



Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts

Heavy Vehicle Emission Standards for Cleaner Air

Final Regulation Impact Statement

December 2021



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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, Communications and the Arts
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
NO _x	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	<i>Road Vehicle Standards Act 2018</i>
SO _x	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

Noxious emissions from road vehicles are a major source of air pollution, causing illnesses and premature deaths. While Australia has standards in place to limit these emissions, key vehicle markets in Europe, North America and Asia have introduced more stringent standards. As Australia accounts for less than one per cent of global heavy vehicle sales, it risks having reduced access to the latest vehicle technologies developed for these markets if it doesn't adopt these more stringent standards for emissions.

Australia currently mandates the international Euro V noxious emissions standards for all heavy vehicles manufactured from 1 January 2011. This Regulation Impact Statement (RIS) evaluates whether the Australian Government should mandate the latest international standards for heavy vehicles, known as Euro VI.


To inform and refine the options considered in this RIS, a draft RIS was released for broad public consultation from October 2020 to February 2021. This included consultation with key stakeholders representing heavy vehicle manufacturers, transport operators, state and territory governments and the broader community. The draft RIS modelled the costs and benefits of mandating Euro VI (Stage D) for all newly approved heavy vehicle models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028. Analysis found the health benefits from this measure (\$6,672 million by 2050) would 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).

Eighteen submissions were received in response to the draft RIS. The majority of submissions, including from heavy vehicle industry stakeholders, suggested that adopting the Stage C requirements of Euro VI from 2024-2025 instead of Stage D from 2027-2028 would deliver greater health benefits and access to the latest vehicle technologies. In response to this feedback, the Department has modelled the costs and benefits of mandating Euro VI (Stage C) from 2024-2025.

If Euro VI (Stage C) was mandated for all newly approved heavy vehicle models manufactured from 1 January 2024 and for all new heavy vehicles manufactured from 1 January 2025, as proposed by industry stakeholders, the benefit-cost analysis indicated this would result in a net benefit of \$6,428 million by 2050 and a benefit-cost ratio of 3.52. The estimated health benefits and fuel savings from this measure (\$8,977 million by 2050) were found to outweigh any expected increases in capital costs for heavy vehicle manufacturers (\$1,488 million over the same period) or possible increases in operating costs for heavy vehicle operators and road managers (\$843 million over this period). The net benefits of this approach outweighed the net benefits of the original proposal for a 2027-2028 introduction by \$2,063 million^a.

The Australian Government Guide to Regulatory Impact Analysis recommends the preferred option should be the option with the highest net benefit. On this basis, this RIS recommends a new Australian Design Rule 80/04 adopting the Euro VI (Stage C) standard (with equivalent US and Japanese standards also accepted) be mandated for all newly approved heavy vehicle models from 1 January 2024 and for all heavy vehicles manufactured from 1 January 2025.

^a The modelling assumptions used in the final RIS incorporated feedback from industry stakeholders and accounted for effects of the COVID-19 pandemic on population and traffic growth. These revised assumptions reduced the net benefit of the 2027 option canvassed in the draft RIS to \$4,365 million.



Stakeholders in the heavy vehicle industry considered these benefits would be greater if additional reforms to offset the impacts of the additional technology required to meet Euro VI on the amount of freight these trucks could carry were also implemented.

In October 2021, the Australian Government agreed, subject to the outcome of a regulatory impact analysis, to allow trucks and trailers up to 2.55m wide (up from the current limit of 2.5m), if they are also fitted with additional safety features. This reform, if adopted will make it easier for manufacturers to supply models available in other markets without making additional changes specifically for the Australian market.

The National Heavy Vehicle Regulator (NHVR) is also working with government and industry stakeholders to reform mass limits for trucks fitted with advanced safety and emission systems, including electric trucks.

What is the problem?

It is estimated that 620 Australians died prematurely because of transport-related air pollution in Australia in 2015, costing our economy approximately \$9.2 billion¹. 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 sources².

To limit the health impacts of noxious emissions from heavy vehicles, Australia has mandated the international 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.

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

- a reduction in emission limits for oxides of nitrogen 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.

While Euro V has, and will continue to, reduce noxious emissions from new heavy vehicles entering the Australian market until the mid-2020s, other countries have introduced more stringent vehicle emissions standards. The more stringent Euro VI standards for heavy vehicles commenced in the European Union (EU) from the end of 2012 and equivalent standards apply in most other major vehicle markets. This, in combination with the introduction of other more stringent safety and fuel efficiency standards, has forced heavy vehicle manufacturers to develop new vehicle and engine technologies across the global market.

This raises the question of whether, and when, Australia should adopt more stringent noxious emissions standards, to achieve a reduction in transport-related air pollution, and make sure Australian transport operators have access to technology available in other markets.

Emissions standards in the global vehicle market

Noxious emissions from heavy passenger and commercial vehicles are 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 (UN Regulation 49) is based on the Euro VI requirements adopted in the EU. Equivalent standards have also 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 increasingly stringent safety and fuel efficiency standards.

Approximately 40,000 heavy vehicles^b are supplied to the Australian market each year, representing less than one per cent of global vehicle sales. Around 85 per cent of these vehicles, particularly lighter trucks and buses, are imported from overseas. The relatively small size of our market makes the adoption of unique Australian standards, and the design and manufacture of bespoke vehicles tailored specifically for it, undesirable in all but the most specialised segments.

Many vehicles supplied to the Australian market are designed to meet the minimum Australian standards (Euro V). Vehicles designed to meet later international noxious emissions standards are often fitted with advanced technologies that cost around three to five per cent more. This makes it difficult to sell vehicles fitted with advanced safety and emissions systems in Australia, as consumers are often attracted to vehicles with a lower purchase price rather than comparing the total operating costs. As a result, many heavy vehicles in Australia 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, particularly given the small size of our market. Their ability to amortise these costs is diminishing and this will continue as more countries, particularly in the Asia-Pacific, adopt more stringent standards in the future.

Air quality in Australia's urban environment

Health effects of vehicle emissions


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 cancer³. Individuals with pre-existing respiratory conditions, such as asthma and allergies, are especially vulnerable. Children are susceptible to a range of additional effects, such as low birth weight⁴, long-term effects on lung function⁵, childhood leukaemia^{6,7}, and childhood brain tumours⁸.

Living close to major roads and highways increases your risk of dying early⁹ and has also been linked to a higher incidence of dementia in the elderly¹⁰. High levels of benzene, a known carcinogen, have been discovered near major roads, particularly when traffic is congested¹¹.

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.

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



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). A 2013 study into the public risk of exposure to air pollutants found 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 cities¹². There is also mounting evidence that PM_{2.5} exposure can contribute to the incidence of Type 2 diabetes¹³.

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}.

The health impacts of vehicle emissions are increasing over time

Noxious vehicle emissions will get worse over time. More Australians are being exposed to them as our population grows and our population density and vehicle use increases, particularly in major cities. 17.7 million Australians lived in a major city in 2017, compared to 14.6 million in 2007, and this is projected to increase to over 21 million by 2027¹⁸. This problem is exacerbated by the ageing of our population who are more at risk of adverse health impacts of vehicle emissions.

While Australia generally has good air quality by global standards, many areas of Australia experience periods of poor air quality. Some pollutants, particularly PM and ground level ozone associated with vehicle emissions, can exceed the air quality standards agreed by Commonwealth, state and territory governments, especially in urban areas with high volumes of traffic. Air quality in the Sydney, Illawarra, Lower Hunter, Melbourne and South East Queensland regions has deteriorated since 2011.

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 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 standards¹⁹.

Contribution of heavy vehicles to air pollution

The most current data available on road vehicle emissions in Australia shows that heavy diesel vehicles account for almost 23 per cent of NOx emissions from all sources in the Sydney region²⁰. The introduction of more stringent noxious emission standards meant heavy vehicles in 2013 produced 37 per cent less NOx emissions per vehicle kilometre than heavy vehicles in 2003. However, total NOx emissions from heavy vehicles only declined by 26 per cent²¹, because there were more vehicles on the road and more vehicle kilometres travelled.

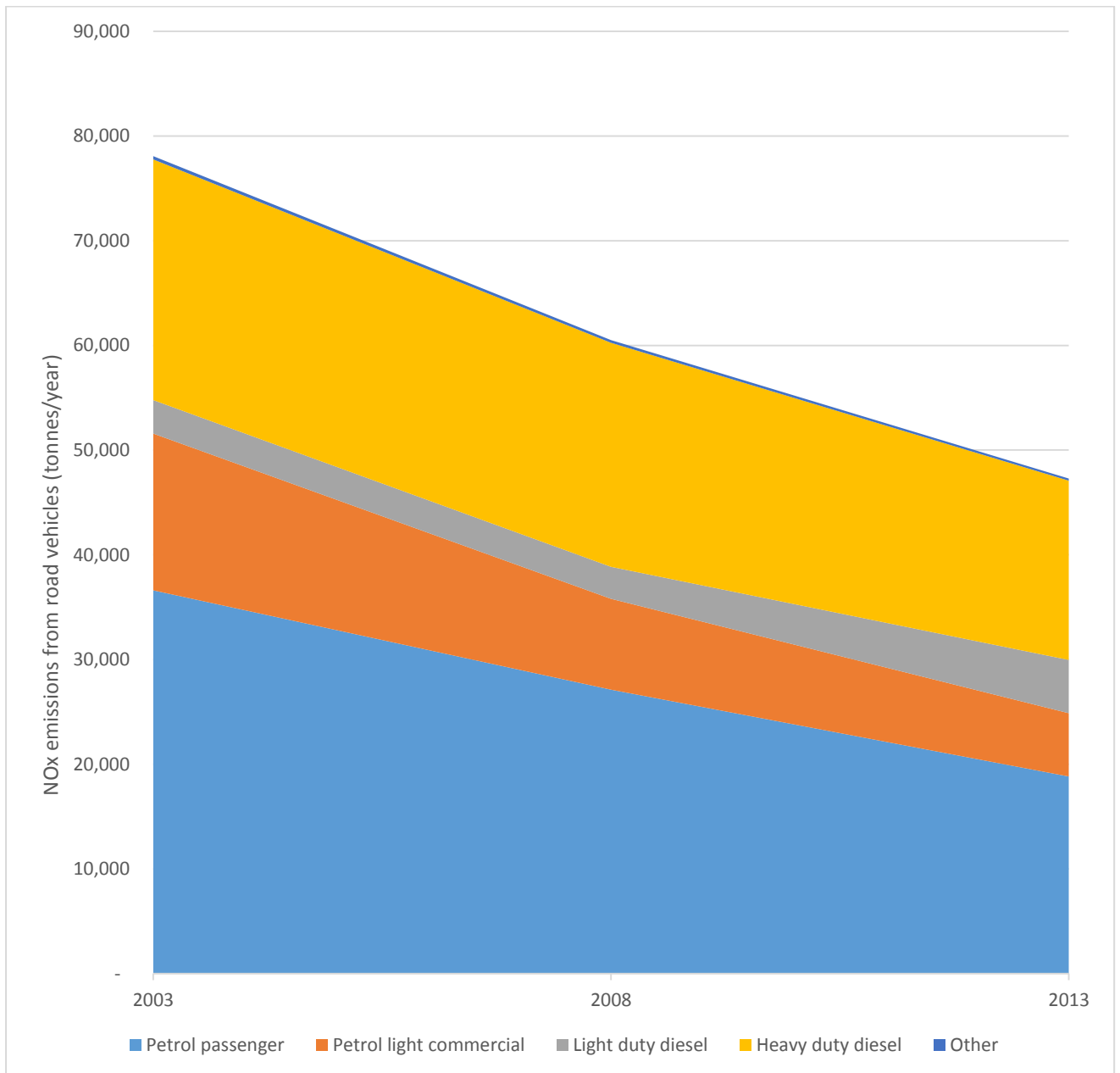


Figure 1 NOx emissions from road vehicles by vehicle type in the NSW Greater Metropolitan region²²

Heavy vehicles^d 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 Australia²³. 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 vehicles²⁴.

^d 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.

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. 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.

Exhaust emissions contribute up to 30 per cent of overall particulate emissions in urban areas. Particulate levels tend to be highest near busy roads and in dense urban areas. Data from New South Wales (Figure 2) shows that heavy diesel vehicles are the largest source of exhaust particulate emissions from road vehicles.

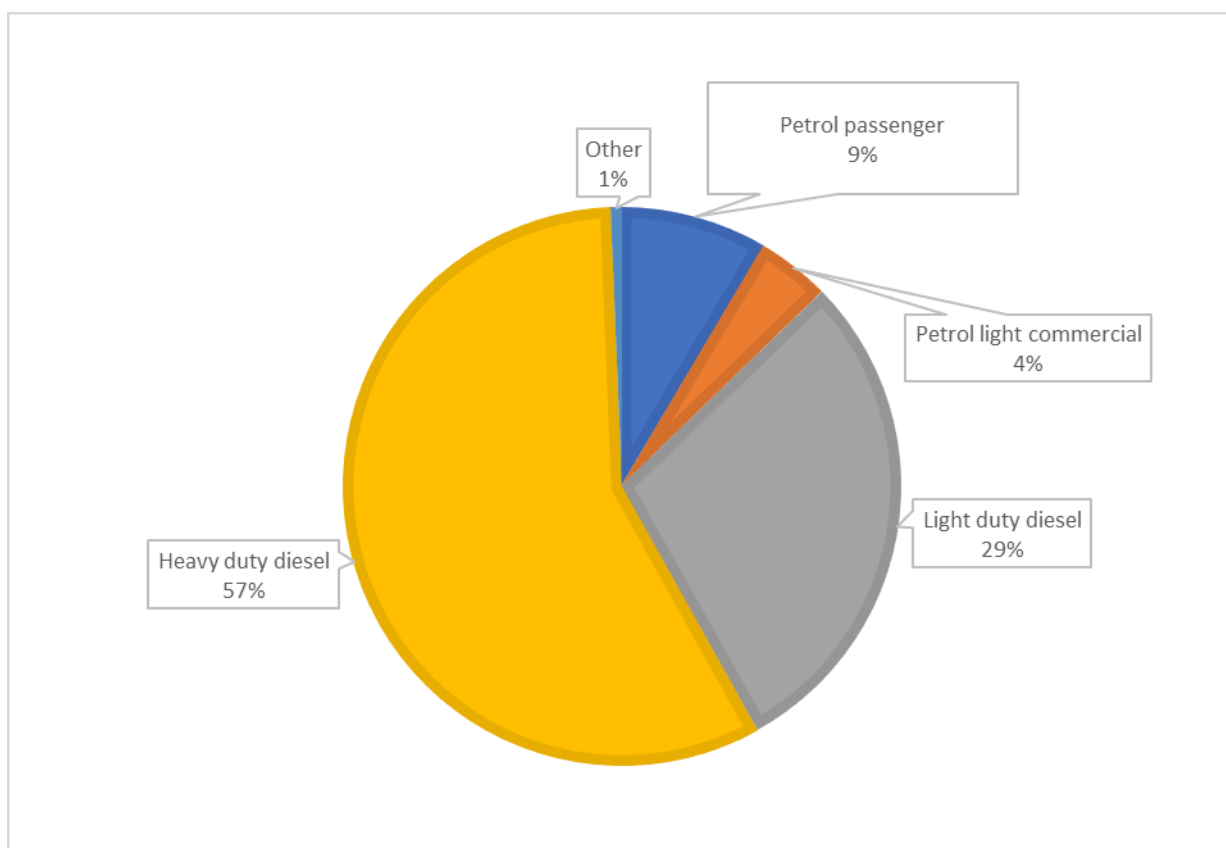


Figure 2 $PM_{2.5}$ exhaust emissions from road vehicles in the NSW Greater Metropolitan region²⁵

Why is further Government action needed?

Existing measures to reduce noxious emissions from heavy vehicles will not remain effective

Since the mid-1990s the Australian Government has taken steps to reduce noxious emissions from heavy vehicles by adopting international noxious emissions standards for heavy diesel vehicles. 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 CO and hydrocarbon (HC) emissions by over 80 per cent, NO_x emissions by almost 40 per cent and PM 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.

However, the impact of existing standards will diminish in the 2020s. This is because there will be more vehicles on the road and more kilometres travelled, which will more than offset the benefit of new vehicles replacing older models, without the introduction of a more stringent standard.

Projections by BITRE (Figure 3) show that, without adopting more stringent standards, NO_x emissions from heavy vehicles will steadily increase until at least 2035.

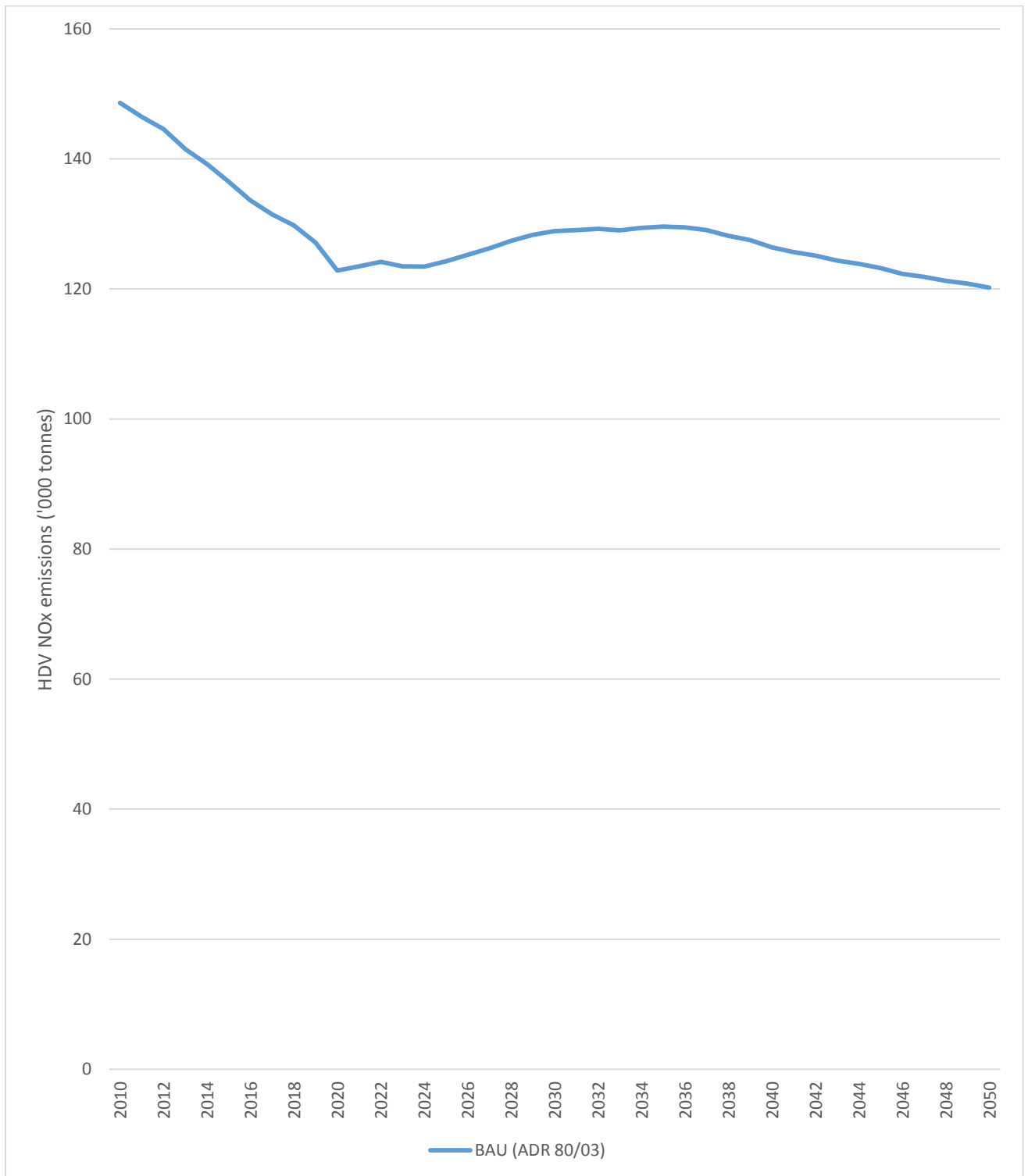


Figure 3 Projected impact of existing noxious emissions standards (Euro V) on NOx emissions from the heavy vehicle fleet (2010–2050)²⁶

BITRE projections also show that under current existing standards, fine particulate emissions from heavy vehicles will continue to decline, but at a decreasing rate from the mid-2020s.

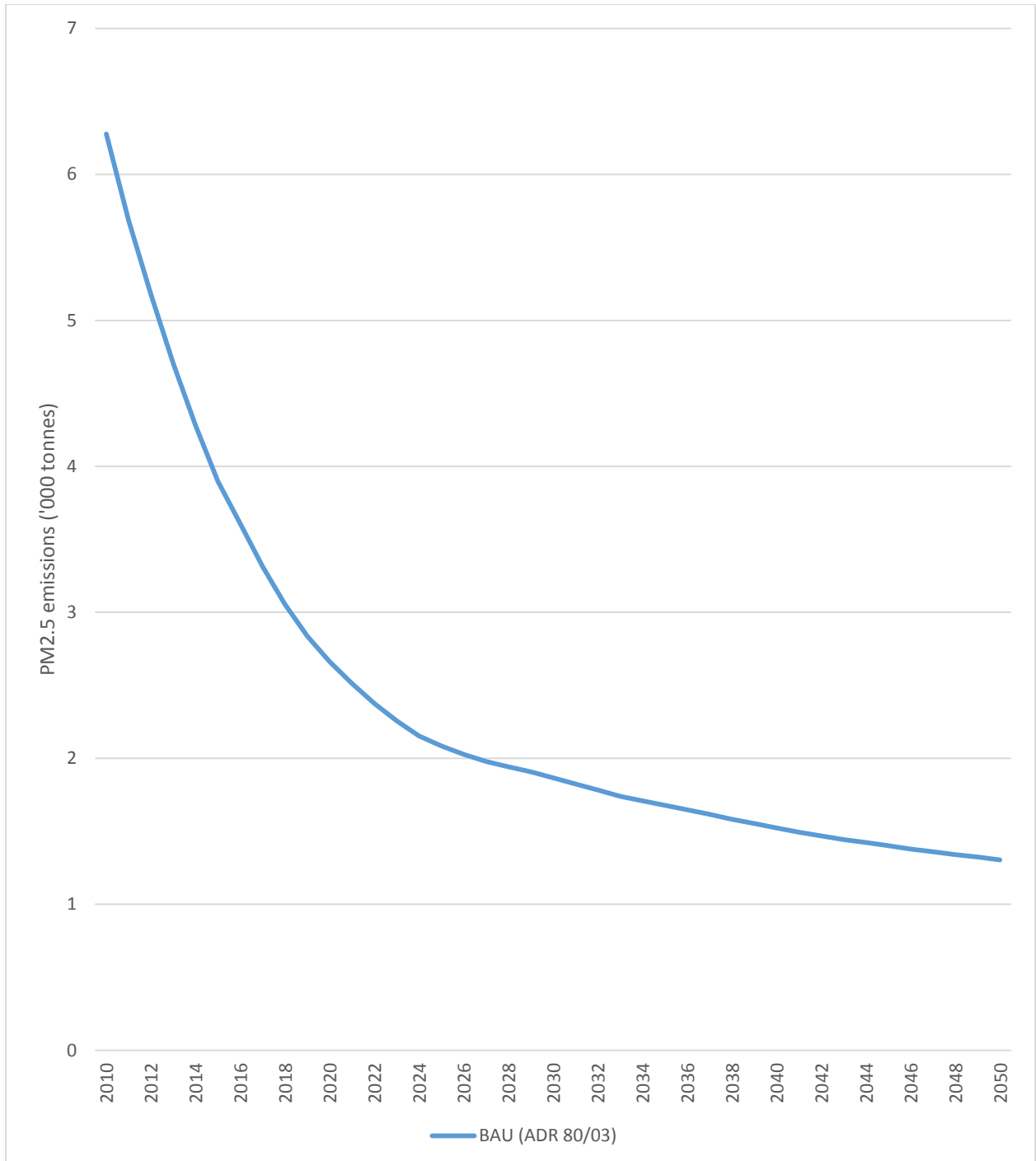


Figure 4 Projected impact of existing noxious emissions standards (Euro V) on PM_{2.5} emissions from the heavy vehicle fleet (2010–2050)²⁷

Without adopting new standards, market forces will lead some manufacturers to continue supplying older technology

The health impacts of noxious emissions from heavy vehicles are not borne by vehicle manufacturers or consumers alone, but are shared by the whole community.

If the new standard is not adopted, a proportion of heavy vehicle businesses will choose not to move to Euro VI, even where the long term benefit outweighs the short term costs (known as present bias in behavioural economics). This would disadvantage early movers in a market where margins are small, and would be likely to cause uptake to stall.

In the absence of a clear market signal from consumers or government to supply new vehicle emission technologies, some manufacturers will choose to continue supplying vehicles meeting less stringent standards, if it is cost effective to do so, particularly in price sensitive segments of the market. For example, the Second National In-Service Emissions Study found that many vehicles sold in Australia between 1986 and 2007 only met the minimum legal requirements at that time despite more advanced technologies being widely available overseas²⁸. If one manufacturer does this to remain competitive in Australia, this will put commercial pressure on other manufacturers to cut costs to remain competitive by supplying older technology.

During stakeholder consultation, heavy vehicle manufacturers advised the Department that their latest models, fitted with the latest safety and fuel saving technologies, are packaged with engines designed to meet Euro VI or equivalent standards required in the larger European, North American and Asian vehicle markets. As Australia is a smaller vehicle market, it risks having access to fewer models fitted with these technologies if its noxious emission standards are not updated. This is because it will be harder to compete with older, cheaper models and it would cost too much to develop and add new safety technologies to older models specifically for the Australian market. This would have implications for model range and the uptake of new vehicle safety and emissions technologies in the Australian heavy vehicle fleet.

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

What is the objective of Government action?

The objectives of Government action are to:

- ensure the most appropriate measures to reduce the impacts of noxious emissions from road vehicles on the Australian community are in place, and
- ensure Australia has access to the latest vehicle technology, through closer alignment with international vehicle standards.

The most appropriate measures will be those which provide the greatest net benefit to society and are in accordance with Australia's international obligations. Where intervention involves the use of regulation, the Agreement on Technical Barriers to Trade requires Australia to adopt international standards where they are available or imminent.

When considering the introduction of more stringent noxious emissions standards, the Australian Government has a policy of harmonising Australia's vehicle standards wherever possible with the international standards established by the United Nations (UN) World Forum for the Harmonization of Vehicle Regulations (WP.29). The current UN regulations for noxious emissions are based on the 'Euro' standards adopted by the European Union (EU).

Options considered:

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)*.

Two approaches to Option 3 are considered in this RIS.

- Option 3a – Mandate Euro VI (Stage D) from 2027-2028 (original approach considered in consultation RIS).
- Option 3b – Mandate Euro VI (Stage C) from 2024-2025 (an alternative approach proposed in stakeholder submissions to the consultation RIS).

Discussion of options

Option 1: Business as usual

The Australian Government requires all RISs 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 to control noxious emissions from heavy vehicles.

The existing noxious emissions standards, which have been in force since 2010, have delivered air quality benefits over the last decade. However, as noted in the previous section, existing standards will stop delivering reductions in NOx emissions and will deliver smaller reduction in PM emissions in the coming years.

The number of vehicles on the road and kilometres travelled is increasing, and without more stringent standards this will more than offset the benefit of new vehicles replacing older models.


A growing proportion of vehicles entering the Australian market are expected to meet Euro VI standards by virtue of its adoption in overseas markets, and demand from large corporate and state/territory government customers in Australia²⁹. However, a significant proportion of the heavy vehicle industry is made up of smaller operators that do not have this driver of demand. This means uptake will occur at a much lower rate than under a mandated standard, as market forces will encourage some manufacturers to continue supplying older models, meeting less stringent standards, in the absence of a level playing field.

There are no additional benefits or costs associated with this option as there are no proposed changes to existing policy settings. The best possible outcome under this option is that the health impacts, and number of premature deaths, from traffic related pollution remain relatively constant in line with increasing number of heavy vehicle kilometres travelled over the next decade.

Option 2: Implement a voluntary standard

Voluntary standards usually involve a high degree of industry participation and responsiveness compared to legislated requirements. 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, because of its voluntary nature, a standard of this kind would only be effective if complying with it is in the commercial interest of heavy vehicle manufacturers and/or their customers. As noted earlier, the health costs of air pollution from heavy vehicles are not borne directly by vehicle manufacturers or consumers, but shared by the whole community. If supplying heavy vehicles meeting more stringent noxious emissions standards to the market causes a competitive disadvantage because compliance is not mandatory, manufacturers are unlikely to commit to, or comply with, a voluntary standard.



Without a more stringent mandatory standard, manufacturers have no clear market incentive to supply vehicles with the latest noxious emissions technology. It is therefore unlikely that a more stringent voluntary standard would achieve a higher level of compliance with Euro VI or equivalent standards, as the only incentive for a manufacturer to comply would be reputational. As many corporate and state/territory government customers already provide an incentive for manufacturers to supply and operators to use Euro VI compliant trucks and buses through their procurement policies, any reputational benefit that is likely to be gained from complying with a voluntary standard may already have been realised by the relevant manufacturers and operators.

Voluntary standards are also harder to enforce. Unlike a mandatory standard, where a manufacturer must demonstrate that a vehicle complies with a standard before it can be supplied, non-compliance with a voluntary standard would only be detected after a vehicle has been supplied, through independent testing and reporting by governments and/or third party experts.

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 complexity³⁰. This would diminish any compliance costs savings from a voluntary standard, in lieu of a mandatory standard.

As manufacturers would have little or no additional incentive to comply with a voluntary standard, and governments would incur a high cost to monitor, detect and respond to breaches, this option was not considered a viable option to reduce noxious emissions from heavy vehicles. As a voluntary standard was unlikely to achieve a higher level of compliance with Euro VI or equivalent standards than existing policy settings, no further analysis of this option has been undertaken as part of this 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.

Under the ADRs, vehicles are approved on a model (or vehicle type) basis known as type approval. 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 test facilities and production processes. The ADRs apply equally to new imported vehicles and new vehicles manufactured in Australia.

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. The NSW EPA found that particulate emissions from in-service heavy vehicles in 2013 were 52 per cent lower per kilometre than heavy vehicles in 2003, thanks to the introduction of Euro III, IV and V standards³¹. 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 vehicles³².

The adoption of Euro VI would deliver the following benefits

- 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 to control fine particle emissions
- improved emissions tests (laboratory and on-road) to ensure reductions in emissions are also 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

Emission	Euro V (Stationary Cycle ^e)	Euro V (Transient Cycle ^f)	Euro VI (Stationary Cycle)	Euro VI (Transient Cycle)
Oxides of nitrogen (NOx)	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)

Options for implementing Euro VI for heavy vehicles in Australia

In the EU and other major vehicle 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 demonstrate the durability of the vehicle's emission systems over the life of the vehicle and includes lower load conditions excluded previously.
- **Stage E:** commenced in the EU from September 2020. It adopts even more stringent on-road emissions testing requirements to also include cold start conditions and a limit on the number of fine particles produced in this test. These requirements have also been adopted in the latest version of the UN regulation for heavy vehicle emissions (UN Regulation 49/07), which was agreed at the June 2021 session of the World Forum for the Harmonisation of Vehicle Regulations (WP.29).

^e A stationary cycle test is performed at steady engine speeds, similar to highway operation

^f A transient cycle test is performed at more variable engine speeds, similar to city operation

Option 3a – Adopt Euro VI (Stage D) from 2027-2028

In October 2020, the Department released a draft consultation RIS, which sought specific feedback on how and when Euro VI could be introduced for heavy vehicles in Australia.

In the draft consultation RIS, the Department proposed adopting 'Stage D' because it was the latest stage adopted in UN Regulation 49 at the time the paper was released for consultation. It was considered that manufacturers would have a clear understanding of the steps required to meet Stage D if the timeframe considered in the consultation RIS (1 July 2027 for newly approved heavy vehicle models and all heavy vehicles manufactured from 1 July 2028) was adopted. This timeframe was chosen in response to feedback received during preliminary consultation with heavy vehicle industry stakeholders, which suggested this would strike a balance between managing Australia's air quality and supporting the ongoing viability of Australia's local heavy vehicle manufacturers and transport operators. Further information on the costs and benefits of adopting Option 3a are discussed in the subsequent sections of this RIS.

Option 3b – Adopt Euro VI (Stage C) from 2024-2025


Heavy vehicle industry stakeholders advised mandating Stage D of Euro VI would significantly increase regulatory burden for heavy vehicle manufacturers, as it would require most heavy vehicle models sold in Australia to be retested specifically for Australian market. This was because:

- The on-road emissions test adopted in Stages D of Euro VI requires vehicles to be tested between 10 and 100 per cent of the vehicle's gross combination mass (GCM) rating, whereas Stage C requires vehicles to be tested at 50 to 60 per cent. As most heavy vehicle models sold in Australia have a higher GCM rating than models sold in Europe, type approvals for models sold in Europe would not be valid for most variants sold in Australia.
- An increasing number of heavy vehicle models sold in Australia are manufactured to comply with an equivalent US or Japanese noxious emission standards in lieu of the Euro standard. As there is currently no US or Japanese equivalent to Stage D, these models would also need to be retested to the Euro VI standard, to avoid gaining a regulatory advantage over models meeting the Euro standard.
- As the Australian market is relatively small, it would be difficult for manufacturers to amortise the costs of additional testing and development required to meet Stage D. The Truck Industry Council advised this could affect the viability of up to 50 per of heavy vehicle models currently available in Australia, including entire model lines offered by some lower volume manufacturers.

Heavy vehicle manufacturers have advised it would be viable to mandate Euro VI from 2024-2025 if the proposed ADR adopted the Stage C requirements, and additional reforms to mass and width limits were also implemented to offset the additional weight and space required by the additional emissions technology.

The emission limits for all stages of Euro VI are the same, but the on-road emissions test requirements for vehicles meeting Stage C are less stringent than Stage D. This means Stage C vehicles may produce higher emissions in some conditions than vehicles meeting Stage D, but would nevertheless be significantly lower than permitted under the current Euro V standards.

In response to this feedback, the Department has modelled the costs and benefits of mandating Euro VI (Stage C) for all newly approved heavy VI models manufactured from 1 January 2024 and for all new heavy vehicles manufactured from 1 January 2025, as Option 3b in this RIS. The impacts of this option are discussed in the subsequent sections of this RIS.



In October 2021, the Australian Government agreed, subject to the outcome of a separate regulatory impact analysis, to allow trucks and trailers up to 2.55m wide (up from the current limit of 2.5m), if they are also fitted with additional safety features. This reform, if adopted will make it easier for manufacturers to supply models available in other markets without making additional changes specifically for the Australian market.

The National Heavy Vehicle Regulator (NHVR) is also working with government and industry stakeholders on options to reform mass limits for trucks fitted with advanced safety and emission systems, including electric trucks.

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 (the US EPA standard for standards for heavy vehicles supplied from 2013 onwards or the Japanese standards for heavy vehicles supplied from 2017 onwards).

Impact on emissions

The impacts of Euro VI on noxious emissions from heavy vehicles in Australia will be influenced by when the standard becomes mandatory for new vehicles entering the Australian vehicle fleet.

Projections by BITRE show that if Option 3a (Stage D from 2027-2028) was implemented, NO_x emissions from the heavy vehicle fleet would peak at 124,000 tonnes in 2025, then decline to less than 30,000 tonnes by 2050 (75 per cent lower than expected under business as usual in 2050).

If Option 3b (Stage C from 2024-2025) was implemented, NO_x emissions from the heavy vehicle fleet would peak at 123,000 tonnes in 2023, then decline to less than 22,000 tonnes by 2050 (or 82 per cent lower than expected under business as usual in 2050).

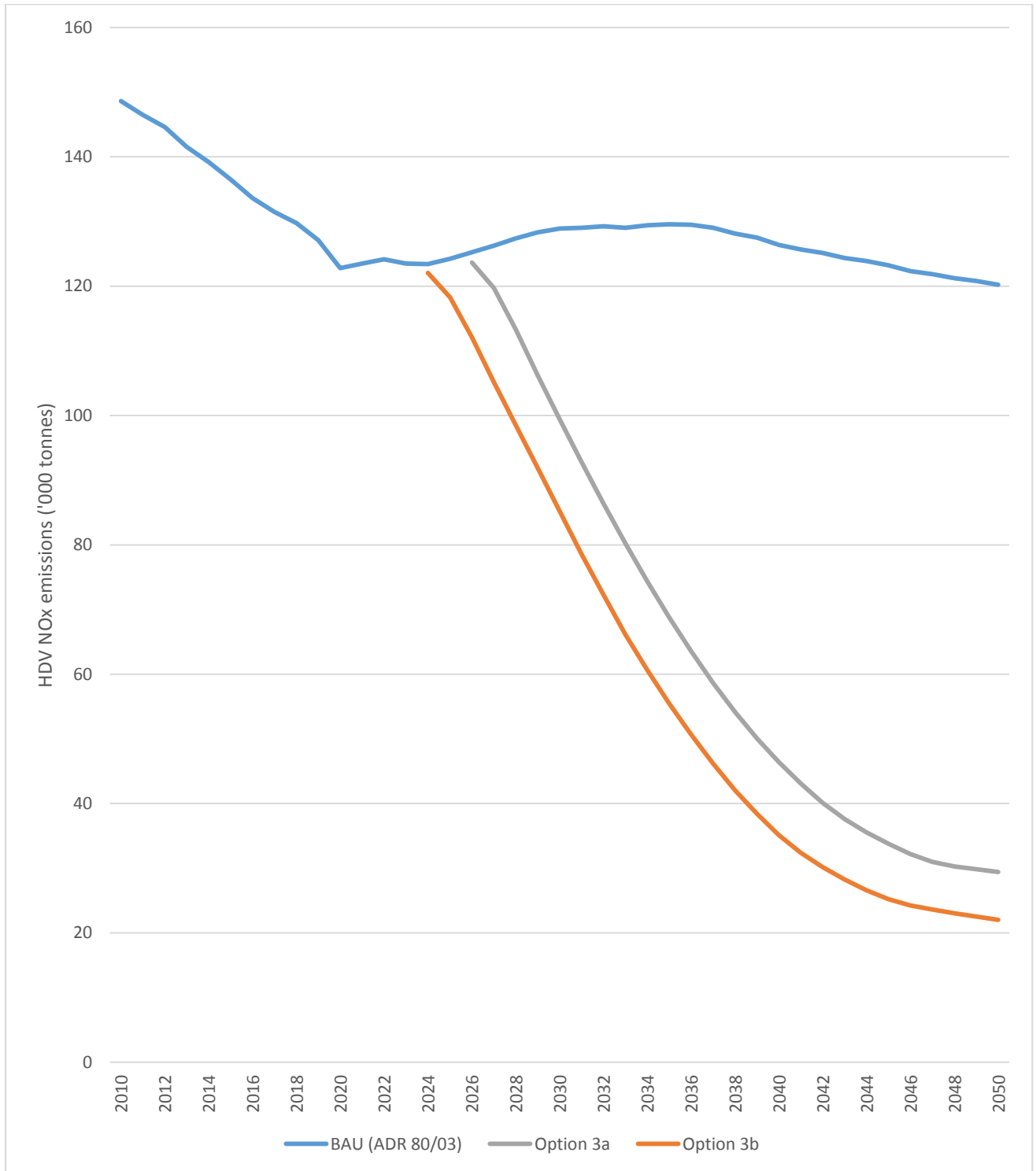


Figure 7 Projected impact of proposed noxious emissions standards (Euro VI and equivalent alternatives) on NOx emissions from the heavy vehicle fleet (2010–2050)³³

BITRE projections (Figure 8) also show that if Option 3a was implemented from 2027-2028, fine particulate emissions from heavy vehicles would decline by more than 63 per cent from 2027 to 2050. This is 43 per cent lower than that expected under business as usual.

If Option 3b was implemented from 2024-2025, fine particulate emissions from heavy vehicles would decline by 67 per cent from 2024 to 2050. This is 47 per cent lower than that expected under business as usual.

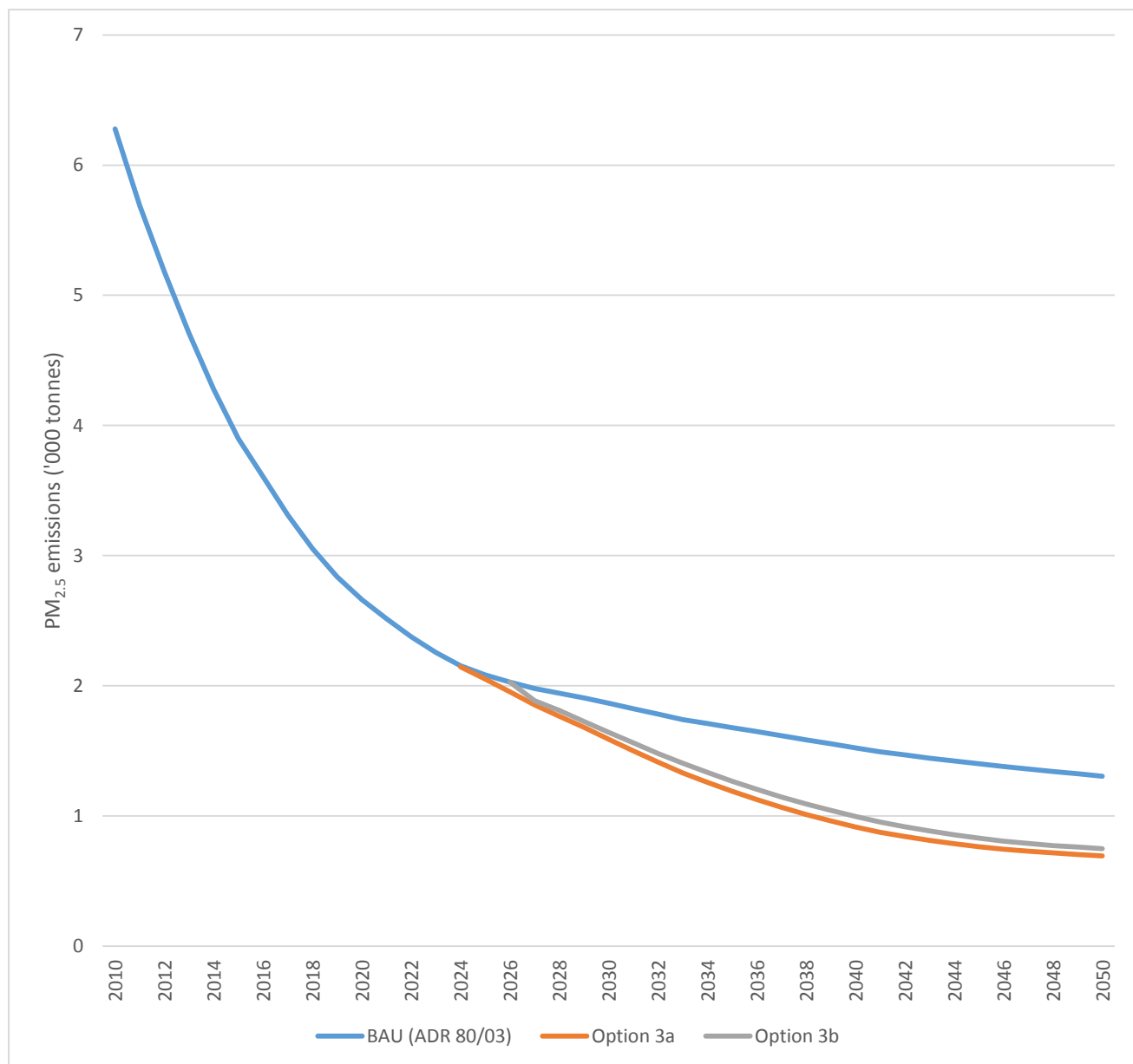


Figure 8 Projected impact of proposed noxious emissions standards (Euro VI and equivalent alternatives) on PM_{2.5} produced by the heavy vehicle fleet (2010–2050)³⁴

Costs and benefits

Introduction

For the draft RIS, the Department undertook a detailed benefit-cost analysis of mandating Euro VI (Stage D) for newly approved heavy vehicle models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028 (as Option 3 in the consultation RIS and Option 3a in this RIS). Following feedback, the Department has also evaluated the costs and benefits of mandating Euro VI (Stage C) for newly approved heavy vehicle models manufactured from 1 January 2024 and for all new heavy vehicles manufactured from 1 January 2025 (as Option 3b).

Costs included in this analysis were:

- additional capital costs borne by heavy vehicle manufacturers and/or their customers,
- additional reagent costs borne by operators, and
- impacts on productivity and/or additional road wear due to the additional weight and/or space required by the additional emission systems required to comply with the new standard.

Benefits included in this analysis were:

- avoided health costs borne by the community, and
- avoid fuel costs for operators from a wider availability of more efficient vehicles.

There are also likely to be significant benefits to all stakeholders from keeping pace with international standards as this will reduce technical and commercial barriers to the supply of the latest heavy 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. This means the estimated benefits in the benefit-cost analysis are likely to be conservative.

The overall period of analysis (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, implementing Option 3a would achieve a net benefit of \$4,365 million and a benefit-cost ratio of 2.82. If Option 3b was implemented, this would achieve a net benefit of \$6,438 million and a benefit-cost ratio of 3.52.

Table 2 provides summary of the benefits quantified in this analysis.

Table 2 - Summary of Results

Option	Option 3a (Euro VI Stage D from 2027-2028)	Option 3b (Euro VI (Stage C) from 2024-2025)
Total Costs	\$2,399.6m	\$2,548.4m
Total Benefits	\$6,764.7m	\$8,976.3m
Net Benefit	\$4,365.1m	\$6,427.9m
Benefit/Cost Ratio	2.82	3.52

What were the main assumptions?

The analysis assumed that emissions reduction technology fitted to 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.

Additional capital cost estimates for the vehicle emission control technologies were informed by industry submissions received in response to the 2020 consultation RIS and previous consultations. It was anticipated that most manufacturers will have to use integrated Exhaust Gas Recirculation and Selective Catalytic Reduction systems with Diesel Particulate Filters to achieve the very low levels of emissions required by the standards proposed in Options 3a and 3b. The introduction of Euro VI is expected to increase vehicle production costs by 3-5 per cent, noting that closer alignment with international standards could also reduce development costs for the Australian market.

Additional reagent costs were also informed by industry submissions to the 2020 consultation RIS, which advised that move to Euro VI would increase the proportion of new vehicles requiring reagent to meet the standards from 68 per cent of new vehicles to 100 per cent. Vehicles currently using reagent to meet existing standards were also expected to require a higher dose of reagent to meet Euro VI emission levels.

Productivity losses and additional road wear cost were informed by industry advice that a Euro VI truck or bus will weigh around 300kg more than an equivalent Euro V vehicle. It was anticipated that 7.5 per cent of trips performed by Euro VI trucks and buses would need to operate at a lower payload to comply with existing mass limits. In cases where vehicles are not operating at capacity, additional road wear was based on the vehicle being 300kg heavier than it otherwise would be.

Avoided health costs were calculated by quantifying the emissions of pollutants and estimating the emissions saved relative to the base case and establishing a value for an average health cost from based on the analysis by Marsden-Jacob Associates in 2018 for the Australian Government’s “Better Fuel for Cleaner Air” Regulation Impact Statement.

Avoided fuel costs were also informed by industry submissions to the 2020 consultation RIS, which advised that current Euro VI trucks and buses used three per cent less fuel on average than equivalent Euro V models.

Benefits

The BITRE analysis found there would be a direct benefit to the health and wellbeing of the Australian community through reductions in air pollution if either option to mandate Euro VI was adopted. Better air quality would reduce pressure on the public health system by reducing the incidence of disease attributable to air pollution, particularly in communities with more vehicle traffic. This would reduce public healthcare costs borne by taxpayers in both urban and regional communities.

Heavy vehicle manufacturers have also advised the introduction of Euro VI is likely to reduce fuel consumption from new heavy vehicles. This is because heavy vehicles meeting Euro VI have also been designed to meet increasingly stringent fuel efficiency requirements in North America, Europe and Japan. Table 3 provides summary of the benefits quantified in this analysis.

Table 3 – Summary of benefits

Benefits (by 2050)	Affected parties	Option 3a	Option 3b
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		(Euro VI Stage D from 2027-2028)	(Euro VI (Stage C) from 2024-2025)
Avoided health costs	Community	\$5,603.4m	\$7,443.9m
Avoid fuel costs	Operators	\$1,161.3m	\$1,532.4m
Total Benefits	All	\$6,764.7m	\$8,976.3m

Costs

To meet Options 3a or 3b, heavy vehicle manufacturers currently producing Euro V vehicles for the Australian market would need to fit additional emission control systems to vehicle models they wish to continue manufacturing for the Australian market. Alternatively, they may choose to replace these models with another model sold overseas that meets these standards. Some or all of these costs, including those borne by manufacturers overseas could be passed on to Australian truck and bus operators purchasing new vehicles.

The emission control systems required to meet Euro VI may add weight and/or require additional space that could otherwise be used to carry freight or passengers, if Option 3a or 3b is implemented. If existing mass limits remain in place, this may reduce the amount of freight or passengers an operator can legally carry. To the extent market forces permit, truck and bus operators may pass these increased costs on to their customers through higher prices for transporting goods or passengers. If a mass concession is implemented to offset these impacts on operations, these impacts will be borne by the community through additional road wear.

In cases where trucks and buses are not operating at capacity, a Euro VI truck or bus will operate at a higher baseline mass than an older truck or bus. This may result in an increase road wear costs borne by the community, if Option 3a or 3b is implemented.

Heavy vehicle manufacturers have also advised the introduction of Euro VI is likely to require operators to purchase more reagent (commonly sold as AdBlue or Diesel Exhaust Fluid) to ensure their Euro VI vehicles continue to comply with the Euro VI emission requirements in-service, if Option 3a or 3b is implemented.

There are also likely to be some costs incurred by the Government to develop, implement and enforce the new standards. These costs are assumed to be absorbed within existing departmental resources.

Table 4 provides summary of the costs quantified in this analysis.

Table 4 – Summary of costs

Cost (by 2050)	Affected parties	Option 3a (Euro VI (Stage D) from 2027-2028)	Option 3b (Euro VI (Stage C) from 2024-2025)
Additional Capital Costs	Manufacturers/operators	\$1,568.5m	\$1,488.3m
Additional Reagent Costs	Operators	\$167.8m	\$216.5m
Productivity loss/additional road wear	Operators/community	\$663.3m	\$843.6m
Total Costs	All	\$2,399.6m	\$2,548.4m

Regulatory burden

The Government has established a deregulation policy that aims to improve productivity growth and enhance competitiveness across the Australian economy. The Department is a regulator and continuous improvement is at the core of this portfolio's regulatory vision. The portfolio is 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 benefit cost analysis as it does not capture the benefits of avoided health costs for the wider community. The average annual regulatory costs of mandating Euro VI for heavy vehicles from 2027 were established by calculating the average undiscounted costs (non-prorated) for each option over the period from 2027 to 2036 inclusive. The average annual regulatory costs of mandating Euro VI for heavy vehicles from 2024 were established by calculating the average undiscounted costs (non-prorated) for each option over the period from 2024 to 2033 inclusive.

The average annual regulatory cost of mandating Euro VI was calculated to be \$273.7 million if Option 3a was implemented (Table 5a), or \$205.7million if Option 3b was implemented (Table 5b). To the extent that market forces allow, the costs to business in the tables below may be passed on to consumers.

Table 5a - Regulatory burden estimate – Option 3a - mandating Euro VI (Stage D) for heavy vehicles from 2027

Average annual regulatory costs (from business as usual)

Change in costs (\$ million)	Business	Community organisations	Individuals	Total change in costs
Total, by sector	274.5			274.5

Table 5b - Regulatory burden estimate – Option 3b - mandating Euro VI (Stage C) for heavy vehicles from 2024

Average annual regulatory costs (from business as usual)

Change in costs (\$ million)	Annual Regulatory Costs for Business	Community organisations	Individuals	Total change in costs
Total, by sector	205.7			205.7

Consultation

The preparation of this RIS considered feedback received from a number of consultation processes.

The Government released a draft RIS evaluating the costs and benefits of mandating Euro VI for heavy vehicles from 27 October 2020 to 26 February 2021. This draft RIS was informed by feedback received during consultation in 2016-17 and discussions with heavy vehicle industry stakeholders in 2019-20.

More stringent noxious emissions standards for heavy vehicles have also been discussed at the Department's peak vehicle standards consultative forums, the Strategic Vehicle Safety and Environment Group (SVSEG) and the Technical Liaison Group (TLG). SVSEG and TLG include senior representatives of governments (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.

Summary of responses to the 2020 draft RIS

The 2020 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, and implementation timing.

Eighteen submissions were received from a range of stakeholders, including from:


- heavy vehicle manufacturers and operators;
- state and territory governments and the National Heavy Vehicle Regulator;
- 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.

Comments received in response to the draft RIS

Stakeholders representing heavy vehicle manufacturers and operators supported the adoption of Euro VI in principle, but did not support the approach proposed in Option 3 of the draft RIS to mandate Euro VI Stage D from 2027-2028. Heavy vehicle industry stakeholders advised mandating Stage D would significantly increase regulatory burden for heavy vehicle manufacturers to a greater extent than estimated in the draft RIS, as it would require most heavy vehicle models sold in Australia to be retested specifically for the Australian market.

Heavy vehicle manufacturers have advised it would be viable to mandate Euro VI from 2024-2025 if the proposed ADR adopted the Stage C requirements instead of Stage D. The Australian Trucking Association, which represents road freight transport operators, advised it would also support an ADR mandating Euro VI Stage C, if trucks meeting Euro VI were permitted to operate at higher mass and width limits to offset any potential productivity impacts, as the technology required to meet Euro VI would add weight and take up additional space on the vehicle.



Health, environment and community groups, and state and territory governments also supported an earlier introduction of Euro VI.

Heavy vehicle manufacturers considered the modelling in the draft RIS, which anticipated an increase in fuel consumption, was not accurate as the latest generation Euro VI trucks use less fuel because they are also designed to meet fuel efficiency standards in other markets. They also considered the modelling in the draft RIS incorrectly anticipated that reagent consumption would decrease. This was because as 38 per cent of new trucks currently sold in Australia do not currently use a consumable reagent to meet the current Euro V requirements, but would need to do so to meet Euro VI³⁵. Trucks and bus manufacturers also advised models that currently use a consumable reagent to meet Euro V emission requirements would require 2-5 per cent more reagent to meet Euro VI emission requirements.

How we have responded to the comments received on the draft RIS

In light of the feedback received during this consultation, the Department modelled the costs and benefits of adopting Euro VI (Stage C) from 2024-2025 as Option 3b. The assumptions used in the modelling for this option and the original Option 3 (Option 3a in this RIS) were also updated to:

- account for the effects of the COVID-19 pandemic on traffic growth, and
- revise the assumptions on fuel and reagent consumption based on the experience of the heavy vehicle industry advised during the consultation process.

The revised modelling for Option 3a also incorporates an updated estimate of compliance costs to account for the additional testing required to comply with this option.

Reforms to mass and width limits

In October 2021, the Australian Government agreed, subject to the outcome of a regulatory impact analysis, to allow trucks and trailers up to 2.55m wide (up from the current limit of 2.5m), if they are also fitted with additional safety features. This reform, if adopted will make it easier for manufacturers to supply models available in other markets without making additional changes specifically for the Australian market.³⁶

The Department does not anticipate that this announcement will not materially affect the outcome of this modelling, but will make it easier for manufacturers to offer models available in other markets with higher width limits. This may reduce development costs.

In June 2020, the National Heavy Vehicle Regulator (NHVR) consulted on a proposal to allow a mass increase for trucks fitted with advanced safety and emission systems³⁷. The NHVR is continuing to work with government and industry stakeholders to reform mass limits to support trucks fitted with advanced safety and emission systems, including electric trucks.

If a future policy decision is made by governments to allow higher mass limits for trucks meeting the latest safety and environmental standards, the Department anticipates productivity impacts on truck operators will be lower than anticipated in this RIS. Productivity savings from a higher mass limit would accrue to truck operators and their customers. However, these savings would be smaller at a community level, as trucks operating at a higher mass would increase road wear costs borne by governments and the broader community. This is not expected to materially affect the outcome of this modelling. The costs and benefits of this reform are beyond the scope of this RIS.

Conclusion and Recommended Option

This RIS examined the case for government action to reduce noxious emissions from heavy road vehicles to improve health outcomes for the Australian community. Our standards currently lag behind most developed countries.

This RIS considered a range of options, including taking no further action (business as usual), establishing voluntary noxious emissions standards (through an agreement with peak industry bodies), or mandating more stringent noxious emissions standards (Euro VI) 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, which is not addressed by the operation of market forces alone. Government action to strengthen noxious emissions standards is recognised as an effective measure to reduce urban air pollution, and such standards have delivered 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 (Option 3a or 3b) for heavy vehicles will bring Australia's vehicle standards into closer alignment with international standards. This will help improve Australian transport operators' access to the latest safety and fuel saving technologies, which are often packaged with Euro VI (or equivalent) engines.

Benefit cost analysis found that there were significant benefits from mandating Euro VI (Option 3a or 3b) that would not otherwise be realised through either a business as usual approach (Option 1) or a voluntary standard (Option 2).

If Option 3a (Euro VI (Stage D), for newly approved models manufactured from 1 July 2027 and for all new heavy vehicles manufactured from 1 July 2028), was adopted, it would result in avoided health costs of \$5,603 million and fuel savings of \$1,163 million. These savings outweigh any increased capital costs to manufacturers of \$1,569 million, or any increase in costs for operators and road managers of \$831 million over the period to 2050. The net benefits over this period were estimated to be \$4,365 million, with a benefit-cost of 2.82.

If Option 3b (Euro VI (Stage C), for newly approved models manufactured from 1 January 2024 and for all new heavy vehicles manufactured from 1 January 2025), was adopted, it would result in avoided health costs of \$7,444 million and fuel savings of \$1,532 million. These savings outweigh any increased capital costs to manufacturers of \$1,488 million, or any increase in costs for operators and road managers of \$1,060 million over the period to 2050. The net benefits over this period were estimated to be \$6,428 million, with a benefit-cost of 3.52.

The Australian Government Guide to Regulatory Impact Analysis advises the recommended option should be the option with the highest net benefit. On this basis, the RIS recommends adopting Option 3b (mandating Euro VI (Stage C) for heavy vehicles for all newly approved models manufactured from 1 January 2024 and for all new heavy vehicles manufactured from 1 January 2025). 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.

Implementation and evaluation

If the Government decides to mandate the Euro VI noxious emissions standards (Option 3a or 3b), 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 Option 3b is adopted, it is proposed that ADR 80/04 adopt the Euro VI (Stage C) requirements as adopted in UN Regulation 49. ADR 80/04 would accept the equivalent technical requirements of EU Regulation 582/2011, as well as the equivalent US (2013) and Japanese (2017) standards.

If Option 3b is adopted, the proposed transitional arrangements for the new ADR 80/04 would be as follows:

- Manufacturers seeking a new vehicle type approval for a heavy vehicle model first supplied to Australia on or after 1 January 2024 will be required to demonstrate that the vehicle complies with the new ADR 80/04.
- Models supplied under a vehicle type approval before 1 January 2024 may continue to supply vehicles that comply with ADR 80/03 until 31 December 2024. If a manufacturer wishes to continue supplying these vehicle models on or after 1 January 2025, they will need to demonstrate that the vehicle model complies with the new ADR 80/04 for their vehicle type approval to remain valid.

It is important to determine the new ADR as soon as possible following a Government policy decision to provide certainty to vehicle manufacturers, and give them sufficient time to undertake necessary business planning before the ADR commences for newly approved models. The Department will 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 and fuel 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, additional reagent and productivity impacts that may be borne by heavy vehicle operators and possible increases in road wear due to Euro VI trucks operating at a higher gross vehicle mass due to the technology required to meet Euro VI.

Two regulatory scenarios have been modelled in this analysis.

The first scenario considers the costs and benefits of an ADR 80/04 mandating Euro VI (Stage D) from 1 July 2027 for newly approved heavy vehicle models (M and N category vehicles with a gross vehicle mass over 3.5 tonnes) and all heavy vehicles manufactured from 1 July 2028. Table A1 provides the modelling results for this scenario.

The second scenario considers the costs and benefits of an ADR 80/04 mandating Euro VI (Stage C) from 1 January 2024 for newly approved heavy vehicle models and all heavy vehicles manufactured from 1 January 2025. Table A2 provides the modelling results for this scenario.

Table A1 Benefit-cost analysis for the implementation of Euro VI (Stage D) standards for new heavy vehicles in Australia from 2027 — net present value, 2019 Australian dollars

Year	Capital cost (\$m)	Diesel Exhaust Fluid Costs (\$m)	Productivity loss/extra road wear costs (\$m)	Total costs (\$m)	Health costs avoided (\$m)	Avoided fuel costs (\$m)	Total Benefits (\$m)	Net benefits (\$m)
2027	149.7	0.4	5.6	155.6	6.9	4.3	11.2	-144.4
2028	188.8	1.4	14.6	204.8	28.1	14.1	42.2	-162.6
2029	177.4	3	22.3	202.7	61	24.6	85.6	-117.1
2030	106.9	4.5	29	140.4	97.2	33.6	130.8	-9.6
2031	100.5	5.9	34.6	140.9	131.4	41.1	172.5	31.6
2032	94.4	7.1	37.7	139.2	163	47.4	210.4	71.2
2033	88.7	8.1	38.8	135.6	191.9	52.6	244.5	108.9
2034	83.3	8.9	39.2	131.4	217.4	56.3	273.7	142.3
2035	76.6	9.4	38.9	124.8	240.4	58.7	299.1	174.3
2036	70.3	9.6	38	117.8	259.5	60.4	319.9	202.1
2037	64.3	9.8	36.7	110.8	277.5	61.5	339	228.2
2038	52.5	9.9	35.2	97.6	292.5	62	354.5	256.9
2039	47.6	9.8	33.5	90.9	304.2	61.9	366.1	275.2
2040	43	9.6	31.8	84.3	312.4	61.3	373.7	289.4
2041	38.6	9.2	30	77.8	317.3	60.3	377.6	299.8
2042	34.5	8.8	28.2	71.5	321.2	59.1	380.3	308.8
2043	30.7	8.2	26.5	65.5	322.1	57.6	379.7	314.2
2044	27.2	7.8	24.9	59.8	317	55.7	372.7	312.9
2045	23.8	7.3	23.3	54.4	310.9	53.7	364.6	310.2
2046	20.3	6.8	21.8	49	303	51.6	354.6	305.6
2047	17.1	6.3	20.4	43.8	295.9	49.3	345.2	301.4
2048	13.8	5.9	18.9	38.6	287.3	47	334.3	295.7
2049	10.7	5.4	17.5	33.5	277.1	44.7	321.8	288.3
2050	7.8	4.9	16	28.8	268	42.4	310.4	281.6
Total	1,568.5	167.8	663.3	2,399.6	5,603.4	1,161.3	6,764.7	4,365.1

Estimated costs: \$2,399.6m

Estimated benefits: \$6,764.7m

Net benefit: \$4,365.1m

Benefit/Cost Ratio: 2.82 (\$6,764.7m/2,399.6m)

Table A2 Benefit-cost analysis for the implementation of Euro VI (Stage C) standards for new heavy vehicles in Australia from 2024 — net present value, 2019 Australian dollars

Year	Capital cost (\$m)	Diesel Exhaust Fluid Costs (\$m)	Productivity loss/extra road wear costs (\$m)	Total costs (\$m)	Health costs avoided (\$m)	Avoided fuel costs (\$m)	Total Benefits (\$m)	Net benefits (\$m)
2024	75.0	0.4	6.7	82.1	8.1	5.2	13.3	-68.8
2025	127.4	1.7	17.5	146.6	32.9	16.9	49.8	-96.8
2026	120.2	3.6	26.8	150.6	71.5	29.5	101.0	-49.6
2027	113.0	5.4	34.8	153.2	113.9	40.3	154.2	1.0
2028	106.2	7.1	41.5	154.8	153.9	49.4	203.3	48.5
2029	99.9	8.5	45.3	153.7	191.0	57.0	248.0	94.3
2030	93.9	9.8	46.6	150.3	224.9	63.2	288.1	137.8
2031	88.3	10.6	47.0	145.9	254.8	67.6	322.4	176.5
2032	81.0	11.2	46.7	138.9	281.7	70.5	352.2	213.3
2033	74.1	11.5	45.6	131.3	304.0	72.6	376.6	245.3
2034	67.7	11.8	44.1	123.6	325.1	73.9	399.0	275.4
2035	61.5	11.9	42.3	115.7	342.7	74.4	417.1	301.4
2036	55.7	11.8	40.3	107.8	356.5	74.3	430.8	323.0
2037	50.3	11.5	38.2	100.0	366.1	73.6	439.7	339.7
2038	45.2	11.0	36.0	92.3	371.8	72.5	444.3	352.0
2039	40.4	10.5	33.9	84.8	376.3	71.0	447.3	362.5
2040	36.0	9.9	31.8	77.7	377.4	69.2	446.6	368.9
2041	31.8	9.3	29.9	71.0	371.5	66.9	438.4	367.4
2042	27.9	8.8	28.0	64.7	364.3	64.5	428.8	364.1
2043	23.8	8.2	26.2	58.2	355.1	61.9	417.0	358.8
2044	20.0	7.6	24.5	52.1	346.7	59.3	406.0	353.9
2045	16.1	7.0	22.7	45.9	336.7	56.5	393.2	347.3
2046	12.5	6.5	21.0	39.9	324.7	53.6	378.3	338.4
2047	9.2	5.9	19.2	34.3	314.1	50.9	365.0	330.7
2048	6.2	5.4	17.5	29.1	303.2	48.3	351.5	322.4
2049	3.5	5.0	15.7	24.1	292.8	45.9	338.7	314.6
2050	1.4	4.5	13.9	19.8	282.3	43.5	325.8	306.0
Total	1,488.3	216.5	843.6	2,548.4	7,443.9	1,532.4	8,976.3	6,427.9

Estimated costs: \$2,548.4m

Estimated benefits: \$8,976.3m

Net benefit: \$6,427.9m

Benefit/Cost Ratio: 3.52 (\$8,965.3m/2,548.4m)

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 above one (at about 1.74). If a 3 per cent discount rate was used, the benefits would exceed costs by a factor of 7.76 to one.

Based on the technology adopted to date by manufacturers to meet equivalent standards in the US, 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, diesel exhaust fluid costs, productivity losses and additional road wear. Benefits included avoided health and fuel costs.

- The capital cost estimates for vehicle emissions control technologies were informed by industry submissions received during previous consultation.
- Fuel cost savings were calculated by assuming that the fuel consumption of a Euro VI heavy vehicle would be 3 per cent lower than an equivalent Euro V vehicle based on advice from heavy vehicle manufacturers.
- Diesel exhaust fluid costs were calculated by assuming that a move to Euro VI would entail more vehicles using urea than the base case, and increased rates of urea consumption, based on the experience to date by the heavy vehicle industry.
- 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 emission standards, which may include changes to mass limits. The costs and benefits of such measures are beyond the scope of this analysis.
- Additional road wear costs were anticipated, as it is assumed that all Euro VI vehicles that are not constrained by mass and/or width limits would operate at a gross vehicle mass approximately 300kg higher than vehicles that comply with older standards.
- 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:

- evaluation period (2040 vs 2050)
- discount rates
- possible social costs avoided from a reduction in greenhouse gas emissions from reduced fuel use.⁹
- possible reductions in capital costs borne by the Australian economy, if capital cost borne by manufacturers overseas were not passed on to their Australian models.

As the second option generated the highest net benefits, sensitivity testing was conducted on the modelling for this scenario. The results are summarised below in Table A3. With net benefits ranging from \$1,896 million to \$17,226 million and all scenarios tested being positive, the estimated net benefit of \$6,428 million from adopting this option appears realistic.

Table A3 Sensitivity test results for Euro VI (Stage C from 2024)

Sensitivity test	Benefit-cost ratio	Net benefits (\$m)
Core Euro VI scenario (to 2050)	3.52	6,427.9
Low discount rate (3 per cent)	7.76	17,225.9
High discount rate (11 per cent)	1.74	1,895.5
2040 analysis period	2.43	3,024.5
Including possible benefits from avoided greenhouse gas emissions	3.64	6,738.7
If capital costs borne by manufacturers overseas are not passed on to Australian customers	6.61	7,618.5

⁹ Based on a value of \$60 per tonne of CO₂ equivalent emissions. The Australian Transport Planning and Assessment Guidelines (2020) agreed by Infrastructure and Transport Ministers, note this value is broadly in the middle of the range of values reported in relevant studies.

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