standards (Euro 6d) on NOx emissions from the light vehicle fleet (2010–2050)[59]

The BITRE projections (Figure 9) also estimate that should Euro 6d be introduced, fine particulates from light vehicles are expected to decline by over one third from 2027 to 2050 (or almost 40 per cent lower than that expected under business as usual).

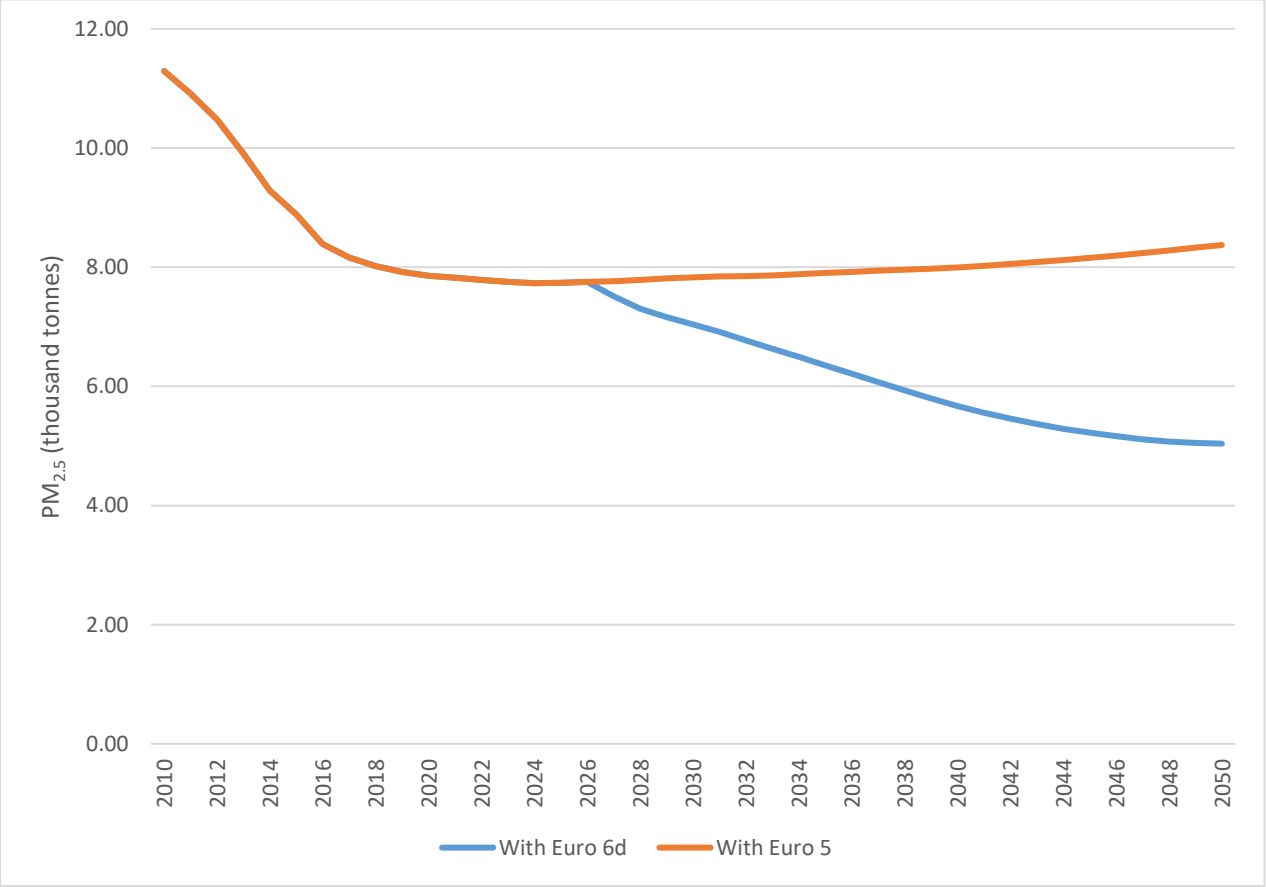

Figure 9 Projected impact of proposed noxious emissions standards (Euro 6d) on $PM_{2.5}$ produced by the light vehicle fleet (2010–2050)[60]

Costs and benefits

The department, through the BITRE, undertook a detailed benefit-cost analysis of implementing Euro 6d standards from 2027 for new model light vehicles and from 2028 for all new light vehicles. Costs and benefits were assessed based on capital costs to light vehicle manufacturers and avoided health costs. The overall period of analysis (out to 2050) covers the time expected for the benefits of the proposed standard to work its way through the Australian light vehicle fleet, based on an average vehicle life of 17 years. Results showed that by 2050, using a discount rate of seven per cent (as required by the Australian Government Guide to Regulation), implementing Euro 6d for new light vehicles in Australia would result in net benefits of $5,282 million and a benefit-cost ratio of 5.79. There are also likely to be significant benefits from keeping pace with international standards, as this will reduce technical and commercial barriers to trade. These benefits have not been quantified, as there is no suitable methodology to do so.

The BITRE analysis found that there would be a direct benefit to the health and wellbeing of the Australian community of $6,385 million by 2050 as a result of a reduction in air pollution. This would have an indirect benefit to governments in terms of reducing pressure on the public health system. The majority of health benefits will accrue in metropolitan and neighbouring areas, where the vehicle activity and air pollution is greater. The Australian Bureau of Statistics estimates that 71 per cent of the population resides in major cities and another 18 per cent in inner regional areas, meaning that

around 89 per cent of the Australian population would potentially directly benefit from improved air quality.

An improvement in air quality in these areas will either reduce total healthcare costs or allow resources to be diverted to alternative programs. In this manner, the improvement of air quality in metropolitan areas would benefit all Australians, even those living in remote locations. Accordingly, reducing noxious emissions benefits both regional areas and cities.

The BITRE also estimated that there would be a direct cost to light vehicle manufacturers of $1,103 million by 2050 as a result of the additional capital costs required to meet new standards. Manufacturers may pass on some or all of these costs to consumers through higher vehicle retail prices; however, the extent to which this may happen is limited by a highly competitive vehicle market in Australia. The adoption of previous noxious emissions standards in Australia does not appear to have led to any appreciable increase in vehicle retail prices. There are likely to be some costs incurred by government to develop, implement and enforce the new standards. These costs are assumed to be absorbed within existing departmental resources.

The quantified benefits of this option far outweigh the costs, resulting in significant net benefits to the community. **Appendix A** provides further details about the benefit-cost analysis of the implementation of Euro 6 standards for new light vehicles in Australia.

Regulatory burden

The Australian Government has established a deregulation policy that aims to improve productivity growth and enhance competitiveness across the Australian economy. The department is a key regulator and continuous improvement is at the core of this portfolio's regulatory vision. The portfolio is vigorously pursuing best practice regulatory reforms, with a focus on achieving efficiencies through harmonising international and domestic regulatory requirements where possible. This will make sure that the standards for Australia's transport systems remain fit for purpose while reducing unnecessary regulatory burden.

The Australian Government Guide to Regulation requires that all new regulatory options are costed using the Regulatory Burden Measurement Framework (RBM). The RBM is a different measure to the full cost benefit analysis as it does not capture the benefits of avoided health issues for the wider community. The average annual regulatory costs were established by calculating the average undiscounted costs (non-prorated) for each option over the period from 2027–2036 inclusive.

The department's analysis (Table 3) found that the average annual regulatory cost associated with this option is $182.4 million. To the extent that market forces allow, the costs to business in the table below may be passed on to consumers.

Table 3: Regulatory burden and cost offsets estimate table: Option 4 - Mandating Euro 6d for light vehicles

Average annual regulatory costs (from business as usual)				
Change in costs ($ million)	**Business**	**Community organisations**	**Individuals**	**Total change in costs**
Total, by sector	182.4	-	-	182.4

Conclusion

This draft RIS examined the case for Government action to improve health outcomes by reducing noxious emissions from new road vehicles entering the Australian vehicle fleet.

Noxious emissions from road vehicles reduce urban air quality, leading to premature death and illness among Australians. Australia has had standards in place that limit noxious emissions from road vehicles for a long time, and these have been progressively strengthened as both technology and international understanding of the health impacts of noxious emissions have improved. However, our current noxious emissions standards now trail most other developed countries including the EU, US, Canada, Japan and South Korea.

This draft RIS considered a range of options to reduce noxious emissions from road vehicles. Following analysis of these options, along with consideration of stakeholder feedback, mandating more stringent noxious emissions standards for light vehicles under the RVSA is recommended. This option has broad stakeholder support and would deliver significant health benefits for the Australian community over a number of years.

Generally, there is a strong case for mandatory standards to reduce noxious emissions from road vehicles. The costs of air pollution from road vehicles are not borne directly by the vehicle manufacturers or by owners but are shared by the community. As such the problem cannot be addressed effectively by the operation of market forces alone as there is no commercial reason to do so. Government action to strengthen noxious emissions standards are internationally recognised as a very effective measure to reduce urban air pollution, and such standards have managed to deliver improvements in urban air quality despite growth in vehicle use.

Mandating Euro 6d for light vehicles will also bring Australia's vehicle standards into closer alignment with international standards adopted by major vehicle markets. This would increase consumer choice and improve Australians access to the latest safety and fuel saving technologies, including electrified vehicle technology, by reducing any technical or commercial barriers to the introduction of vehicles meeting Euro 6d or equivalent standards.

Our analysis found that there were significant benefits for the Australian community to be gained from improving air quality by mandating Euro 6d for new light vehicles. These benefits would not otherwise be realised either through a business as usual approach or through various other non-regulatory options.

The analysis suggested that the adoption of Euro 6d, if phased in from 1 July 2027 for new model light vehicles and from 1 July 2028 for all new light vehicles, would result in avoided health costs of $6,385 million and increased capital costs to manufacturers of $1,103 million over the period to 2050. The net benefits over this same period were estimated to be $5,282 million and a benefit-cost ratio of 5.79.

This draft RIS proposes that the Government mandate Euro 6d for light vehicles for all newly approved models manufactured from 1 July 2027 and for all new vehicles manufactured from 1 July 2028. The proposed implementation timeframe was chosen after careful consideration of previous stakeholder views, particularly those of light vehicle manufacturers and consumer groups. The timeframe would allow manufacturers sufficient time for production planning and importantly, align with improvements to Australia's petrol quality standards, which manufacturers consider necessary to support Euro 6d technology.

As diesel fuel quality in Australia is already of a high standard and can support Euro 6 vehicles, the department seeks further stakeholder feedback on whether the proposed timeframe for the introduction of Euro 6 for light diesel vehicles should remain aligned with petrol vehicles or if it should be implemented sooner. The department also seeks feedback on whether Euro 6b should be adopted as an interim step for light petrol vehicles before mandating Euro 6d from 1 July 2027. If there is a strong justification for doing so, the department will consider modelling the costs and benefits of alternative implementation timeframes in the final RIS, before a decision is made by the Government.

A final recommendation to Government will be made following further targeted stakeholder consultation on this draft RIS.

Implementation and evaluation

If the Australian Government chooses to mandate new noxious emissions standards (Euro 6d), this would be done through a new ADR, under the RVSA. New ADRs, or amendments to the ADRs, are determined by the Minister under section 12 of the RVSA.

The Australian Government has a long-term policy to harmonise the ADRs with international regulations adopted by the UN. The UN regulations for noxious emissions are traditionally based on the 'Euro' standards adopted by the EU. In this case, Euro 6d has been adopted as a EU regulation, but has not yet been transposed into a UN regulation. The process is well underway, however, with Euro 6d expected to be fully incorporated into the UN regulations (which are currently at Euro 6b) by 2021.

Historically, the Euro standards adopted by the EU for light vehicles, have been transposed into a new series of UN Regulation 83. However, the department understands that the WLTP and RDE components of Euro 6d are intended to be adopted as a requirement for International Whole Vehicle Type Approval. For these reasons, the UN World Forum's Working Party on Pollution and Energy (GRPE) has proposed that the Euro 6d requirements be transposed into three separate UN regulations.

- New UN Regulation 154 – which adopts the tailpipe emissions, evaporative emissions, durability and on-board diagnostic requirements of Euro 6d as its Level 1A approval requirements.
- New UN Regulation 'RDE' - which will adopt harmonised on-road emissions testing requirements based on the Euro 6d and Japanese RDE requirements.
- A '08' series of amendments to UN Regulation 83 – adopting the residual requirements of Euro 6d.

As Australia is a contracting party to International Whole Vehicle Type Approval, the department wishes to seek feedback from vehicle manufacturers on whether it may be appropriate for Australia to adopt these regulations as separate ADRs. This approach would enable ADR requirements for the WLTP and RDE components of Euro 6d to be determined as soon as the UN Regulations enter into force, which may provide greater certainty to vehicle manufacturers and enable them to progressively comply with each element of Euro 6d. As the currently laboratory test for noxious emissions is also used to measure fuel consumption, CO_2 emissions, energy consumption and battery range for the purposes of the fuel consumption labelling standard (ADR 81/02), this approach may enable the Government to review the current fuel consumption labelling standard sooner, to ensure it remains relevant and provides appropriate information to consumers.

It would be important to determine the new ADRs as soon as possible following a Government policy decision. This would provide certainty to manufacturers, and would maximise their time to undertake necessary business planning before the new ADRs commence.

The ADRs are subject to review every ten years as resources permit. This ensures that they remain relevant, cost effective and do not become a barrier to the importation of safer and/or lower emissions vehicles. The ADRs mandating Euro 6d would be scheduled for a full review on an ongoing basis and in line with this practice.

Consultation

Previous consultation

This draft RIS was prepared taking into account the feedback received through a range of consultative processes.

On 11 February 2016, the Governement released a discussion paper seeking feedback on possible measures that could be adopted to reduce the impacts of emissions from road vehicles, including standards and alternative measures. The paper closed for comment on 8 April 2016 and a total of 80 submissions were received. The submissions reflected strong community support for taking action on vehicle emissions.

From 20 December 2016 to 10 March 2017, the Government subsequently released a draft RIS prepared by the department on more stringent noxious emissions standards for new light and heavy vehicles (referred to in this draft RIS as the 2016 RIS). It also released a discussion paper prepared by the Department of the Environment and Energy on improving fuel quality standards.

These papers were informed by feedback from both the Vehicle Emissions Discussion Paper and from formal stakeholder engagement meetings held by then Ministerial Forum on 7 December 2015 and 4 April 2016.

From 25 January to 8 March 2018, the Government released for consultation a draft RIS prepared by the Department of the Environment and Energy on proposed changes to fuel quality standards.

The 2016 RIS received submissions from over 40 stakeholders, including vehicle manufacturers, fuel suppliers, transport operators, consumer, health and environment groups, and individuals. A summary of the submissions on light vehicle noxious emissions standards received in response to the 2016 RIS is below.

The proposal to mandate Euro 6 noxious emissions standards for light vehicles has also been discussed a number of times at meetings of the peak vehicle standards consultative forum, the Strategic Vehicle Safety and Environment Group (SVSEG). SVSEG consists of senior representatives of government (Australian and state/territory), the manufacturing and operational arms of the industry including organisations such as the Federal Chamber of Automotive Industries (FCAI), and consumer and road user organisations such as the Australian Automobile Association (AAA).

The department has also met informally with key stakeholders and light vehicle manufacturers during the development of this draft RIS.

Summary of previous public comment

The 2016 RIS was released for public consultation to elicit views from all interested parties on its key proposals. Feedback was specifically sought on the estimated benefits and costs of the proposals, as well as the implementation timing.

Forty-three submissions were received from a wide range of stakeholders, including from:

- light vehicle manufacturers
- heavy vehicle manufacturers and operators
- state governments

- consumer and business representative groups
- environment and health groups
- component suppliers
- fuel industry organisations
- individuals and community groups.

Overall, the submissions supported Government action to improve air quality by reducing noxious emissions from road vehicles.

There was broad support for implementing Euro 6 for new light vehicles. However, light vehicle manufacturers and consumer groups raised concerns that the proposed 2019 to 2020 implementation timeframe was too ambitious as:

- it would significantly disrupt vehicle production plans that are already in place
- it did not take into account the timing of necessary improvements to Australia's petrol quality standards
- it did not allow time for Euro 6d to be translated from an EU regulation to an internationally recognised UN regulation.

Non-confidential submissions were also published on the department's website at: https://infrastructure.gov.au/vehicles/environment/forum/index.aspx.

This draft RIS recognises these concerns and effectively responds to them by proposing a new implementation timeframe of 2027 for new light vehicle models and 2028 for all new light vehicles. This allows manufacturers sufficient time for production planning and aligns with the proposed move to better quality petrol (reduced sulfur and aromatics). The transposition of Euro 6d into a new series of UN regulations is being done by the UN WP.29 through the GRPE. The department has participated in meetings of GRPE in 2019 and 2020 and understands that the transposition process will be completed by 2021.

Health, environment and community groups, along with state and territory governments supported an immediate or early implementation timeframe noting that similar standards are already in place in many other countries. The department considers the revised timeframe achieves a balance between minimising regulatory burden to industry while still achieving significant health benefits for the Australian community.

Stakeholders had a range of opinions on the benefit-cost analysis. Light vehicle manufacturers claimed that the costs of moving from Euro 5 to Euro 6d were underestimated. The FCAI provided updated cost estimates. At the same time, health, environment and community groups, and state and territory governments suggested that the analysis used out of date information that significantly underestimated the health impacts of noxious emissions.

For this draft RIS, the department, through the BITRE, has undertaken a revised benefit-cost analysis that responds to these claims. The analysis uses updated estimates of capital costs (based on the information provided by FCAI) and health costs.

In terms of the health costs, the Government released a RIS by the Department of the Environment and Energy on possible changes to Australia's fuel quality standards to reduce noxious vehicle emissions and improve access to the latest vehicle technology in 2018. The Department of the Environment and Energy engaged independent consultants Marsden Jacob Associates to undertake

the benefit-cost analysis. Marsden Jacob Associates used an 'impact pathways' approach that resulted in more robust and relevant estimates of the health impacts of noxious vehicle emissions on the Australian community compared with those previously used for the 2016 RIS.

The BITRE have used the Marsden Jacob Associates analysis to update the health cost estimates for this draft RIS. The revised estimates are higher than those in the 2016 RIS. They are also expected to increase over time, reflecting increasing exposure to the pollutants in Australian urban areas due to growth in population (and population density).

The updated health cost estimates mitigate stakeholder concerns about the lower estimates used for the 2016 RIS, and achieve consistency across the two major pieces of work by the Government on noxious emissions standards and fuel quality standards.

Future consultation

This draft RIS is now being released for further targeted consultation with key stakeholders. It does not represent a Government decision or formal Government policy. Comments on the draft RIS are requested by 26 February 2021 and should be submitted as a separate Word or PDF document to vemissions@infrastructure.gov.au, or posted to:

Sustainable Transport
Department of Infrastructure, Transport, Regional Development and Communications
GPO Box 594
CANBERRA ACT 2601

The feedback received in response to this draft RIS, and further individual stakeholder discussions, will help inform the department to finalise the RIS before a final decision is made by Government.

Appendix A: Benefit cost analysis of introducing Euro 6 emissions standards in Australia

The key indicators of the economic viability of a proposed option are its net benefits and benefit-cost ratio (BCR). A positive net benefit means that the returns on the option will outweigh the resources outlaid. The BCR is a measure of the efficiency of the option. If the net benefits are positive, the BCR will be greater than one. A higher BCR means that, for a given cost, the benefits are paid back a number of times over.

- Benefits were determined from the health costs avoided relative to business as usual.
- Additional costs were based on the estimated capital costs likely to be incurred by manufacturers to fit more advanced emissions systems.
- Costs and benefits were assessed based on capital costs and avoided health costs.

Table 4: Benefit-cost analysis for the implementation of Euro 6 standards for new light vehicles in Australia—net present value, 2019 Australian dollars

Year	Capital costs ($m)	Avoided health costs ($m)	Net benefit ($m)
2027	78.8	17.9	-60.9
2028	132.8	59.2	-73.7
2029	114.2	106.3	-7.9
2030	100.7	151.9	51.2
2031	90.8	193.3	102.5
2032	81.5	229.7	148.1
2033	73.2	261.3	188.2
2034	65.6	288.0	222.4
2035	57.0	309.7	252.7
2036	49.4	326.6	277.2
2037	42.8	339.0	296.2
2038	37.1	347.2	310.1
2039	32.3	352.1	319.8
2040	27.9	354.1	326.2
2041	24.1	349.6	325.4

Year	Capital costs ($m)	Avoided health costs ($m)	Net benefit ($m)
2042	20.7	343.0	322.3
2043	17.5	334.7	317.2
2044	4.3	325.0	320.7
2045	10.4	314.1	303.7
2046	24.9	302.5	277.6
2047	7.2	290.5	283.2
2048	5.2	277.1	272.0
2049	3.3	263.2	259.9
2050	1.6	249.4	247.8
Total	1,103.3	6,385.3	5,282

Estimated costs: $1,103.3m

Estimated benefits: $6,385.3m

Net benefit: $5,282m

Benefit/Cost Ratio: 5.79 ($6,385.3m/1,103.3m)

Assumptions

The BITRE analysis assumed that the emissions-reduction technology on vehicles purchased during most years of the evaluation period would continue to generate benefits beyond the end of the evaluation period in 2050.

Since the benefits from this technology are fairly constant over the lives of the vehicles, an approximation to residual evaluation was obtained by prorating the cost of the technology over the lives of the vehicles, then only counting costs attributed to years before 2050.

The average vehicle life (median survival time) was assumed to be 17 years. For vehicles purchased during the later years of the evaluation period, the cost of the emissions-reducing technology was annualised over 17 years.

A standard discount rate of seven per cent was used, as required by the Office of Best Practice Regulation (OBPR). Sensitivity testing was conducted on discount rates of 3 and 11 per cent, as required by OBPR, show that, even with a higher discount rate of 11 per cent, the BCR would remain well above one.

The analysis assumed an increase in the proportion of new vehicle models employing GDI technology, with GDI light vehicles possibly approaching half of new petrol-vehicle sales before 2025. It also assumed that oil prices would remain relatively close to current levels over the medium term and then

gradually rise over ensuing decades. Electric vehicle uptake was also anticipated to increase as predicted in the BITRE Research Report 151 'Electric Vehicle Uptake – Modelling a Global Phenomenon'[61].

Costs of introducing Euro 6 for new light vehicles in Australia were assessed based on increased capital costs associated with fitting new emissions reduction technologies. The cost estimates for these technologies were informed by industry submissions to the Vehicle Emissions Discussion Paper and the 2016 RIS along with a range of studies.

The total estimated cost of meeting Euro 6 was likely slightly conservative as it did not include additional maintenance costs. It is anticipated that there would be some increase in the maintenance costs for light diesel vehicles, notably in relation to the exhaust after-treatment system. Over the long term, as the technology becomes more mature, maintenance costs would likely reduce.

Further, possible changes in fuel costs from meeting Euro 6 were not included. The fuel economy of Euro 6 compliant light vehicles depends on the emissions abatement technology used and duty cycles, that is how the engine is going to be used and, in particular, its operating temperature profile. A sensible assumption would be that, in a competitive environment, engine/vehicle manufacturers would make every effort to minimise fuel consumption to the lowest possible levels subject to compliance with the Euro 6 standards. Based on this, possible additional fuel costs were assumed to be negligible. A 2017 study by ABMARC also suggests Euro 6 engines are more likely to be fitted with fuel saving technologies, as vehicle manufacturers were concurrently required to meet more stringent fuel efficiency standards in other markets[62].

The benefits of introducing Euro 6 were assessed based on avoided health costs. The first step was to estimate the tonnes of emissions saved under Euro 6 relative to business as usual. The second step was to establish a value for an average health cost ($ per tonne of emissions) from the latest available data. The final step was to calculate the total health benefits (i.e. health costs avoided) by multiplying tonnes of emissions saved by unit values for health costs. The unit values for the health costs were derived from work undertaken by independent consultants Marsden Jacob Associates for the Department of the Environment and Energy's RIS on fuel quality standards.

Sensitivity testing

Given the inevitable uncertainties with some of the assumptions used, sensitivity tests were undertaken on assumptions around: vehicle maintenance and capital costs, and discount rates. The results are summarised below.

Table 5: Sensitivity test results for Euro 6 for light vehicles

Sensitivity test	Benefit-cost ratio	Net benefits ($m)
Core Euro 6 scenario	5.79	5,282
'Worst case' scenario—high range extra capital costs and significant increases in average service / maintenance costs	2.73	4,047
Low discount rate (3 per cent)	7.54	12,644
High discount rate (11 per cent)	4.53	2,354

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