Australian Government

Department of Infrastructure, Transport, Regional Development and Communications

Heavy Vehicle Emission Standards for Cleaner Air

Draft Regulation Impact Statement

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Contents

Acronyms and abbreviations

ABS	Australian Bureau of Statistics
ADR	Australian Design Rule
ATA	Australian Trucking Association
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
GVM	Gross vehicle mass
HC	Hydrocarbons
ICCT	International Council on Clean Transportation
NEPM	National Environment Protection (Ambient Air Quality) Measure
NCAA	National Clean Air Agreement
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
RIS	Regulation Impact Statement
RVSA	*Road Vehicle Standards Act 2018*
SOx	Sulfur oxides
SVSEG	Strategic Vehicle Safety and Environment Group
TIC	Truck Industry Council
UN	United Nations
US EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres travelled
VOC	Volatile organic compound

WHSC	Worldwide Harmonised Stationary Cycle
WHTC	Worldwide Harmonised Transient Cycle
WP.29	World Forum for the Harmonization of Vehicle Regulations
WTO	World Trade Organisation

Executive summary

Australia currently mandates the Euro V noxious emissions standards for newly approved heavy vehicle models first manufactured from 1 January 2010, and for all heavy vehicles manufactured from 1 January 2011. This Early Assessment Regulation Impact Statement (draft RIS) evaluates whether the Australian Government should mandate more stringent standards to reduce noxious emissions from heavy road vehicles.

After analysing several options, including no change to existing standards and a voluntary standard, this draft RIS has found that there would be significant benefits for the Australian community if a new Australian Design Rule mandating the latest noxious emissions standards for heavy vehicles, known as Euro VI, was adopted under the *Road Vehicle Standards Act 2018*[a] (RVSA). These benefits would not otherwise be realised under the Euro V noxious emissions standards currently mandated by Australia, or from implementing other options such as industry introducing its own, more stringent, voluntary standards.

In response to feedback received during our preliminary consultation with heavy vehicle manufacturers, the Department of Infrastructure, Transport, Regional Development and Communications (the department) has modelled the costs and benefits of mandating Euro VI for all newly approved heavy vehicle models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028. Industry stakeholders have argued that this strikes a balance between managing Australia's air quality and supporting the ongoing viability of Australia's local heavy vehicle manufacturers and transport operators.

If Euro VI was mandated for all newly approved heavy vehicle models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028, the benefit-cost analysis suggested that its adoption would result in a net benefit of $5,189 million by 2050 and a benefit-cost ratio of 4.53. The estimated health benefits from this measure of ($6,672 million by 2050) were found to far outweigh any expected increases in capital costs for heavy vehicle manufacturers ($985 million over the same period) or possible increases in operating costs for heavy vehicle operators ($489 million over this period).

However, the department wishes to seek further stakeholder feedback on how and when Euro VI could be implemented for heavy vehicles in Australia. In particular, the department wishes to seek your views on whether it is possible to introduce Euro VI from an earlier date. This could include, for example, your views on whether Euro VI for some heavy vehicle categories, such as medium duty trucks and buses, could be introduced from an earlier date or whether elements of Euro VI could be implemented in a 'staged approach' (as was done in Europe and other markets). 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 Set to replace the Motor Vehicle Standards Act 1989 by 1 July 2021.

Consultation

This 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 is separately progressing a RIS to consider the case for mandating more stringent Euro 6 noxious emissions standards for light 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.

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 heavy diesel road vehicles since the mid-1990s. Australia currently mandates the Euro V noxious emissions standards for newly approved models first manufactured from 1 January 2010, and for all heavy vehicles manufactured from 1 January 2011. Australia also accepts heavy vehicles meeting equivalent standards that apply in the United States (US) or Japan.

While Euro V has, and is continuing to, reduce noxious emissions from new heavy vehicles entering the Australian market, other countries are introducing or have introduced more stringent vehicle emissions standards. The more stringent Euro VI emission standards for heavy vehicles commenced in the European Union (EU) from the end of 2012. Equivalent standards already apply in most other major vehicle markets including the US, Canada, China, Korea and Japan. This, in combination with the introduction of other more stringent safety and emissions standards, has forced heavy vehicle manufacturers to develop new vehicle and engine technologies across the global market.

The main changes under Euro VI compared with Euro V are:

- a reduction in emission limits for oxides of nitrogen (NOx) by up to 80 per cent
- a reduction in emission limits for particulate matter by up to 66 per cent
- a new particle number limit to reduce ultrafine particle emissions; and
- a new, more representative engine bench test and new on-road emissions test.

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 the global market and Australian transport operators have access to technology available in other markets.

Emission standards in the global vehicle market

Noxious emissions from heavy 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. The ADRs also set minimum requirements for vehicle safety, environmental performance and anti-theft protection.

When developing national vehicle standards, the Australian Government has committed to harmonising its technical requirements with those adopted in the relevant 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 heavy vehicle noxious emissions has adopted the Euro VI 'Stage D' requirements as its minimum.

The heavy vehicle market in Australia only represents approximately 1.2 per cent of global vehicle sales. The relatively small size of our market makes the regulation of unique Australian standards, and the design and manufacture of bespoke vehicles tailored specifically for it, undesirable in all but the most specialised segments.

Globally, major manufacturers are being required to develop vehicles and engine technologies that can meet increasingly stringent vehicle emissions standards. Euro VI or equivalent noxious emissions standards have been adopted in the US, Canada, Europe, Japan, China, Korea and India. These countries, which account for over 80 per cent of global new vehicle sales, also require heavy vehicle manufacturers to meet fuel efficiency standards as well as increasingly stringent safety requirements.

Stakeholders are concerned that Australia's less stringent emissions standards are beginning to affect the range of vehicles that are being allocated to the Australian market. This has also delayed the uptake of vehicles fitted with advanced safety and emissions systems that are available as standard overseas.

Approximately 40,000 heavy vehicles[b] are supplied to the Australian market each year. Two-thirds of these, predominantly light[c] or medium[d] rigid trucks, vans and buses, are imported. This is either as a cab-chassis with a body added at an assembly plant in Australia or as a complete vehicle. The remaining third are heavy rigid and articulated trucks. Unlike their lighter counterparts, almost half of these heavier vehicles, or just over 6,000 trucks each year, are engineered and manufactured in Australia specifically for the Australian market.

Heavy vehicles supplied to the North American, European and Japanese markets need to meet similar and increasingly stringent safety, fuel efficiency and emissions standards. Heavy vehicle manufacturers are developing engine platforms that meet these requirements and offer a package of advanced safety, fuel efficiency and emissions technologies such as Euro VI and Autonomous Emergency Braking (AEB) as standard.

Heavy vehicle manufacturers in Australia sell a range of models directly imported from overseas. However many vehicles supplied to the Australian market, whether imported or locally produced, are only designed to meet the minimum Australian standards such as Euro V. Vehicles designed to meet international noxious emissions standards are fitted with advanced technologies that cost around three to five per cent more to produce, while vehicles designed to meet our older Australian standards tend to be cheaper. The more advanced safety and emission features required overseas as standard are often only offered as options at extra cost.

Many heavy vehicle manufacturers, particularly those without an engineering presence in Australia, are concerned that it is more difficult to sell vehicles fitted with advanced safety and emissions systems in Australia. Consumers are often attracted to vehicles with a lower purchase price rather than comparing the total operating costs. This means that consumers are less likely to consider buying more models fitted with advanced safety and emissions systems as these models often have a higher

[b] Consistent with UN Regulations, heavy vehicles are defined in this RIS as passenger (M category) and goods carrying (N category) vehicle a gross vehicle mass over 3.5 tonnes.
[c] GVM 3.5 to 8 tonnes.
[d] GVM over 8 tonnes, but with a gross combination mass under 39 tonnes.

purchase price[e]. As a result, many heavy vehicles entering the Australian fleet use more fuel, produce higher noxious emissions and offer less protection to drivers and other road users.

While it is technically possible to adapt older engine platforms to add more advanced safety and emissions systems (as some manufacturers do), this may not always be technically possible or commercially viable. Many vehicle manufacturers are reluctant to invest in the additional research and development required to incorporate these advanced vehicle technologies into Australian vehicles. Their ability to amortise these costs is diminishing which will continue as more countries, particularly in the Asia-Pacific, adopt more stringent standards in the future.

The risk that these advanced safety and fuel saving technologies may not be offered in the Australian market will increase the longer our standards remain unaligned with those prevalent overseas. This will intensify if international emission standards are tightened further as the EU proposes from the mid-2020s. Although less significant for heavier, more specialised vehicles, the risk is that if our standards further diverge from UN regulations and those prevalent across the global vehicle market, it may not be commercially viable for global manufacturers to offer more advanced vehicle models in Australia.

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[3]. 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[4], long-term effects on lung function[5], childhood leukaemia[6,7], and childhood brain tumours[8].

Living close to major roads and highways increases your risk of dying early[9] and has even been linked to a higher incidence of dementia in the elderly[10]. High levels of benzene, a known carcinogen, have been discovered near major roads, particularly when traffic is congested[11].

The two main air pollutants of greatest concern to health experts are fine particles[f], 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[12]. A study into the public risk of exposure to air pollutants from 2013 found that long-term population exposure to $PM_{2.5}$

[e] Truck manufacturers have provided information to the department that suggested their current generation Euro VI models were 5 to 10 per cent more fuel efficient than previous generation Euro V models, with future generations potentially up to 15 per cent more fuel efficient, due to fuel efficiency standards in the US, European and Japanese markets. Offsetting this, the unladen mass of their Euro VI models were around 100-150kg heavier than equivalent Euro V models.

[f] Airborne particulate matter measuring less than 2.5 micrometres in aerodynamic diameter.

alone was attributable to nine per cent of all deaths from ischemic heart disease in Australia's four largest cities[13].

Health experts agree that there is no safe level of exposure to particulates and that any reduction in particulate concentrations would improve population health outcomes[14,15,16,17]. 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[18]. 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[19]. 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[20].

The problem 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.

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[g], especially in urban areas with high volumes of traffic. On average, the air quality index in most major urban regions of Australia[h] has improved since 2006. However of these regions, the air quality index in the Sydney, Illawarra, Lower Hunter, Melbourne and South East Queensland regions has deteriorated since 2011[21].

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[22]. 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[23]. 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 also exacerbating this problem. The proportion of the Australian population aged over 65 is expected to more than double over the next 40 years[24]. This may lead to, as seen in Japan, an increase in the mortality rate attributed to air pollution despite reductions in ambient air pollution[25].

While our average level of exposure to $PM_{2.5}$ is declining in part due to reductions in exhaust emissions from new road vehicles entering the fleet, our exposure to ozone is increasing. Furthermore, although an Australians 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 emissions standards[26].

[g] 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 complimentary state and territory legislation.

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

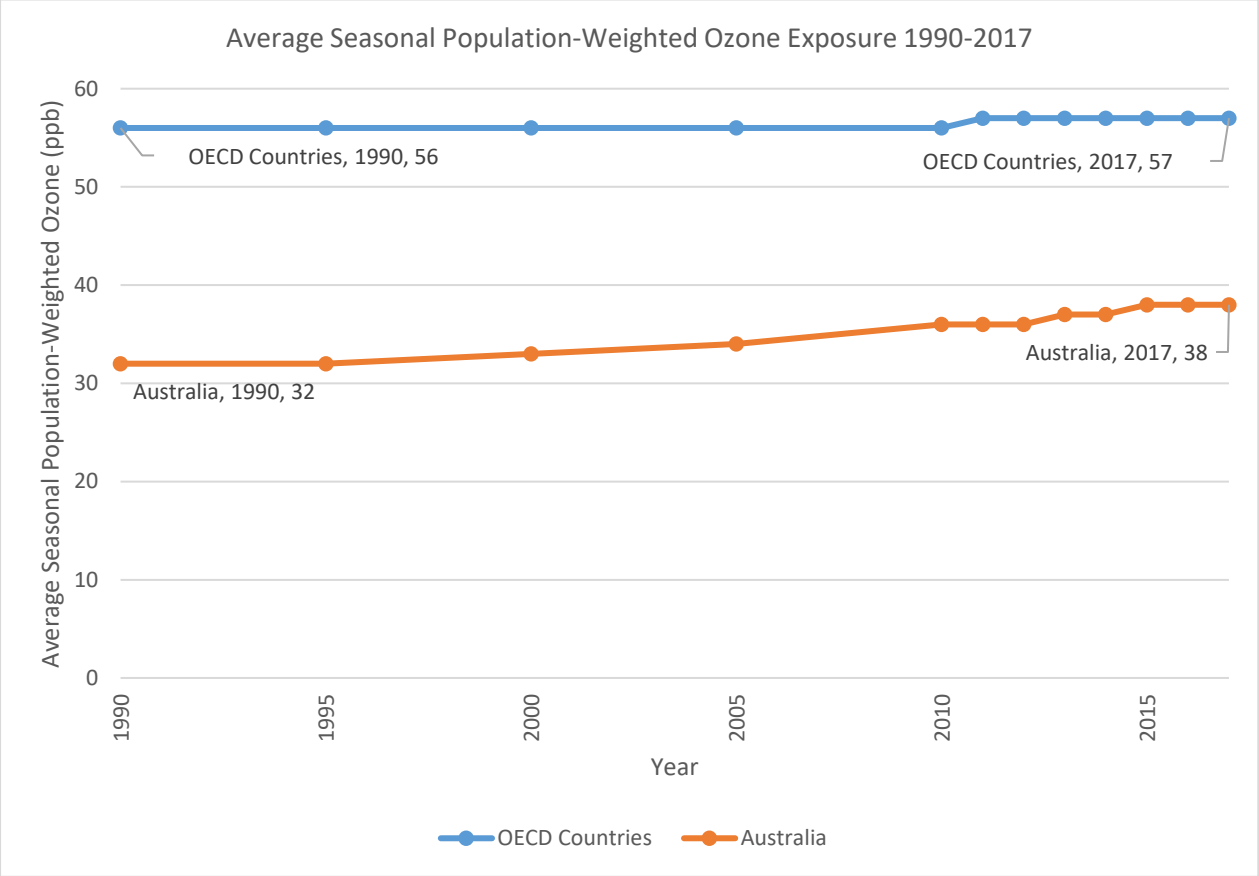

Figure 1 Average seasonal population weighted exposure to ozone in Australia and OECD countries[27]

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. Heavy diesel vehicles are now the largest source of NOx emissions in the Sydney region, accounting for almost 40 per cent of NOx emissions from road vehicles[28]. Data from New South Wales also show that NOx emissions from heavy diesel vehicles declined by 37 per cent per vehicle kilometre travelled since 2003. This was due to more stringent standards applying to new vehicles entering the fleet. However, total NOx emissions produced by heavy diesel vehicles in New South Wales only declined by 26 per cent. This was because, as demand for transport services increased over that period, improvements in NOx emissions for vehicles entering the fleet were offset by an increase in the total workload and vehicle kilometres travelled by heavy diesel vehicles. By comparison, NOx emissions from light vehicles declined by up to 71 per cent per vehicle kilometre travelled and 45 per cent in total[29].

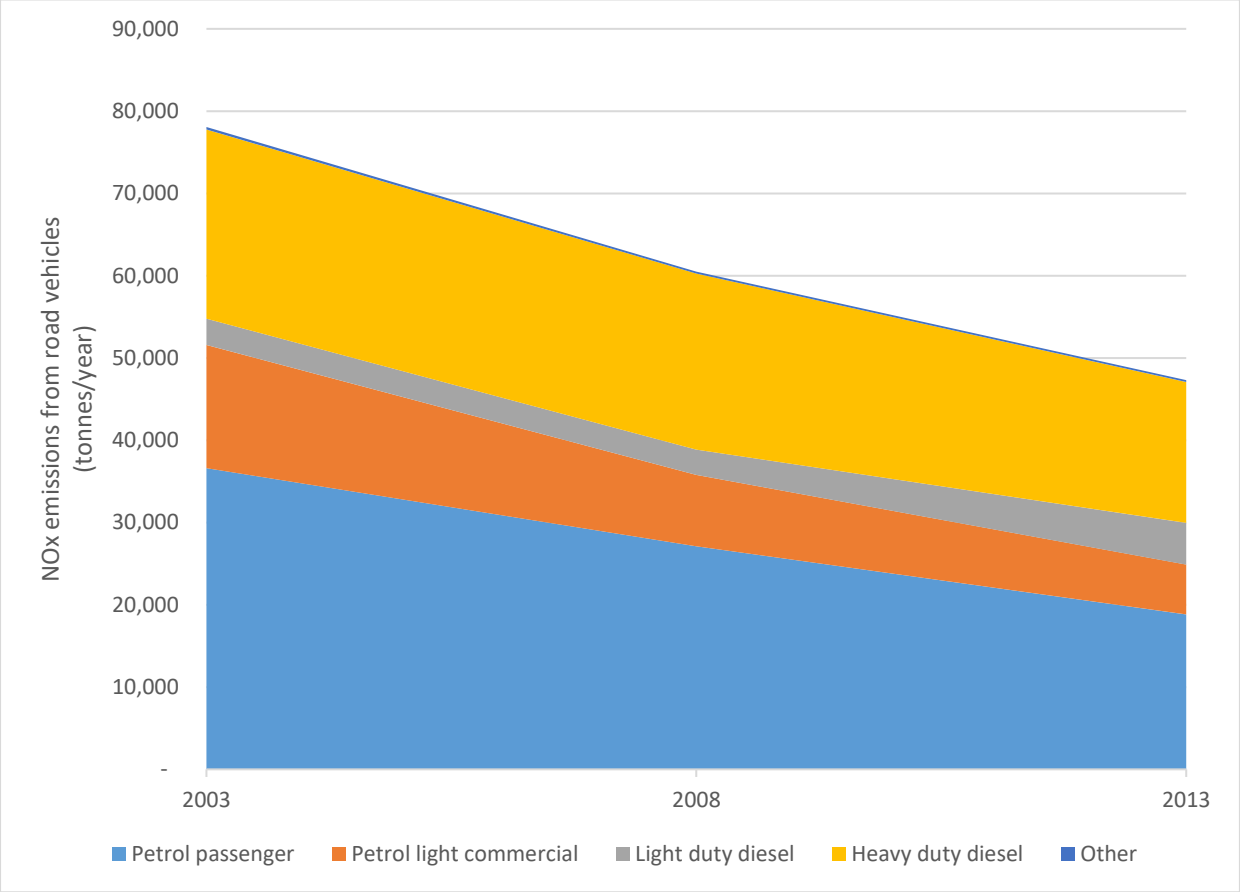

Figure 2 NOx emissions from road vehicles by vehicle type in the NSW Greater Metropolitan region[30]

Heavy vehicles[i] account for a disproportionate share of noxious road vehicle emissions. They constitute approximately four per cent of road vehicles in Australia, but perform about eight per cent of road vehicle kilometres travelled (VKT) and account for 23 per cent of all road transport fuel consumed in Australia[31]. Diesel engines, which generally emit higher levels of NOx and particulate emissions, accounted for 94 per cent of the heavy vehicle fleet and 98 per cent of kilometres travelled by heavy vehicles[32].

Heavy vehicle use and diesel fuel consumption is steadily increasing. Total heavy vehicle travel is predicted to grow by 66 per cent between 2016 and 2040 and heavy vehicle diesel fuel consumption is predicted to grow by 56 per cent over the same period[33]. In the absence of more stringent standards, this growth in vehicle activity will start to outweigh reductions in noxious emissions from newer vehicles replacing older vehicles meeting less stringent standards.

The majority of man-made particulate emissions in major Australian population centres can be attributed to combustion sources such as wood heaters, fuel reduction burns, coal fired power stations and vehicular traffic. While road vehicles are not the only source of these, exhaust emissions can contribute up to 30 per cent of overall particulate emissions in urban areas[34]. Particulate levels tend to be highest near busy roads and in dense urban areas. Data from New South Wales (Figure 3)

i Consistent with the UN regulations, the Australian Design Rules for heavy vehicle emissions apply to passenger (M category) or goods carrying (N category) vehicles with a gross vehicle mass over 3.5 tonnes.

shows that heavy diesel vehicles are the largest source of exhaust particulate emissions from road vehicles[35]. As we are responsible and have control over these sources of air pollution, any reduction will benefit the community.

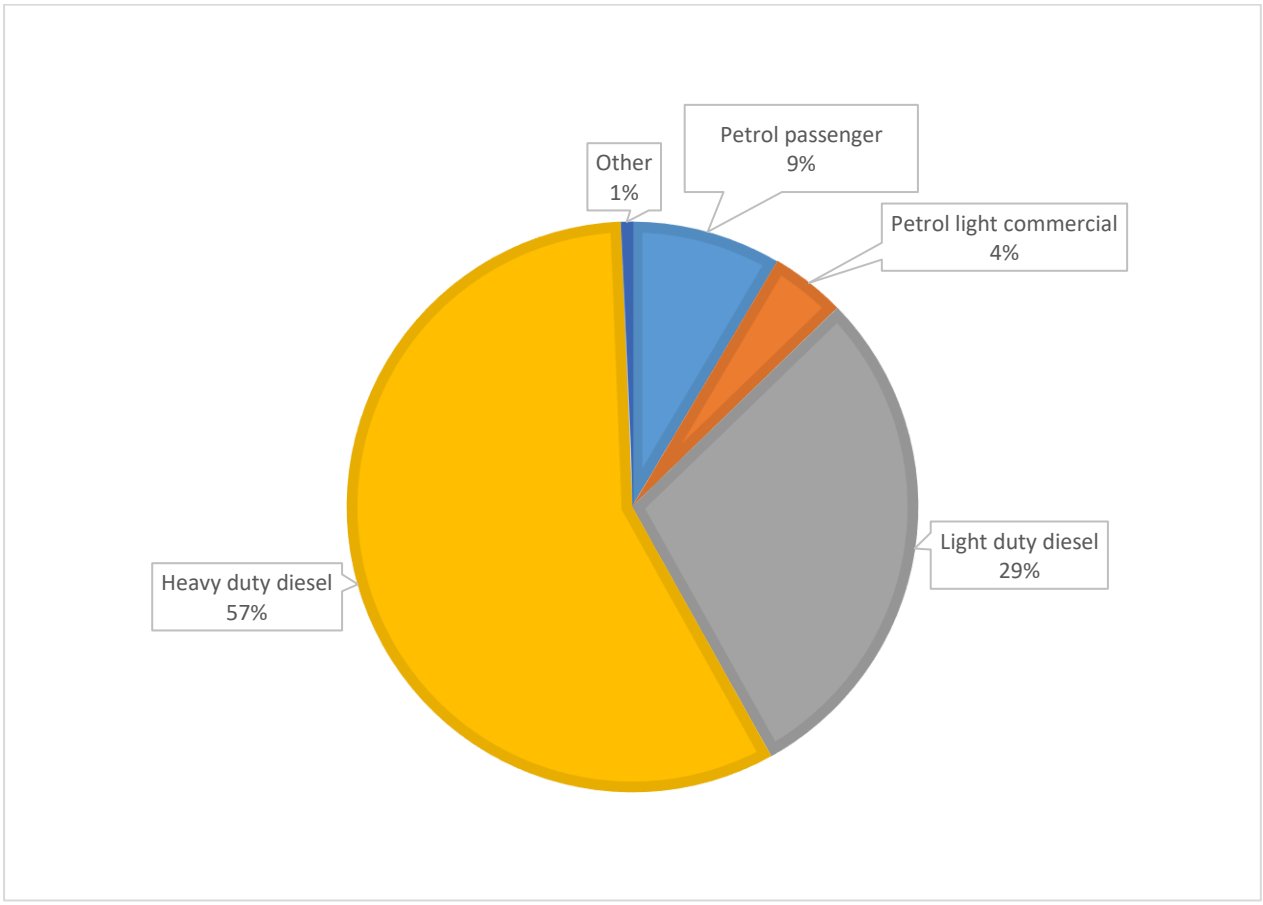

Figure 3 PM2.5 exhaust emissions from road vehicles in the NSW Greater Metropolitan region[36]

Particulate emissions produced by heavy diesel vehicles have declined by 52 per cent per kilometre since 2003. This was smaller than the rate of improvement for light petrol and light diesel vehicles, which declined by 88 and 93 per cent per kilometre respectively. This is because improvements in the emissions intensity of heavy duty diesel engines have been partly offset by an increase in the average workload performed by heavy diesel vehicles[37].

As outlined above, 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. The impact of exposure to noxious emissions from vehicles on human health makes addressing this issue a priority.

Why is further Government action needed?

Australian governments are already taking action to improve air quality. Australia has mandated the Euro V noxious emissions standards for heavy diesel vehicles for all newly approved models first manufactured from 1 January 2010 and all new heavy vehicles manufactured from 1 January 2011. But Australia has had noxious emissions standards in place for heavy 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, and
- increases in the size of and make up of vehicle fleets as well as vehicle usage patterns, particularly in urban areas.

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) estimates that, since 1990, heavy vehicle noxious emissions standards have reduced carbon monoxide and hydrocarbon emissions by over 80 per cent, nitrogen oxide emissions by almost 40 per cent and particulate mass emissions by approximately 50 per cent. These improvements have occurred despite the fact there are almost 60 per cent more heavy vehicles on the road and total vehicle kilometres travelled by heavy vehicles have increased by over 80 per cent over the same period.

More broadly, in December 2015, Australia's Environment Ministers established the National Clean Air Agreement (NCAA) 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 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[38].

The National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM)[39] 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, particularly in higher volume segments that are more price sensitive.

Most developed countries have now adopted noxious emissions standards for heavy vehicles based on, or equivalent to, Euro VI. 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. 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. In most cases, where it is cost effective to do so, manufacturers will design vehicles to meet the minimum requirements demanded by consumers and regulators in that market.

Almost half (47.7 per cent) of all of heavy duty rigid and articulated trucks[j] supplied to the Australian market are built in Australia specifically for the Australian market, due to the unique requirements of Australia's interstate road freight industry. This means that regulations in other markets have less influence on this segment of the Australian heavy vehicle fleet. In the absence of further government intervention, the adoption of Euro VI or equivalent emission systems in heavy duty trucks in Australia is likely to remain relatively independent of the rate of adoption in other markets.

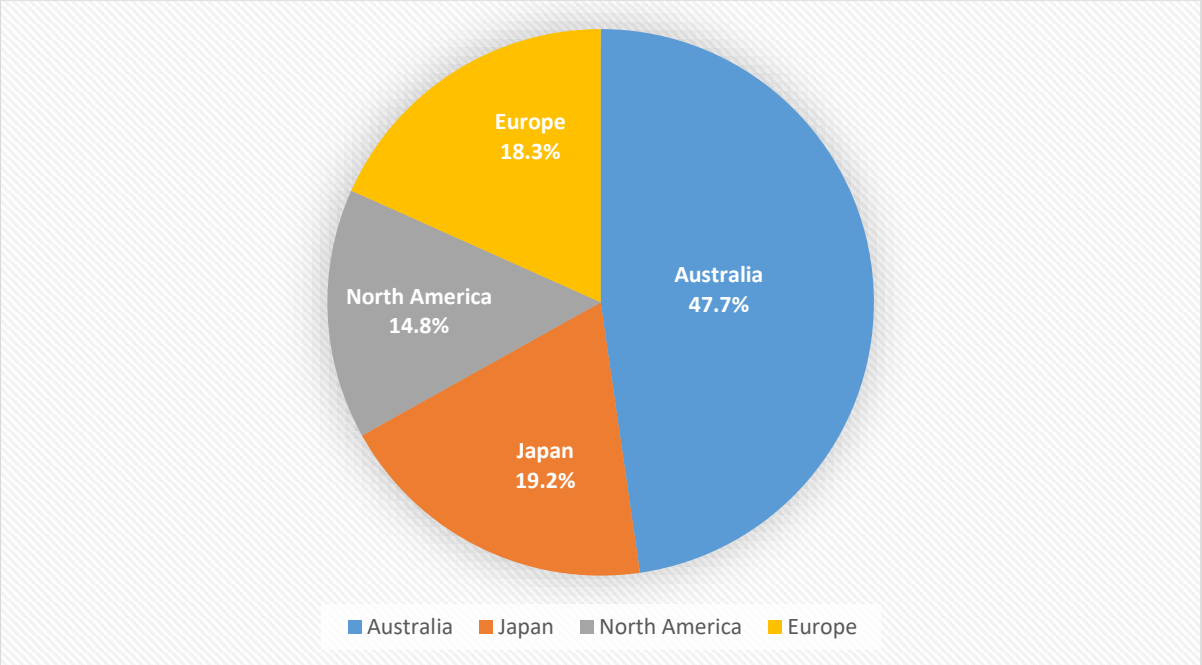

Figure 4 Heavy duty truck sales in Australia by country/region of manufacture[40]

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 VI 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 V

[j] The Truck Industry Council sales data defines heavy duty trucks are defined as trucks with a) 3 or more axles; or b) 2 axles, a GVM >8 tonnes, and a GCM > 39 tonnes.

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 heavy road vehicles?

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

- **Option 1:** Business as usual – allow the existing Euro V noxious emissions standards and market forces to provide a solution.
- **Option 2:** Voluntary standard - maintain Euro V noxious emissions standards as the minimum legal requirement, but encourage vehicle manufacturers, through peak industry groups, to enter into an agreement with the Government to meet increased noxious emissions performance requirements.
- **Option 3:** Increased mandatory standards - mandate Euro VI (and equivalent US and Japanese standards) for heavy vehicles under the *Road Vehicle Standards Act 2018* (RVSA).

Discussion of options

Option 1: Business as usual

The 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 Government would not intervene further and instead rely on existing Euro V noxious emissions standards and market forces to continue delivering 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 V noxious emissions standards replace older vehicles that do not. A growing proportion of vehicles entering the Australian market may even meet Euro VI standards, reflecting the implementation of these standards in overseas markets, and join the number of Euro VI compliant vehicles already available in Australia[41].

From an emissions perspective, existing standards are unlikely to continue delivering reductions in NOx and PM emissions in the longer term. The differences in emissions level between vehicles entering and exiting the fleet will diminish and will start to be outweighed by growth in number of kilometres travelled by the heavy vehicle fleet. As a result, the health impacts of disease attributable to noxious emissions from heavy vehicles are expected to increase as the population ages.

Projections by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) (Figure 5) show that under current policy settings, emissions of oxides of nitrogen (NOx) from heavy vehicles will decline until 2020, then steadily increase out to 2050.

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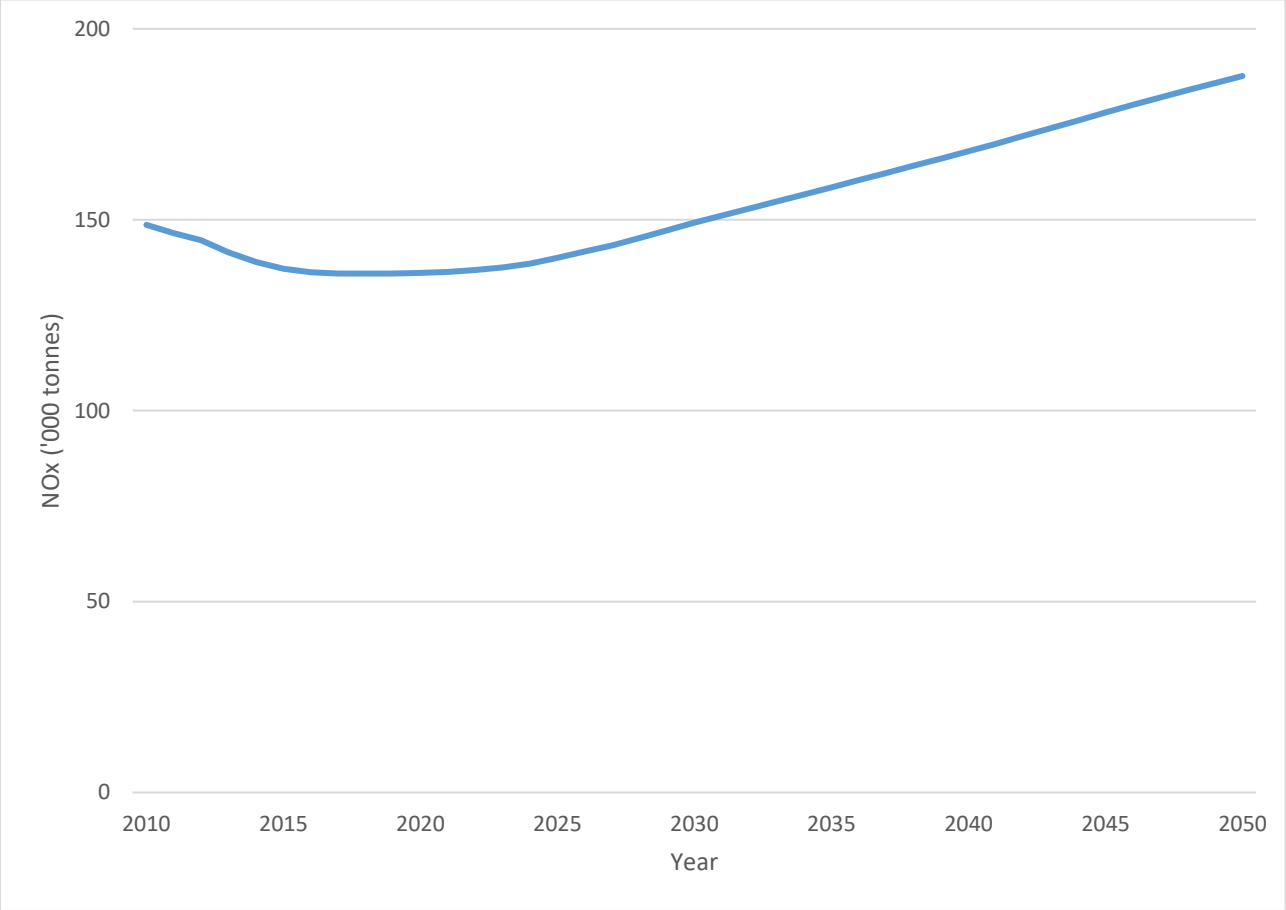

Figure 5 Projected impact of existing noxious emissions standards (Euro V) on NOx emissions from the heavy vehicle fleet (2010–2050)[42]

BITRE projections also show that under current policy settings, fine particulate emissions from heavy vehicles will continue to decline until 2025 before increasing over the same period to 2050.

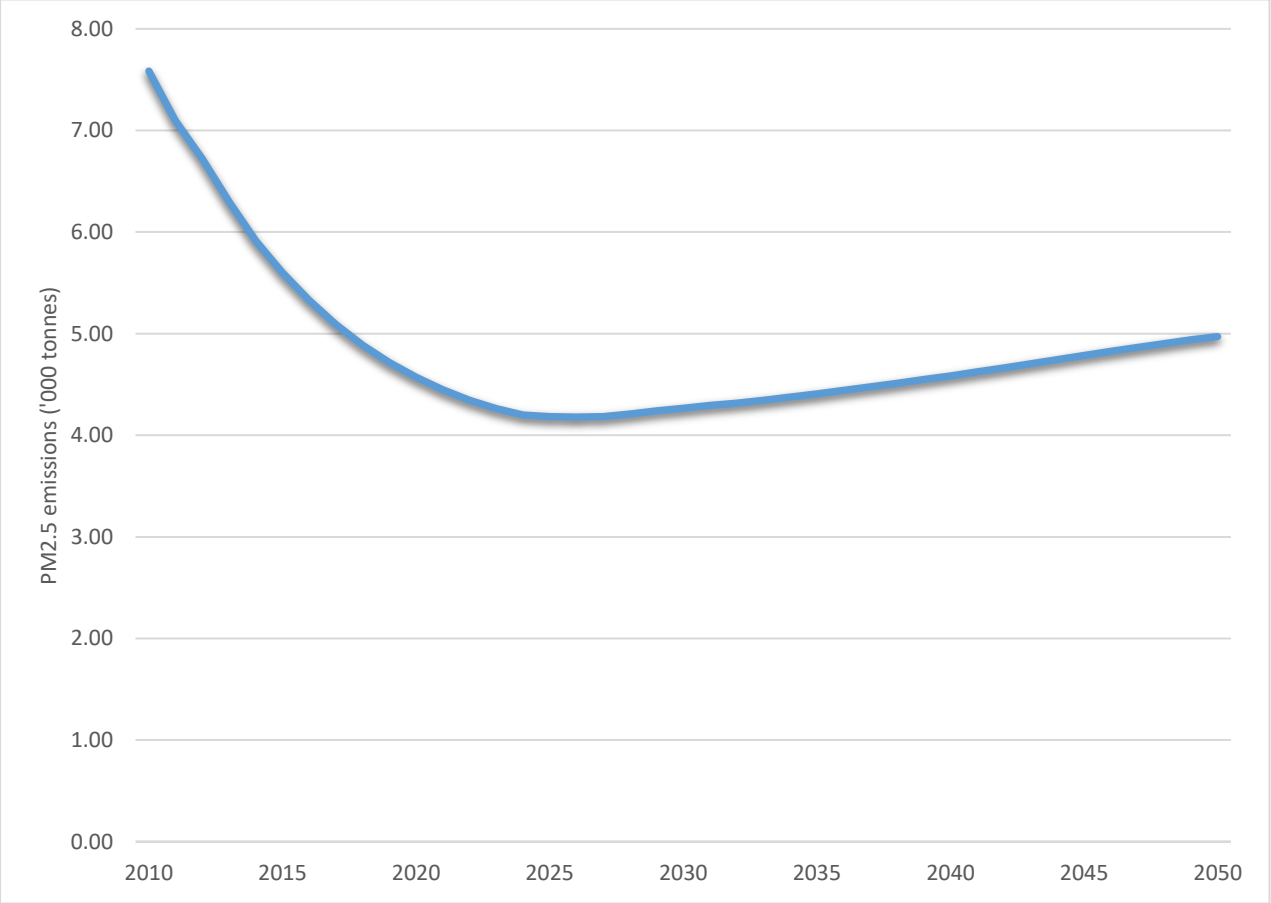

Figure 6 Projected impact of existing noxious emissions standards (Euro V) on $PM_{2.5}$ emissions from the heavy vehicle fleet (2010–2050)[43]

In the absence of more stringent mandatory standards, some manufacturers will choose to continue supplying vehicles meeting current minimum 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[44].

Because of this, there is no guarantee under a business as usual option that large numbers of Euro VI and other next generation vehicles will be offered by all manufacturers to the Australian market. It will also not resolve the issue raised by heavy vehicle manufacturers that our outdated vehicle emissions standards are making it more difficult to offer more advanced fuel saving and safety features to the Australian market.

There are no additional benefits or costs associated with this option as there are no proposed changes to existing policy. However, this does not mean that the costs of complying with existing standards or the health impacts of noxious emissions from heavy 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: Implement a voluntary standard

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 be an agreement by heavy vehicle manufacturers to fit emission control systems meeting Euro VI or equivalent standards to heavy vehicles over and above the current mandated Euro V 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 heavy vehicle manufacturers and/or their customers. If there is no incentive to supply heavy 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 heavy 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 heavy 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 VI 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 certification processes that essentially duplicate those for mandatory standards, which would increase costs and complexity[45]. This would diminish any compliance costs savings from a voluntary standard, in lieu of a mandatory standard.

As compliance with a voluntary noxious emissions standard would be strongly dependent on the commercial interests of heavy 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 3: Increased mandatory standards (Euro VI) for heavy vehicles

Under this option, the Government would mandate improved noxious emissions performance for heavy vehicles by determining a new ADR under the RVSA. The current proposal would be to mandate Euro VI in Australia for new heavy vehicle models from 1 July 2027 and from 1 July 2028 for all new heavy vehicles. Other option to implement Euro VI 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 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 on the basis of country of origin or manufacture and this has been the case since the introduction of motor vehicle standards legislation.

Vehicle standards for noxious emissions in Australia and overseas 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 in-service heavy vehicles are 37 per cent lower per kilometre than heavy vehicles in 2003. Particulate emissions from in-service heavy vehicles are 52 per cent lower per kilometre than heavy vehicles in 2003[46]. Studies by the International Council for Clean Transportation have also found that 'real-world' NOx emissions from Euro VI vehicles were significantly lower than Euro IV and V vehicles[47].

The adoption of Euro VI would deliver the following key benefits for the heavy vehicle fleet:

- an increase in the durability requirements for vehicle emissions control systems
- a 70 per cent reduction in emissions limits for HC/VOC
- a 77-80 per cent reduction in the emissions limits for NOx
- a 50-66 per cent reduction in the mass emissions limits for particulates
- the introduction of a limit on the number of particles in order to control fine particle emissions
- the adoption of the Worldwide Harmonised Stationary and Transient Cycles (WHSC and WHTC) and a new on-road test to make sure reductions in emissions are realised during normal operation on the road
- more stringent requirements for on-board diagnostic systems that monitor the emissions 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).

Table 1 outlines the key changes in emissions limits from Euro V to Euro VI.

Table 1 Euro V and Euro VI emissions limits for heavy diesel vehicles

Pollutant	Euro V		Euro VI	
	Stationary Cycle	Transient Cycle	Stationary Cycle	Transient Cycle
Oxides of nitrogen	2,000 mg/kWh	2,000 mg/kWh	400 mg/kWh (80% lower)	460 mg/kWh (77% lower)
Particulate matter	20 mg/kWh	30 mg/kWh	10 mg/kWh (50% lower)	10 mg/kWh (66% lower)

Alignment of standards with the global vehicle market

Mandating Euro VI for heavy vehicles would also bring Australia's vehicle standards into closer alignment with international standards adopted by major vehicle markets, which also supply the majority of heavy vehicles to Australia. This would increase Australians access to the latest models fitted with latest safety and fuel saving technologies, by reducing technical and commercial barriers to the importation of vehicles meeting Euro VI or equivalent standards. By reducing technical and commercial barriers to the introduction of latest global models, fitted with the latest technologies, mandating Euro VI for all new heavy vehicles sold in Australia, would indirectly improve the safety and fuel efficiency of the Australian heavy vehicle fleet.

Impact on emissions

Projections by the Bureau of Infrastructure, Transport and Regional Economics (BITRE) show that under the proposed ADR, if implemented from 2027, NOx emissions from the heavy vehicle fleet will peak at 140,000 tonnes in 2025, then decline to less than 36,000 tonnes by 2050, or 81 per cent lower than expected under business as usual in 2050.

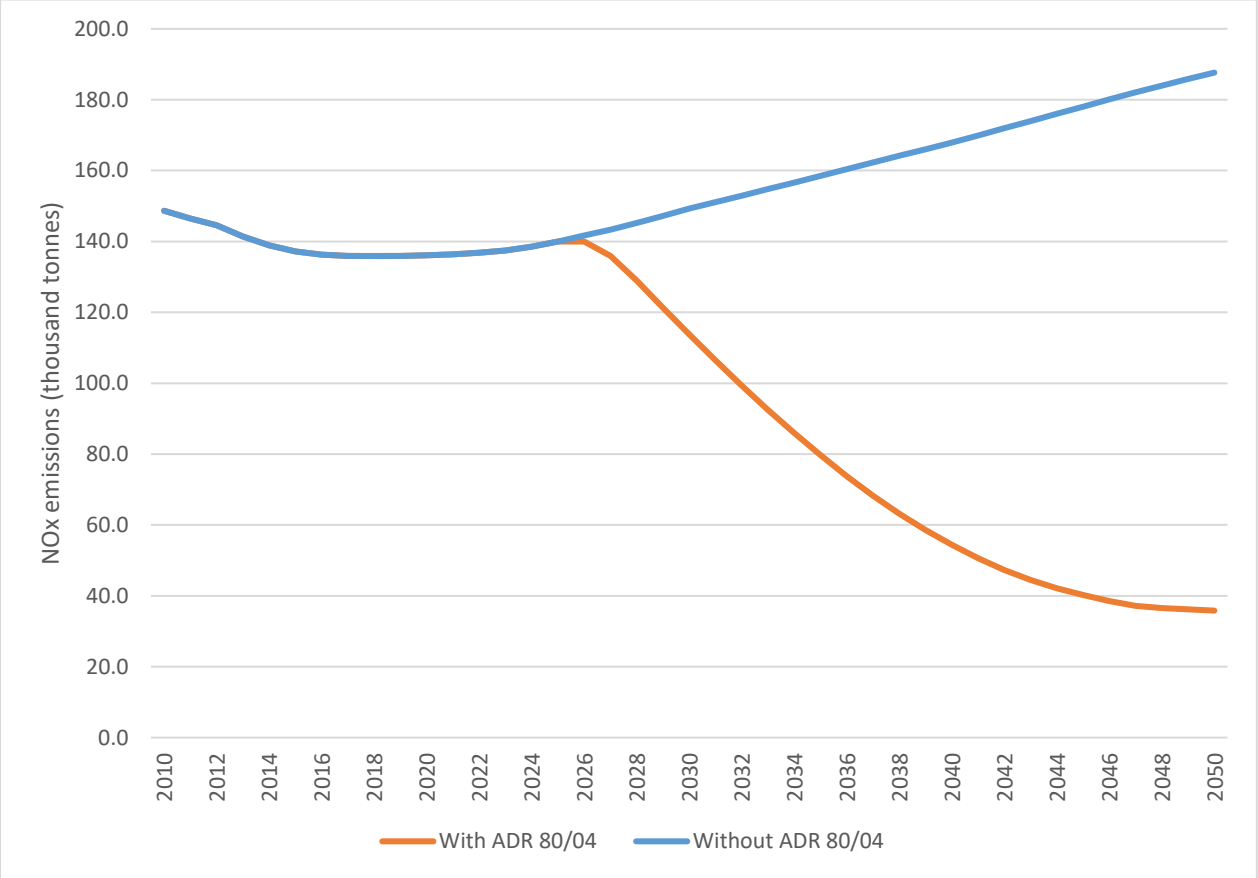

Figure 7 Projected impact of proposed noxious emissions standards (Euro VI and equivalent alternatives) on NOx emissions from the heavy vehicle fleet (2010–2050)[48]

BITRE projections (Figure 8) also estimate that under the proposed ADR, if implemented from 2027, fine particulate emissions from heavy vehicles will decline by more than 50 per cent from 2027 to 2050. This is also 59 per cent lower than that expected under business as usual.

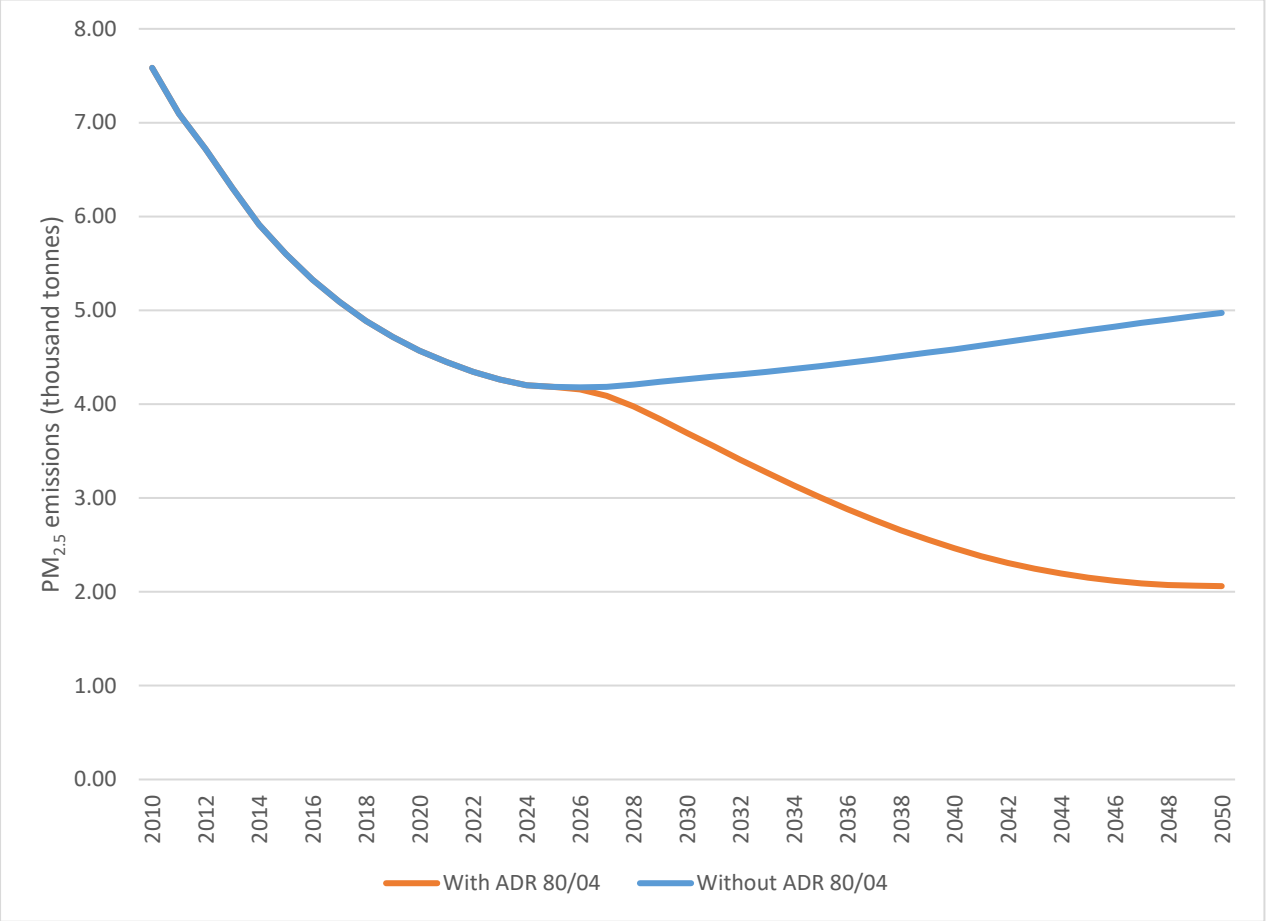

Figure 8 Projected impact of proposed noxious emissions standards (Euro VI and equivalent alternatives) on $PM_{2.5}$ produced by the heavy vehicle fleet (2010–2050)[49]

Costs and benefits

The department, through BITRE, undertook a detailed benefit-cost analysis of mandating Euro VI for newly approved heavy vehicle models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028. Costs included in this analysis were additional capital costs for heavy vehicle manufacturers and possible impacts on operating costs for transport operators. Benefits included in this analysis were avoided health costs.

There are also likely to be significant benefits from keeping pace with international standards as this will reduce technical and commercial barriers to the supply of the latest heavt vehicle models fitted with the latest safety and fuel saving technologies as standard. However, as there is no methodology to estimate these benefits reliably, these benefits cannot be quantified and have been excluded from the benefit-cost analysis. The estimated benefits in the cost-benefit analysis are therefore likely to be conservative.

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 heavy vehicle fleet, based on an average vehicle life of 20 years. The results showed that by 2050, using a discount rate of seven per cent (as required by the Australian Government Guide to Regulation), implementing Euro VI or equivalent standards from 2027 would achieve a net benefit of $5,198 million and a benefit-cost ratio of 4.53.

The BITRE analysis found that there would be a direct benefit of $6,672 million by 2050 to the health and wellbeing of the Australian community under this option through reductions in air pollution. This would have an indirect benefit to governments by reducing pressure on the public health system through reductions in the incidence of disease attributable to air pollution. The majority of health benefits will accrue in metropolitan and neighbouring areas, where the number of people and average level of exposure to noxious emissions from road vehicles 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 benefit directly 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, improved air quality in metropolitan areas would benefit all Australians, including those living in more remote locations.

To meet Euro VI or equivalent standards, heavy vehicle manufacturers would incur additional capital costs, as they would be required to fit additional technology to ensure the emissions levels produced by their vehicles meet the requirements of these standards. This technology may also add weight and/or take up space available to operators to carrying goods or passengers, or affect the cost of operating and maintaining a truck or bus.

BITRE also estimated there would be a direct cost to heavy vehicle manufacturers of $985 million by 2050 as a result of the additional capital costs required to meet Euro VI standards. Some or all of these costs could be passed on to transport operators purchasing new vehicles.

To meet Euro VI, heavy vehicle manufacturers may be required to fit additional technology that adds weight and/or takes space. This may lead to a loss in productivity of $279 million by 2050 for heavy vehicle operators in the form of reduced payload for trucks or seating capacity for buses or coaches. There may be higher maintenance costs for heavy vehicle operators of $196 million to ensure heavy vehicles continue to comply with these standards in service. Heavy vehicle operators may pass these increased costs on to consumers through higher prices for transporting goods or passengers.

There are also 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 or covered by cost recovery options.

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

Regulatory burden

The Government also 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 makes 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 costs 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 to 2036 inclusive.

Our analysis found that the average annual regulatory cost associated with this option is $273.7 million. To the extent that market forces allow, the costs to business in the tables below may be passed on to consumers.

Table 2 - Regulatory burden and cost offsets estimate table – mandating Euro VI for heavy vehicles

Average annual regulatory costs (from business as usual)				
Change in costs ($ million)	**Business**	**Community organisations**	**Individuals**	**Total change in costs**
Total, by sector	273.7			273.7

Options for implementing Euro VI for heavy vehicles in Australia

The department seeks your feedback on how and when Euro VI could be introduced for heavy vehicles should the Government decide to do so. This includes your views on whether it is possible to introduce Euro VI from an earlier date for some heavy vehicle categories or whether a staged approach to implementation could be adopted. 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.

Earlier commencement of Euro VI for some heavy vehicle categories

As outlined above, for the purposes of this draft RIS the department has modelled the costs and benefits of mandating Euro VI for all newly approved heavy models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028.

This timeframe was chosen in response to feedback received during preliminary consultation with heavy vehicle industry stakeholders. Several stakeholders argued that this implementation date strikes a balance between managing Australia's air quality and supporting the ongoing viability of Australia's heavy vehicle manufacturers and transport operators. It was also argued that it would provide certainty for investment decisions and allow the necessary lead time required to develop and manufacture heavy vehicles suitable for Australia's unique operating conditions, such as higher vehicle speeds, distances and temperatures.

Unlike light vehicles, which are now fully imported, almost half of heavy rigid and articulated trucks supplied to Australia are built in Australia specifically for the Australian market. This is due to the unique operating conditions and configurations, such as B-Double and road train combinations. The Australian heavy vehicle manufacturing sector produces over 6,000 trucks each year and directly employs approximately 4,000 people, with many more employed in sales, equipment, second stage manufacturing (such as bodybuilding) and distribution[50].

As locally manufactured vehicles are predominantly heavy duty trucks with a gross vehicle mass over 12 tonnes (NC category vehicles), the department seeks your feedback on whether Euro VI could be mandated from an earlier date for other heavy vehicle categories, such as medium duty trucks (NB category) and buses (MD and ME category). These vehicles are often designed for an international market and are more likely to operate over shorter distances in urban areas than heavier (NC category) trucks, which are more likely to be used for long haul interstate road freight operations[51].

An earlier introduction date for some vehicle categories may also align more closely with the proposed introduction of an ADR for AEB. This could enable manufacturers to develop vehicles that comply with both changes in a single engineering process. As other markets that require AEB have also mandated Euro VI or equivalent standards, this could reduce development costs for heavy vehicle manufacturers, by allowing them to sell models already available overseas.

Unlike petrol vehicles, where the introduction of more stringent noxious emissions standards is contingent on the availability of local refineries to produce ultra low sulfur petrol, diesel fuel sold in Australia already has a maximum a sulfur content of 10 parts per million. No evidence has been provided to the department that further changes to the automotive diesel standard are needed to support the introduction of Euro VI for heavy diesel vehicles.

Adopting a staged approach to the introduction of Euro VI

In the EU and other major markets, Euro VI or equivalent standards were implemented over a number of stages to allow time for the technology to develop and mature.

- **Stage A:** commenced in the EU at the end of 2012. It adopted the Euro VI emissions limits, new test cycle and on-road test, and initial on-board diagnostic system requirements.
- **Stage B:** commenced in the EU in September 2014. It adopted more stringent requirements for on-board diagnostics.
- **Stage C:** commenced in the EU at the end of 2015. It adopted even more stringent requirements for on-board diagnostics.
- **Stage D**: commenced in the EU in September 2018. It adopted more stringent on-road emissions testing requirements to include lower load conditions.
- **Stage E:** commenced in the EU in September 2020. It adopts more stringent on-road emissions testing requirements to include cold start conditions and a particle number limit (1.63 times the bench test limits). These requirements have been adopted as in the EU as Regulation 2019/1939, but are yet to be transposed into UN Regulation 49/06.

If the proposed timeframe of 1 July 2027 for the introduction of Euro VI is adopted, it is proposed that Australia would implement 'Stage D' of the standard. By this date Euro VI 'Stage D' will have been in force in the EU for nine years and manufacturers should have a clear understanding of the steps required to meet these standards.

Some heavy vehicle manufacturers have advised that it may be possible to adopt an earlier stage of Euro VI before 2027. The emissions limits for all stages of Euro VI are the same but other requirements, such as on-board diagnostics which monitor the performance of emission systems. would be less stringent than those required in 'Stage D'.

Equivalent alternative standards

As is the case under the current ADR mandating Euro V for heavy vehicles (ADR 80/03), it is intended that the new ADR recognise equivalent US or Japanese standards as alternative standards. Specific feedback is sought from the heavy vehicle industry on which US and Japanese standards should be recognised as equivalent alternative standards in an ADR to mandate Euro VI.

Conclusion

Noxious emissions from road vehicles reduce urban air quality, leading to premature deaths and illnesses among Australians. This draft RIS examined the case for Government action to reduce these emissions in order to improve health outcomes.

Australia has long had standards in place that limit noxious emissions from road vehicles, 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 lag most developed countries.

This draft RIS considered a range of options in addition to taking no further action to reduce noxious emissions from road vehicles. These options included that the Government establish voluntary noxious emissions standards through an agreement with peak industry bodies or mandate more stringent noxious emissions standards for heavy vehicles under the RVSA.

There is a strong case for mandatory standards to reduce noxious emissions from road vehicles. Air pollution from road vehicles is a negative externality, and so the problem will not be addressed by the operation of market forces alone. Government action to strengthen noxious emissions standards is 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. Without further government intervention in this area the health impacts and number of premature deaths resulting from traffic-related pollution caused by noxious emissions from heavy vehicles are expected to increase over the next decade.

The introduction of Euro VI for heavy vehicles will bring Australia's vehicle standards into closer alignment with international standards adopted by major vehicle markets. This will help improve Australian transport operators' access to the latest safety and fuel saving technologies, by reducing technical and commercial barriers to the introduction of technologies packaged with engines meeting Euro VI or equivalent standards, particularly in the lighter, less specialised segments of the heavy vehicle market that do not have as strong a manufacturing or engineering presence in Australia.

Our analysis found that there were significant benefits for the Australian community to be gained from improving air quality by mandating Euro VI for new heavy vehicles. These benefits would not otherwise be realised either through a business as usual approach or through other options, such as voluntary standards. The analysis suggested that, if adopted, the introduction of Euro VI for heavy vehicles for all newly approved models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028 would result in avoided health costs of $6,672 million and increased capital costs to manufacturers of $985 million over the period to 2050. The net benefits over this same period were estimated to be $5,198 million, with a benefit-cost of 4.53.

This draft RIS proposes that the government mandate Euro VI for heavy vehicles for all newly approved models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028. The proposed implementation timeframe was modelled after consideration of stakeholder views, particularly those of heavy vehicle manufacturers and trucking operators. The timeframe would allow manufacturers sufficient time to develop and source products designed to meet these new emission standards.

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

Consultation

Previous consultation

This draft RIS was prepared following consideration of feedback received through a range of consultative processes.

On 11 February 2016, the Government 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 on more stringent noxious emissions standards for new light and heavy vehicles. The 2016 RIS was prepared by the department following consideration of submissions received in response to the Discussion Paper and feedback received at stakeholder engagement meetings on 7 December 2015 and 4 April 2016.

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

The proposal to mandate Euro VI noxious emissions standards for light and heavy 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 Truck Industry Council and the Australian Trucking Association, and consumer and road user organisations such as the Australian Automobile Association.

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

Summary of previous public consultation

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

Truck and bus manufacturers generally supported a move to Euro VI, but indicated a preference for a longer lead time before its introduction. Truck manufacturers, through the Truck Industry Council (TIC), noted that implementing Euro VI would help improve access to advanced safety and fuel-saving technologies that are impractical to add to Euro V trucks with older technology, as these technologies are typically packaged with Euro VI engine technology in other markets.

However, TIC also noted that a combination of significant challenges in selling new trucks and an increase in national freight task in recent years has resulted in an ageing truck fleet, with nearly half the fleet meeting no, or only basic, noxious emissions standards. TIC called for Government incentives to encourage the uptake of new trucks and remove older, dirtier trucks from the road. TIC also called for increases to mass and dimension limits for new heavy vehicles to offset the productivity impacts of meeting Euro VI.

Truck operators, through the Australian Trucking Association (ATA), did not support a move to Euro VI. They raised concerns that Euro VI trucks would cost more to both purchase and operate. The ATA proposed alternative options such as extending the fuel tax credit maintenance criteria to heavy manufactured after 1996 and regulating off-road engine emissions. Like TIC, the ATA proposed changes to mass and dimension limits.

Health, environment and community groups, along with state and territory governments supported the introduction of Euro VI as soon possible, 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. 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, while the ATA considered the 2016 RIS analysis did not demonstrate an overall net benefit, as it did not include maintenance costs and likely underestimates additional urea costs. Bus manufacturers also questioned the assumptions for fuel, urea and productivity impacts.

In terms of the health costs, in early 2018, the Government released a RIS developed 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. 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 arguably more robust and relevant estimates of the health impacts of noxious vehicle emissions on the Australian community compared with those used by BITRE for the 2016 RIS.

BITRE used this Marsden Jacob Associates analysis to update the health cost estimates for this draft RIS. The revised estimates are notably higher than those used in the 2016 RIS. Further, they are

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 firstly mitigate stakeholder concerns about the lower estimates used for the 2016 RIS, and secondly achieve consistency across the two major, related pieces of work by the Government, noxious emissions standards and fuel quality standards.

During further consultation with truck and bus manufacturers in 2019, truck manufacturers provided information to the department that suggested:

- Their current generation Euro VI models were 5 to 10 per cent more fuel efficient than previous generation Euro V models, with future generations potentially up to 15 per cent more fuel efficient, due to fuel efficiency standards in the US, European and Japanese markets.
- The unladen mass of their Euro VI models were around 100-150kg heavier than equivalent Euro V models. This is about half the mass penalty suggested in previous modelling.

The Bus Industry Confederation provided data that found that Euro VI buses used 1 to 2 per cent less fuel than Euro V buses, but used more exhaust fluid. The department also notes that truck operator TNT tested two similar Scania trucks (one Euro V and one Euro VI) under exactly the same conditions on Australian roads in 2018. Both trucks consumed a similar amount of fuel, while the Euro VI truck consumed only half the amount of AdBlue diesel exhaust fluid[52].

For this draft RIS, the department, through BITRE, has undertaken a revised benefit-cost analysis that responds to these claims. The updated base case analysis:

- uses updated estimates of health costs
- includes an estimate of productivity costs based on a 300kg mass increase and maintenance costs
- assumes that overall fuel and exhaust fluid costs for Euro VI vehicles are similar to those for Euro V vehicles (with higher fuel costs being offset by lower fluid costs or vice-versa).

Future consultation

The above feedback on the 2016 RIS, feedback received at a further Ministerial Forum on Vehicle Emissions stakeholder engagement meeting on 15 February 2017, and the Government's decision on 25 February 2019 on fuel quality standards, has informed the development of this draft RIS.

This draft RIS is now being released for further targeted consultation with key stakeholders. It does not represent a Government decision nor 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 for a final policy decision by the Government.

Implementation and evaluation

If the Government decides to mandate the Euro VI noxious emissions standards, this would be implemented through a new ADR 80/04, under the RVSA. New ADRs, or amendments to the ADRs, are determined by the Minister under section 12 of the RVSA.

The Government has a long-term policy to harmonise the ADRs with international regulations adopted by the UN. If the proposed approach is adopted, it is proposed that ADR 80/04 adopt the Euro VI requirements as adopted in UN Regulation 49, as last amended by Supplement 6 to the 06 series of amendments. ADR 80/04 would accept the equivalent technical requirements of EU Regulation 582/2011, as last amended by EU Regulation 2018/932, as well as equivalent US and Japanese standards, to be determined in consultation with industry, as alternative standards.

It would be important to determine the new ADR as soon as possible following a Government policy decision. This would provide certainty to manufacturers about this decision, and would give them sufficient time to undertake necessary business planning before the ADR commences for newly approved models. The department will need to consult closely with heavy vehicle manufacturers and peak bodies when drafting the new ADR, particularly in relation to the proposed alternative standards.

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. ADR 80/04 would be scheduled for a full review on an ongoing basis and in line with this practice.

Appendix A: Benefit cost analysis of introducing Euro VI 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 emission systems.
- Costs and benefits were assessed based on capital costs and avoided health costs.

Table A1 - Benefit-cost analysis for the implementation of Euro VI standards for new heavy vehicles in Australia—net present value, 2019 Australian dollars

Year	Capital cost ($m)	Maintenance costs ($m)	Fuel costs ($m)	Diesel Exhaust Fluid ($m)	Productivity loss/extra road wear ($m)	Greenhouse gas emissions ($m)	Total costs ($m)	Health costs avoided ($m)	Net benefits ($m)
2026	53.0	1.4	0.5	-0.3	2.4	0.1	57.1	6.2	-50.9
2027	89.6	3.6	1.9	-0.9	6.3	0.2	100.7	26.6	-74.1
2028	84.3	5.5	3.5	-1.9	9.7	0.4	101.4	60.5	-40.9
2029	79.2	7.2	4.8	-2.8	12.5	0.6	101.4	98.2	-3.3
2030	74.5	8.6	5.9	-3.6	14.8	0.7	100.9	133.7	32.7
2031	70.0	9.5	6.7	-4.3	16.1	0.8	98.7	166.5	67.8
2032	64.2	10.0	7.0	-4.9	16.5	0.8	93.6	197.2	103.6
2033	58.8	10.2	7.3	-5.4	16.5	0.8	88.3	225.5	137.2
2034	53.7	10.3	7.5	-5.8	16.3	0.8	82.7	251.5	168.8
2035	48.8	10.3	7.6	-6.3	15.8	0.8	77.1	275.2	198.1
2036	44.2	10.2	7.6	-6.6	15.2	0.8	71.4	296.6	225.2
2037	39.9	10.0	7.6	-7.0	14.5	0.8	65.8	315.6	249.8
2038	35.9	9.8	7.5	-7.2	13.7	0.8	60.4	332.4	272.0
2039	32.1	9.5	7.3	-7.4	12.9	0.8	55.1	346.8	291.7
2040	28.6	9.2	7.1	-7.6	12.1	0.7	50.1	359.0	308.8
2041	25.3	8.8	6.9	-7.7	11.3	0.7	45.4	364.5	319.1
2042	22.1	8.3	6.7	-7.7	10.5	0.7	40.6	367.9	327.2
2043	19.1	7.9	6.4	-7.8	9.8	0.7	36.1	369.0	332.9
2044	16.3	7.5	6.2	-7.8	9.1	0.6	31.9	368.0	336.1

Year	Capital cost ($m)	Maintenance costs ($m)	Fuel costs ($m)	Diesel Exhaust Fluid ($m)	Productivity loss/extra road wear ($m)	Greenhouse gas emissions ($m)	Total costs ($m)	Health costs avoided ($m)	Net benefits ($m)
2045	13.6	7.2	5.9	-7.8	8.5	0.6	28.0	365.6	337.6
2046	11.0	6.9	5.6	-7.7	7.9	0.6	24.3	362.1	337.8
2047	8.6	6.5	5.3	-7.7	7.3	0.5	20.7	356.9	336.2
2048	6.3	6.2	5.1	-7.6	6.8	0.5	17.3	350.1	332.8
2049	4.1	5.9	4.8	-7.4	6.3	0.5	14.1	342.3	328.2
2050	2.0	5.5	4.6	-7.3	5.9	0.4	11.1	334.4	323.3
Total	**985.2**	**195.8**	**147.3**	**-148.3**	**278.7**	**15.7**	**1,474.4**	**6,672.3**	**5,197.9**

Estimated costs: $1,474.4m

Estimated benefits: $6,672.3m

Net benefit: $5,197.9m

Benefit/Cost Ratio: 4.53 ($6,672.3m/1,474.4m)

Assumptions

The BITRE analysis assumed that 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 20 years. For vehicles purchased during the later years of the evaluation period, the cost of the emissions reduction technology was annuitised over 20 years.

A standard discount rate of 7 per cent was used, as required by the OBPR. Sensitivity testing was conducted on discount rates of 3 and 11 per cent, which showed that, even with a higher discount rate of 11 per cent, the benefit-cost ratio was well above one (at about 3.60).

Based on the technology adopted to date by manufacturers to meet equivalent standards in North America, Europe and Japan, it was assumed that that most manufacturers will use integrated Exhaust Gas Recirculation and Selective Catalytic Reduction systems with Diesel Particulate Filters to achieve low levels of emissions set out in the proposed Euro VI standards.

Costs considered included capital costs, fuel costs, diesel exhaust fluid costs, productivity losses, and greenhouse gas emissions. Benefits included health costs avoided.

- The capital cost estimates for vehicle emissions control technologies were informed by industry submissions received during previous consultation.
- Fuel cost impacts were calculated by assuming that the fuel consumption of a Euro VI heavy vehicle would be 0.5 to 1 per cent higher than an equivalent Euro V vehicle due to the heavier vehicle mass and the use of Exhaust Gas Recirculation systems, which tend to be less fuel efficient. This assumption is considered to be conservative. Some truck and bus manufacturers have advised the department that data from their customers indicates that many Euro VI models are more fuel efficient, or no less efficient, than their Euro V models.
- Diesel exhaust fluid costs were calculated by assuming that a move to Euro VI would entail more vehicles using urea than the base case, but with reduced rates of urea consumption per vehicle. While bus manufacturers have advised the department that these costs have been higher than originally anticipated, they have been offset by reductions in fuel consumption. As a result, this is unlikely to materially affect the outcome of the modelling.
- Productivity losses were calculated by estimating the cost of the reduced payload or seating capacity directly, assuming no change in legal mass and dimension limits when Euro VI is mandated. The department notes that the National Heavy Vehicle Regulator (NHVR) is considering options to incentivise the adoption of trucks meeting advanced safety and emissions standards, which may include changes to mass and dimension limits. The costs and benefits of such measures are beyond the scope of this analysis.
- No additional road wear costs were anticipated in the base case, as it is assumed that all Euro VI vehicles will continue to operate within legal mass and dimension limits to the same extent as existing vehicles.
- Changes in greenhouse gas emissions were estimated from increased carbon dioxide emissions from the increased fuel consumption. This is considered to be conservative as this does not include possible reductions in black carbon greenhouse gas emissions. It is also possible that fuel consumption may not increase, as many Euro VI engines are also packaged with additional fuel saving technologies.
- Avoided health costs were calculated by quantifying the emissions of pollutants and estimating the emissions saved relative to the base case and by establishing a value for an average health cost from existing studies.

Sensitivity testing

Given the inevitable uncertainties with some of the assumptions used, sensitivity tests were undertaken on assumptions around:

- impacts on productivity
- impacts on road wear
- impacts on maintenance costs
- evaluation period (2040 vs 2050)
- base and price year (2016 vs 2019)
- discount rates.

The results are summarised below in Table A2. With net benefits ranging from $1,972 million to $5,900 million and all scenarios tested being positive, the estimated net benefit of $5,198 million from adopting this option appears realistic.

Table A2 Sensitivity test results for Euro VI for heavy vehicles

Sensitivity test	Benefit-cost ratio	Net benefits ($m)
Core Euro VI scenario (to 2050, 2016 base year)	4.53	5,197.9
Low discount rate (3 per cent)	5.96	14,624.0
High discount rate (11 per cent)	3.53	1,972.4
Shorter analysis period (2026 to 2040)	3.51	2,211.6
2019 base year	4.33	5,899.5
Higher maintenance costs with additional road wear	2.60	4,105.6
Higher maintenance costs and productivity losses with additional road wear	2.08	3,460.1
Higher maintenance costs and mass concession (lower productivity losses and higher road wear)	2.40	3,887.4

1 International Council on Clean Transportation – Anenberg, S, Miller, J, Henze, D, Minjares, R (2019). A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015. Available at: https://theicct.org/publications

2 Department of the Environment and Energy (2016), National Pollutant Inventory. Available at: http://www.npi.gov.au/data/search.html.

3 Straif K, Cohen A, Samet J & International Agency for Research on Cancer (2013). IARC Scientific Publication No. 161: Air pollution and cancer. World Health Organization, Geneva. Available at: www.iarc.fr/en/publications/books/sp161/AirPollutionandCancer161.pdf.

4 Brauer M, Lencar C, Tamburic L, Koehoorn M, Demers P & Karr C (2008). A cohort study of traffic-related air pollution impacts on birth outcomes. Environmental Health Perspectives 116(5):680–686.

5 Peters JM, Avol E, Berhane K, Gauderman JW, Gilliland F, Jerrett M, Junzli N, London S, McConnell R, Navidi B, Rappaport E, Thomas D, Lurmann F, Roberts P, Alcorn S, Funk T, Gong H, Linn WS, Cass G & Margolis H (2004). Epidemiologic investigation to identify chronic effects of ambient air pollutants in Southern California, prepared for the California Air Resources Board and the California Environmental Protection Agency. Available at: https://www.arb.ca.gov/research/single-project.php?row_id=60245.

6 Whitworth KW, Symanski E & Coker AL (2008). Childhood lymphohematopoietic cancer incidence and hazardous air pollutants in southeast Texas, 1995–2004. Environmental Health Perspectives 116:1576–1580.

7 Heck JE, Park AS, Qiu J, Cockburn M & Ritz B (2014). Risk of leukemia in relation to exposure to ambient air toxics in pregnancy and early childhood. International Journal of Hygiene and Environmental Health 217:662–668.

8 Peters S, Glass D, Reid A, de Klerk N, Armstrong BK, Kellie S, Ashton LJ, Milne E & Fritschi L (2012). Parental occupational exposure to engine exhausts and childhood brain tumors. International Journal of Cancer 132:2975–2979.

9 Gan WQ, Tamburic L, Davies HW, Demers PA, Koehoom M, Brauer M (2010). Changes in residential proximity to road traffic and the risk of death from coronary heart disease. Epidemiology 21(5): 642-649. Available at https://www.ncbi.nlm.nih.gov/pubmed/20585255

10 Chen H, Kwong JC, Copes R, Tu K, Villeneuve PJ, van Donkelaar A, Hystad P, Martin RV, Murray BJ, Jessiman B, Wilton AS, Kopp A & Burnett RT (2017). Living near major roads and the incidence of dementia, Parkinson's disease, and multiple sclerosis: a population-based cohort study. The Lancet 389(10070):718–726.

11 Department of the Environment and Heritage (2005), Air Quality Fact Sheet – Air Toxics. Available at http://www.environment.gov.au/protection/publications/air-toxics.

12 Rao X, Patel P, Puett R, Rajagopalan S (2015). Air pollution as a risk factor for type 2 diabetes. Toxicology Sciences 143: 231–241. Available at http://doi. org/10.1093/toxsci/kfu250.

13 Golder Associates (2013), Exposure Assessment and Risk Characterisation to Inform Recommendations for Updating Ambient Air Quality Standards for PM2.5, PM10, O3, NO2, SO. Available at: http://www.environment.gov.au/system/files/pages/dfe7ed5d-1eaf-4ff2-bfe7-dbb7ebaf21a9/files/exposure-assessment-risk-characterisation.pdf.

14 Daniels MJ; Dominici F; Zeger SL; Samet JM (2004), The national morbidity, mortality, and air pollution study Part III: PM10 concentration-response curves and thresholds for the 20 largest US cities. Research Report (Health Effects Institute) 94 Pt 3:1–21.

15 Samoli E; Analitis A; Touloumi G; Schwartz J; Anderson HR; Sunyer J; Bisanti L; Zmirou D; Vonk JM; Pekkanen J; Goodman P; Paldy A; Schindler C; Katsouyanni K (2005), Estimating the exposure-response relationships between particulate matter and mortality within the APHEA multicity project. Journal Environmental Health Perspectives, 113:88-95.

16 Schwartz J; Coull B; Laden F; Ryan L (2008), The effect of dose and timing of dose on the association between airborne particles and survival. Journal Environmental Health Perspectives, 116:64-69.

17 Schwartz J (2004), The effects of particulate air pollution on daily deaths: a multi-city case crossover analysis. Journal Occupational and Environmental Medicine, 61:956-961.

18 International Agency for Research on Cancer, World Health Organisation (2012), Press Release No. 213, 12 June 2012.

19 Health Effects Institute (2019) State of Global Air 2019. Special Report

20 United States Environmental Protection Agency (U.S. EPA) (2006), Air quality criteria for ozone and related photochemical oxidants. Volume I. United States Environmental Protection Agency.

21 Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2018), Progress in Australian Regions, Yearbook 2018

22 Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2019), Information Sheet 96 - An Introduction to where Australians Live.

23 Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2018), Progress in Australian Regions, Yearbook 2018

24 Commonwealth of Australia (2015) 2015 Intergenerational Report – Australia in 2055, available at http://www.treasury.gov.au/PublicationsAndMedia/Publications/2015/2015-Intergenerational-Report

25 Health Effects Institute (2019), ibid

26 Institute for Health Metrics and Evaluation (2018) - Global Burden of Disease Study 2017.
27 Health Effects Institute (2019) State of Global Air 2019, Data from Institute for Health Metrics and Evaluation (2018) - Global Burden of Disease Study 2017
28 State of New South Wales and the NSW Environment Protection Authority (2019), Air Emissions Inventory for the Greater Metropolitan Region in New South Wales 2013 Calendar Year Consolidated Natural and Human-Made Emissions: Results, available at: https://www.epa.nsw.gov.au/your-environment/air/air-emissions-inventory/air-emissions-inventory-2013
29 NSW EPA (2020), pers comm
30 NSW EPA (2019), ibid
31 Australian Bureau of Statistics (2019) 9208.0 – Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2018, available at https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/9208.0Main+Features112%20months%20ended%2030%20June%202018?OpenDocument
32 Ibid
33 Bureau of Infrastructure, Transport and Regional Economics (2019) unpublished
34 Greenbaum, D.S. Chapter 5. Sources of Air Pollution: Gasoline and Diesel Engines, IARC Scientific Publication, available at: https://www.iarc.fr/en/publications/books/sp161/161-Chapter5.pdf
35 State of New South Wales and the NSW Environment Protection Authority 2019, ibid
36 NSW EPA (2019), ibid
37 NSW EPA (2020), pers comm
38 See the Department of the Environment and Energy's website at http://www.environment.gov.au/protection/air-quality/national-clean-air-agreement
39 Australian Government (2015) National Clean Air Agreement 2015-17 work plan. Available at: http://www.environment.gov.au/system/files/resources/188756ab-ed94-4a3c-9552-62763ca86a7f/files/ncaa-work-plan.pdf
40 Truck Industry Council (2015), Fleet Report 2015, retrieved from:
https://assets.website-files.com/5cbe46bce3c2320cf45d2b62/5cc685a9dca8011f040934f5_TIC-National-Truck-Fleet-Report-2015-March.pdf, January 2019
41 Truck Industry Council, Budget submission 2020-21
42 BITRE projections, 2019, unpublished
43 BITRE projections, 2019, unpublished
44 Department of the Environment, Water, Heritage and the Arts (2009) *The Second National In-Service Emissions* Study. Available at http://www.environment.gov.au/archive/transport/publications/pubs/nise2-technical-summary.pdf.
45 European Commission (2007), Commission Staff Working Document, Annex to the Proposal for a Regulation of the European Parliament and of the Council on the approximation of the laws of the Member States with respect to emissions from on-road heavy duty vehicles and on access to vehicle repair information, Impact Assessment
46 NSW EPA (2020), pers comm
47 International Council for Clean Transportation (2015), Briefing - Comparison of real-worldoff-cycle NOx emissions control in Euro IV, V, and VI
48 BITRE projections, 2019, unpublished
49 BITRE projections, 2019, unpublished
50 Truck Industry Council, Budget submission 2020-21
51 Australian Bureau of Statistics (2019) 9208.0 – Survey of Motor Vehicle Use, Australia, 12 months ended 30 June 2018, available at https://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/9208.0Main+Features112%20months%20ended%2030%20June%202018?OpenDocument
52 Powertorque, Issue 85, p46-51