



Australian Government

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

Final Impact Analysis for Improving Pedestrian Safety—Acoustic Vehicle Alerting Systems for Quiet Road Transport Vehicles

December 2023

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Director – Internal Comms and Creative Services
Communication Branch
Department of Infrastructure, Transport, Regional Development, Communications and the Arts
GPO Box 594
Canberra ACT 2601
Australia

Email: publishing@infrastructure.gov.au | Website: www.infrastructure.gov.au

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Executive Summary

Pedestrian collisions

On average, over 160 pedestrians die on Australian roads every year.¹ Thousands more are injured.

The impact of pedestrian road crashes is significant, costing the Australian community over \$1.2 billion each year. For those involved in these crashes and their families, there is an immeasurable personal cost.

This Impact Analysis focuses on a specific pedestrian safety problem relating to quiet road transport vehicles (QRTVs)². These vehicles are typically very quiet at low speeds, when tyre and wind noise is negligible, which can make it difficult for pedestrians, particularly those with low vision to hear these vehicles, increasing the risk of a collision. QRTVs mainly comprise electric and hybrid vehicles, which are growing in number, as Australia continues to decarbonise its road transport sector.

This is a particular issue for the blind and low vision community, given their reliance on sound to negotiate the road network independently. A 2018 survey by the Monash University Accident Research Centre (MUARC), commissioned by Vision Australia, found that people in this community had an increased feeling of vulnerability on roads due to electric vehicles, with 35% of those who responded to the survey reporting that they had experienced either a collision or near-collision with an electric vehicle. A follow-up survey by Vision Australia in 2023 found that the proportion of respondents who had experienced a collision or near-collision with an electric vehicle had risen to over 50%.

Acoustic Vehicle Alerting Systems

Over the past 10 or so years there has been global action to address the pedestrian safety concerns of quiet electric vehicles. Most major vehicle markets, including the European Union, United Kingdom, Japan, Korea, China and the United States, have already mandated the fitment of Acoustic Vehicle Alerting Systems (AVAS) to their electric vehicles. These systems are designed to emit a sound external to the vehicle, when the vehicle is travelling at low speeds, that must be able to be detected by pedestrians.

The United Nations (UN) World Forum for the Harmonization of Vehicle Regulations (WP.29) has established an international vehicle regulation for AVAS, known as UN Regulation 138/01 – Uniform Provisions Concerning the Approval of Quiet Road Transport Vehicles with Regard to their Reduced Audibility (UN R138/01).

The Australian Government has a strong history of acting to improve road safety. One of its key actions is setting mandatory national vehicle standards, known as the Australian Design Rules (ADRs), under the *Road Vehicle Standards Act 2018* (RVSA). Where possible, the ADRs are harmonised with international vehicle regulations, as developed through the UN.

¹ BITRE, Road Trauma Australia—Annual Summaries, Australia, May 2023

² In this Impact Analysis, the term ‘Quiet road transport vehicles’ (QRTVs) means vehicles that can be propelled for any period time without an internal combustion engine. These include battery electric vehicles (powered by an electric motor only), hybrid electric vehicles (powered by both an electric motor and an internal combustion engine) and hydrogen fuel cell vehicles (which generate electricity to power the vehicle through a chemical reaction of hydrogen and oxygen).

Public comment

On 28 March 2023, the Government released a draft Impact Analysis for public consultation that explored the potential costs and benefits of mandating UN R138/01 as a new ADR, phased in from 2025 to 2026. While UN R138/01 applies to all light and heavy vehicles with an electric powertrain, the draft proposed that a new ADR would apply only to new light vehicles. This was due to insufficient data being available to determine the likely benefits and costs of mandating AVAS for quiet heavy vehicles in Australia.

Public consultation closed on 26 May 2023 and the Government received 392 submissions from governments, organisations, and individuals, with strong representation from the blind and low vision community. Submissions from governments and organisations, including the light and heavy vehicle industry, were strongly supportive of mandating AVAS in Australia. Submissions from individuals were more mixed, with around 60% supporting AVAS, and 40% not supporting it due to concerns about possible noise pollution impacts.

Two key themes emerged from the public consultation process to affect this Impact Analysis. First, stakeholder submissions and subsequent stakeholder engagement found strong support for the inclusion of AVAS for new heavy vehicles. Secondly, some submissions also highlighted that several cost variables required updating to better represent the experience in other markets that have mandated AVAS. As a result, this Impact Analysis includes updated manufacturing and vehicle collision related costs to reflect these changes.

Cost-benefit analysis

The department engaged MUARC to conduct analysis that indicated 36.8% of light vehicle collisions involving pedestrians occurred in conditions applicable to AVAS for light vehicles (i.e. where vehicles are likely to be travelling at 20 km/h or less). MUARC also found that mandating the fitment of AVAS to electric vehicles could reduce the likelihood of an electric vehicle being involved in a collision with a vulnerable road user by 17.7%. This is projected to lead to avoid at least 65 fatalities and over 5,000 non-fatal trauma incidents over a 35-year period.

The cost-benefit analysis indicates that fitment rates would reach 100% by 2027 with government invention while the business as usual approach would likely not exceed 84% by the 2060s. These results underscore the importance of government intervention.

There would be costs associated with implementation for manufacturers, although most vehicle manufacturers supplying vehicles to Australia also supply vehicles to markets where AVAS is already mandated, and will be familiar with the steps required to test and fit the technology to Australian models. There are few direct benefits for business, but employers would indirectly benefit from reduced employee absences due to road trauma. AVAS component manufacturers and suppliers would also benefit from increased demand.

Consumers and road users would receive a direct net benefit from these changes through reduced risk of collision with QRTVs. This would be more significant for the blind and low vision community, and other vulnerable road users. While some manufacturers may pass on fitment costs to consumers, fitment costs for new technologies tend to decrease as the technology becomes commonplace.

For government, indirect benefits stem from a reduction in road trauma which would have otherwise been borne by the public health system. The proposed changes also support the Government's commitment to promoting human rights for people with a disability. The average annual regulatory cost of mandating AVAS was estimated to be between \$16.8 and \$18.4 million (depending on the option adopted).

Table A: Summary of benefits, costs, lives saved and injuries avoided for each option considered over 35 years (Likely Case – over 15 years of regulation, plus an additional 20 years in service for vehicles supplied during the regulated period)

Case	Gross benefits (\$m)	Net benefits (\$m)	Cost to business (\$m)	Cost to Government (\$m)	Benefit-cost ratio	Number of lives saved	Serious injuries avoided	Minor injuries avoided
Option 1 (Business as usual)	-	-	-	-	-	-	-	-
Option 2 (Light vehicles from Jan 2025)	372.8	201.2	171.1	0.5	2.17	65	2,585	2,863
Option 3a (Light vehicles from Jan 2025, heavy vehicles from Nov 2025)	389.3	210.3	178.5	0.5	2.18	68	2,701	2,991
Option 3b (light and heavy vehicles from Nov 2025)	377.3	208.4	168.4	0.5	2.23	68	2,675	2,962

Recommended Option

There are three options for the introduction of AVAS that would result in different adoption rates.

- Option 1 relies on the business as usual approach where the market determines the introduction of these systems.
- Option 2 mandates the fitment of AVAS to new light QRTVs (up to 3.5 tonnes gross vehicle mass) from January 2025.
- Option 3 is effectively the same as Option 2 but also mandates the fitment of AVAS to heavy QRTVs from November 2025. Two timeframes for Option 3 were evaluated:
 - 3a - mandating AVAS for light vehicles from January 2025 and heavy vehicles from November 2025, and
 - 3b - mandating AVAS for light vehicles and heavy vehicles from November 2025.

The impact analysis, released for public consultation in March 2023, found there were substantial benefits from mandating AVAS for light vehicles over the business as usual approach. In response to feedback received during the public consultation, which strongly supported mandating AVAS for heavy vehicles as well as light vehicles, a third option mandating AVAS for heavy vehicles in addition to light vehicles, was evaluated. Options 3a and 3b both include fitment of AVAS to light and heavy vehicles (consistent with the adoption of UN R138/01), with the key difference being implementation timing between the two categories of vehicle. Our analysis found that Option 3a was likely to have the greatest net benefit and safety outcomes. However, as this option would allow less than 12 months for light vehicle manufacturers to update and recertify vehicles that do not currently comply, this Impact Analysis recommends implementing Option 3b to allow sufficient time for safety benefits and minimise road trauma for vulnerable road users, especially for the blind and low vision community without unduly disrupting the supply of new, safer and cleaner vehicles to customers currently experiencing prolonged waiting times.

The Impact Analysis Process

This Final IA has been written in accordance with the Australian Government IA requirements. In the subsequent nine chapters, the seven assessment questions set out in the *Australian Government Guide to Policy Impact Analysis (2023)* have been addressed. In addition, measurement of regulatory burden and cost offsets are considered. The seven IA questions addressed are:

1. What is the problem you are trying to solve and what data is available?
2. What are the objective, why is government action needed to achieve them, and how will success be measured?
3. What policy options are you considering?
4. What is the likely net benefit of each option?
5. Who did you consult and how did you incorporate their feedback?
6. What is the best option from those you have considered and how will it be implemented?
7. How will you implement and evaluate your chosen option against success metrics?

In line with the principles for Australian Government policy makers, the regulatory costs imposed on business, the community and individuals associated with each viable option were quantified. It is anticipated that regulatory savings from further alignment with international standards will offset the additional costs of implementing the recommended option

1. What is the problem you are trying to solve and what data is available?

1.1 Road Crashes in Australia impose a significant cost on the community

The impact of road crashes on society is significant, costing the Australian community over \$30 billion per year in healthcare, lost productivity, and property expenses (NRSS 2021-2030). This translates to an average cost of over \$1,100 levied upon every person in Australia. For those individuals and families involved in these crashes, there is an immeasurable personal cost.

1.1.1 Road trauma involving pedestrians is not improving

Pedestrians comprise the largest single road user group, as almost everyone is a pedestrian at some point of their travel journey. Most Australians regularly walk for leisure, to go to work, school or local shops and to access other modes of transport. Pedestrians are considered particularly vulnerable because they have little or no protection if struck by a road vehicle.

Pedestrians travel low kilometres relative to other road user groups, yet comprise 13% of all road fatalities in Australia, amounting to over 160 deaths annually on average (BITRE, 2020). Thousands more are injured. Pedestrian crashes alone cost the Australian community over \$1.2 billion each year. Pedestrian road use risk clearly increases when a pedestrian's vision or attention is compromised.

Research shows pedestrians distracted by their mobile phones are at increased risk of being involved in a collision. Pedestrians using mobile devices tend to walk slower and more unevenly, pay less attention to their environment and have more safety-related incidents. One observational study conducted by MUARC found around 20% of pedestrians observed crossing roads were distracted by smart phones and 31% of those displayed high-risk behaviour like not looking before crossing the road³.

Pedestrians and cyclists are also at greater risk from heavy vehicles, noting that electric buses and trucks are still operating in small numbers. Although heavy vehicles represent only around 3% of total registered vehicles in Australia, 20% of pedestrian and cyclist fatalities involved a heavy vehicle in 2021.⁴ Most of these fatalities were children and young people, a figure likely to be connected to not only the mass difference between a heavy vehicle and a pedestrian, but the blind spots associated with trucks and buses.

While pedestrian fatalities decreased during COVID-19, likely due to the decrease in the number of vehicles on the road (especially during lockdowns), pedestrian fatalities have started to increase again since 2021. At its lowest point in the last few years, 133 pedestrians were killed in 2021, however this increased by 21.8% to 162 pedestrian deaths in 2022. In the 12 months to October 2023, 166 pedestrian deaths have been recorded in Australia.⁵

Pedestrian hospitalisations represent nearly 6% of hospitalisations due to road trauma, with 2,334 pedestrians hospitalised in 2021. While not a perfect measure, hospital admission provides the best available indication of serious injury crashes in Australia. The majority of these incidents involved a light vehicle striking a pedestrian. This data does not include cyclists, although the hospitalisation rates are significantly higher, with 8,163 cyclists hospitalised in 2021 due to road trauma (representing over 20% of road user hospitalisations due to road trauma). National data collected by road safety authorities does

³ Monash University Accident Research Centre, Pedestrian Distraction from Smartphones (July 2022) Report No.349

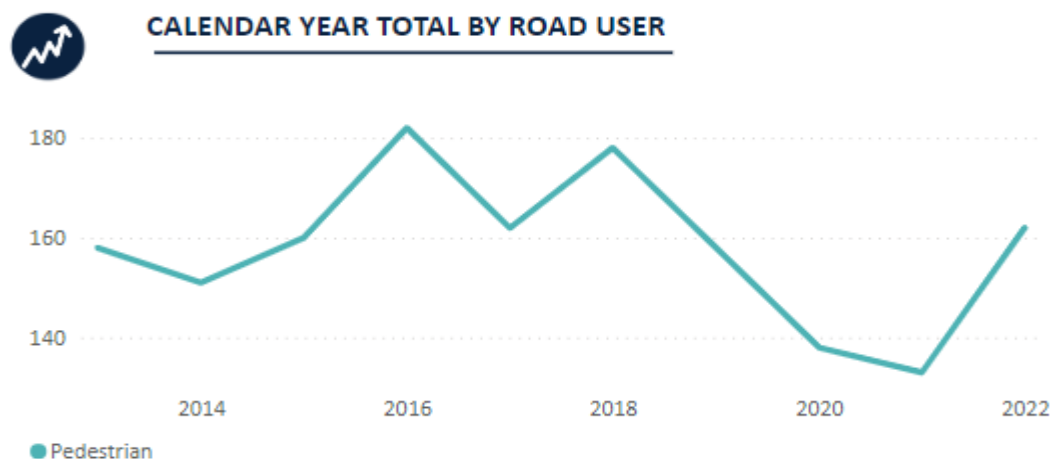
⁴ BITRE, National Crash Database; Road Vehicles, Australia, January 2023

⁵ BITRE, Road Deaths Australia—Monthly Bulletins, Australia, November 2023

not consistently record the type of vehicle involved in the collision (i.e. whether it is an electric, hybrid or internal combustion engine vehicle).

Figure 1 shows the number of pedestrian fatalities in Australia from 2013 to 2022.

Figure 1: Pedestrian fatalities 2013 - 2022 (BITRE, 2023)



1.2 Quiet Road Transport Vehicles are more likely to collide with pedestrians

Quiet road transport vehicles (QRTVs), such as hybrid and electric vehicles, which can operate at low speed with an internal combustion engine operating, produce significantly less noise than internal combustion engine vehicles. The uptake of QRTVs that emit significantly less noise than conventional internal combustion engines pose a substantial risk to pedestrians and other vulnerable road users (VRUs), such as cyclists, who navigate areas on and surrounding public roads and have little to no protection from crash forces, if involved in a collision. All road users are VRUs at some point in their journey; this includes the estimated 453,000 people in Australia who are blind or have low vision. This figure is expected to increase by 2030.

A 2017 study by the United States National Highway Traffic Safety Administration (NHTSA) found that, compared with an internal combustion vehicle, a QRTV was around 20% more likely to be involved in a pedestrian crash. Due to availability of data, this Impact Analysis focuses specifically on pedestrians. However, it is worth noting that the NHTSA found cyclists in the US faced a similar risk from QRTVs as pedestrians.

This risk to the safety of pedestrians and other VRUs is expected to increase as QRTVs become more common on Australian roads. While QRTVs currently account for around 2.8%⁶ cent of passenger vehicles on the road, the number of QRTVs on the road is expected to increase substantially when electric vehicles become more cost competitive with internal combustion engine vehicles over the period to 2030.

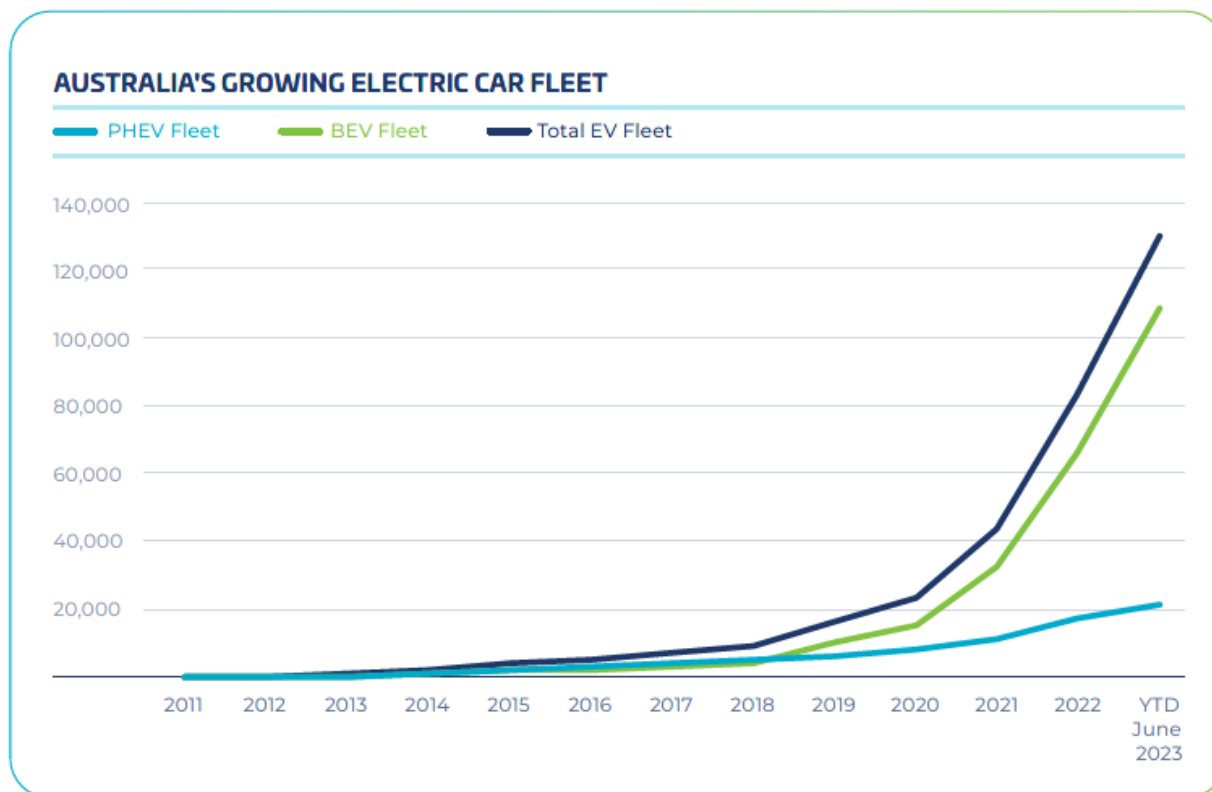
In 2022, electric vehicles made up only 3.8% of Australia's national car market, but in the first half of 2023, electric vehicle sales increased to 7.8%⁷ of total new vehicle sales. There are around 80,000 electric vehicles now registered in Australia, representing an increase of 114% over 2022. The most recent *State of Electric Vehicles* report, published by the Electric Vehicle Council in July 2023, shows a rapid increase in electric vehicle sales over the past two years (Figure 2).

⁶ BITRE, Road Vehicles, Australia, January 2023

⁷ VFACTS, National Report, July 2023

In 2019, it was estimated that by 2050, nearly 70% of passenger vehicles on the road will be electric (BITRE, 2019). With the Australian Government recently committing and adopting measures to accelerate the uptake of electric vehicles in Australia (such as the Electric Car Discount), this number may end up being much higher. Recent research indicates around 548,000 Australians plan to buy an electric vehicle in the next four years, representing around 12.5% of all those intending to purchase a new vehicle in this period. (Roy Morgan 2023)

Figure 2: New electric vehicle sales in Australia (Electric Vehicle Council, 2023)



The number of quiet trucks and buses is also increasing, reflecting a stronger demand, particularly in urban areas, for lower emission school and public transport buses, and medium to heavy rigids like municipal or delivery trucks. The Truck Industry Council (TIC) has advised the Government it expects 25% of all new truck sales will be QRTVs by 2030, with over 18,000 lower emissions trucks on the road.

1.2.1 Safety Risks are Greater for the Blind and Low Vision Community

While QRTVs present a risk for all pedestrians, there is a particular concern for blind and low vision pedestrians, as they may rely on auditory or other sensory cues to navigate independently.

According to Vision 2020 Australia in its submission to the public consultation process, around half a million Australians have some level of vision loss. The majority of these are over the age of 65 with comorbidities that occur with age. This results in increased fall rates, heightened risks of depression, hip fractures and increased use of public health services more generally.

Vision Australia claims the transition to QRTVs would further exacerbate these factors. This includes potential socio-economic disadvantage as a consequence of affected persons opting for costlier forms of transport over pedestrian options.

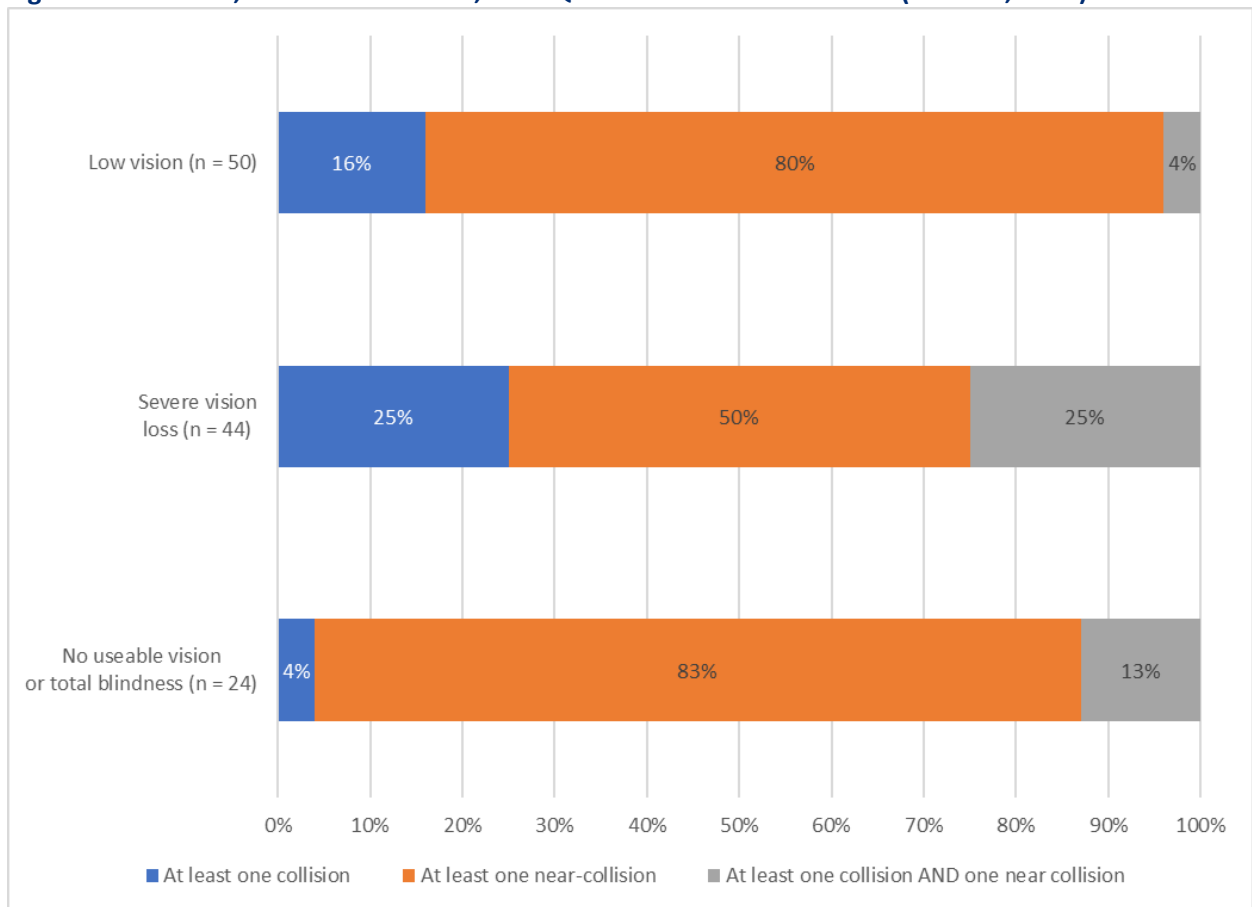
In 2018, MUARC conducted a study on the road safety impacts of QRTVs on these pedestrians. The study was commissioned by Vision Australia, which provides blindness and low vision services nationally.

As part of this study, MUARC conducted a survey of 246 people who all had a degree of vision loss that cannot be corrected. When asked about collisions or near-collisions with QRTVs (excluding bicycles), 35%

(86) of participants indicated they had been involved in either a collision, near-collision or both, and some more than once. The majority of these events occurred while crossing a road (58%). (Liu et al, 2018)

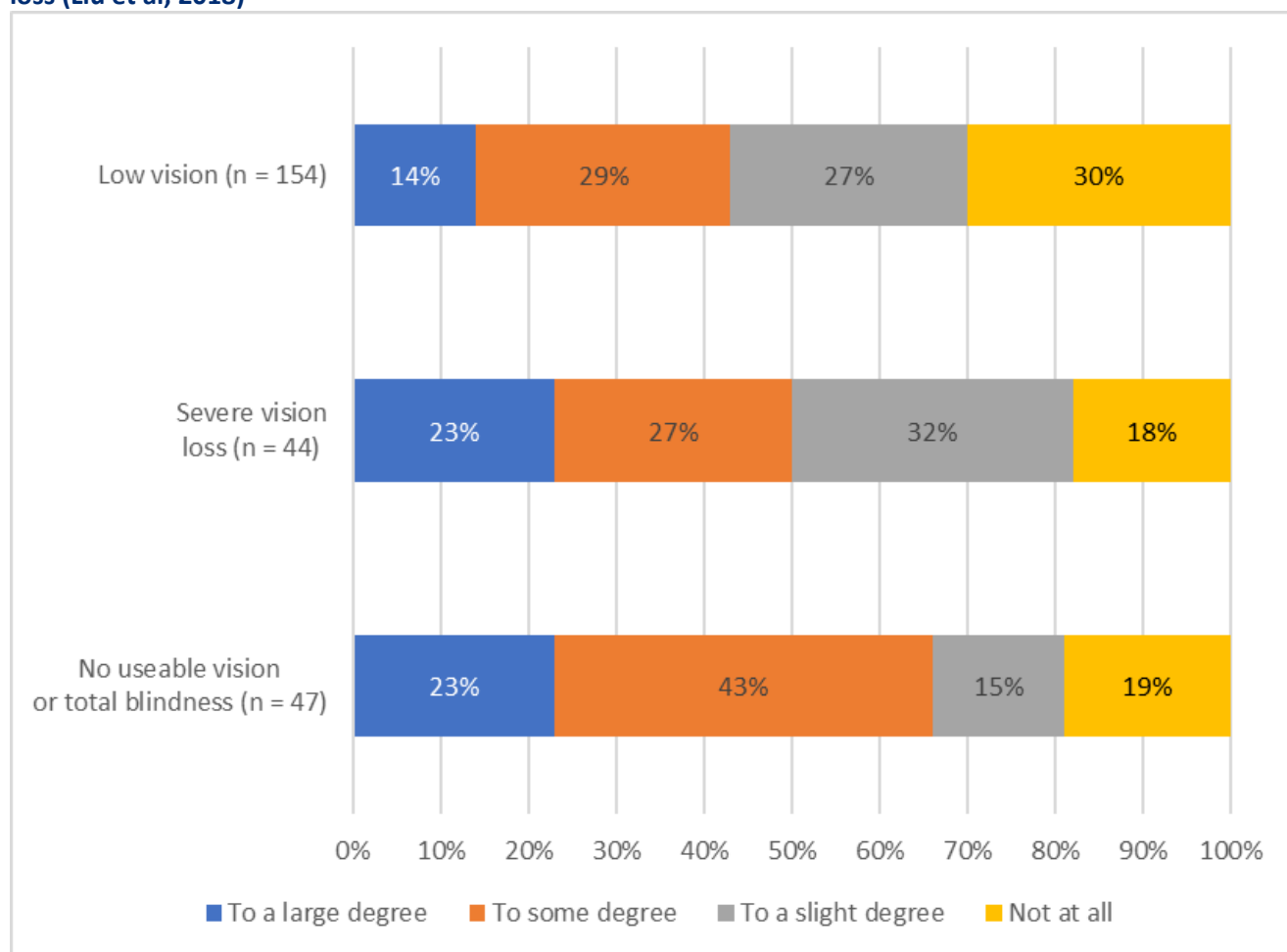
Figure 3 below shows the breakdown of these collision and near-collision events relative to vision loss.

Figure 3: Collisions, and near collisions, with QRTVs relative to vision loss (Liu et al, 2018)



These events were found to have significant consequences for the mental health of those involved, particularly through increased anxiety and depression. Participants in the study were asked to reflect on whether the introduction of QRTVs in Australia had reduced their confidence to walk near and cross roads. Sixteen per cent indicate that it had affected their confidence to a large degree, 31% to some degree, and 26% to a slight degree. Figure 4 below breaks down these figures further relative to vision loss. (Liu et al, 2018)

Figure 4: Degree of reduced confidence as a pedestrian from the presences of QRTVs, relative to vision loss (Liu et al, 2018)



In a more recent survey conducted by Vision Australia, close to 100% of respondents were supportive of the introduction of AVAS for QRTVs. Importantly, over 51% of respondents said they had experienced at least one collision or near-collision. This is an increase from 35% from the previous survey conducted by MUARC in 2018. Given the nature of vision impairment, it is likely these figures are conservative given some persons may not have been aware they were involved in near-incidents.

It was widely acknowledged in the most recent survey that cyclists would also benefit from AVAS.

1.2.2 Distracted Pedestrians are also Emerging as a Concern

Another safety concern is the growing number of pedestrians using increasingly more sophisticated and attention-absorbing handheld devices, like smartphones, while on and near roads.

In 2020, MUARC undertook research to determine the impact of smartphone-related distractions on pedestrian safety. The research included a literature review, observational studies of pedestrian smartphone use, interviews and focus groups.

In general, the literature review found smartphone use to have a negative impact on pedestrian safety. Smartphone-using pedestrians walk slower and more unevenly, and pay less attention to their surrounding environment. (Osbourne, R. et al, 2020)

In its observational study, MUARC found that around 20% of pedestrians used a smartphone when crossing a road. These pedestrians had a significantly higher proportion of critical safety events, such as near misses, compared with those not using a smartphone. The interviews and focus groups showed

increasing community awareness of the safety risks associated with smartphone use on and near roads. (Osbourne, R. et al, 2020)

While MUARC did not specifically consider QRTVs in the context of distracted pedestrians, it is logical to conclude that distracted pedestrians would be an increased risk of collision with a QRTV if they cannot hear it coming towards them.

2. What are the objectives, why is government intervention needed to achieve them, and how will success be measured?

2.1 Objectives of Government Action

As noted in the previous section, we are not seeing significant safety improvements in safety outcomes for pedestrians with the current policy settings in place. QRTVs present a new risk to the safety of pedestrians and other VRUs, especially at low speeds. The uptake of QRTVs has increased exponentially in recent years and this trend will continue, as efforts are made by governments and the general public to reduce transport emissions by increasing the electrification of the vehicle fleet. This risk could be acute for the blind and low vision community in particular.

There is strong commitment from all levels of government in Australia to improve road safety in line with community expectations. For this reason, there are a range of regulatory and non-regulatory measures already in place, including mandatory national vehicle standards, the National Road Safety Strategy and Action Plan, consumer information programs like ANCAP, and dedicated funding for road safety initiatives and infrastructure upgrades. Appendix B—Government Actions to Address Road Trauma provides further details on existing measures to improve road safety outcomes.

VRU Safety and Vehicle Safety are key priorities in the National Road Safety Strategy 2021-30 and all Australian governments have committed to 2030 targets to reduce road fatalities by 50% and serious injuries by 30%. The Strategy also commits to a target of zero road deaths in city CBD areas by 2030.

Therefore, the objectives of Government action considered in this Impact Analysis are to enable governments to achieve the targets detailed in the National Road Safety Strategy and its Action Plan by:

- reducing road trauma involving VRUs; and
- reducing safety risks to VRU safety by improving the audibility of QRTVs supplied to Australia.

2.2 Government intervention needed to achieve these objectives

Government action is often needed where the market fails to find the most efficient and effective solution to a problem. The Australian Government has a strong history of intervening to improve road safety, particularly through mandating national vehicle standards, known as the Australian Design Rules (ADRs), which are made under the *Road Vehicle Standards Act 2018* (RVSA).

To address the safety risks from reduced audibility of QRTVs, the National Road Safety Action Plan 2023-25 highlighted the need to consider a new Australian Design Rule (ADR) for AVAS for QRTVs in 2023, subject to the outcome of an impact analysis.

ADRs have played a significant role in reducing road deaths and injuries over the last 50 years, above and beyond what would have been achieved through market forces alone. ADRs covering vehicle structures and restraint systems have improved crash performance significantly. Passive safety features such as airbags, seat belts, collapsible steering columns, head restraints and padded surfaces help prevent or manage the forces of impact in crashes. More recent ADRs for technologies that assist in mitigating crashes, such as advanced braking systems, electronic stability control, and advanced emergency braking, are delivering further reductions in road trauma.

Where possible, the ADRs are harmonised with international vehicle regulations, as developed through the UN. Harmonising with international regulations provides consumers with access to vehicles meeting the latest levels of safety and innovation at the lowest possible cost. The Government, through the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (the department), has actively participated in the development of the UN vehicle regulations for a number of years.

2.2.1 Acoustic Vehicle Alerting Systems (AVAS) is mandated in other markets to improve the audibility of QRTVs

To address the risk QRTVs pose for VRU safety, the United Nations (UN) World Forum for the Harmonization of Vehicle Regulations (known as WP.29) has established UN Regulation 138– Uniform Provisions Concerning the Approval of Quiet Road Transport Vehicles with Regard to their Reduced Audibility. The current series of this regulation, UN R138/01, sets out requirements for AVAS for QRTVs.

AVAS are sets of components installed in QRTVs for the purpose of emitting a sound external to the vehicle to improve its audibility to VRUs. The sound emitted at low vehicle speeds must be able to be detected by pedestrians, particularly at speeds where the contribution of tyre and wind noise is minimal (Lawrence et al, 2020).

Most major vehicle markets, including the EU, UK, Japan, Korea, China and the US have mandated UN R138/01, or equivalent standards.

2.2.2 An Australian mandate is also required to address these risks

While many governments overseas have acted to mitigate the pedestrian safety risk from QRTVs by mandating the fitment of AVAS, mandating a technology overseas does not guarantee that vehicles imported into Australia will be fitted with the technology. Vehicles in different markets, that otherwise appear identical to the consumer may be tailored by the manufacturer to the requirements of each market.

It is estimated that around 20% of QRTVs supplied to the Australian market are already fitted with AVAS, and this percentage is expected to increase over the years. However, some manufacturers, particularly those supplying higher volume models in price sensitive segments, may find it more cost effective to supply vehicles to Australia without AVAS fitted, if it is not demanded by regulation or consumers.

There is unlikely to be a strong consumer demand for the technology, as consumers are generally more likely to focus on technologies that benefit them directly, rather than benefitting other road users.

The costs and benefits of mandating a new ADR for AVAS are examined in the Sections 3 and 4 of this Impact Analysis.

2.3 How will success in achieving these objectives be measured?

The National Road Safety Strategy 2021-30 sets out Australia's road safety objectives over the next decade, and includes key priorities for action and targets to reduce the annual number of fatalities by at least 50% and serious injuries by at least 30% by 2030. The National Road Safety Action Plan 2023-25 is the first Action Plan under the Strategy and details the specific actions all Australian Governments will take to implement the Strategy in the three years to 2025.

The primary measures of success are overall reductions in road trauma, however the Strategy also includes other indicators to help measure progress at a more granular level. This includes safety performance indicators, as well as a series of 'demonstrating zero' measures, which are designed to demonstrate the success against all Australian Government's commitment to Vision Zero 2050.

A Road Safety Data Working Group, which consists of senior representatives from the Australian and all state and territory governments, was established under the Action Plan governance arrangements to make data available for the safety performance indicators and demonstrating zero measures, including for the demonstrating zero measure 'Zero deaths in CBD areas', where VRUs are more prevalent.

Data on performance of the Strategy and Action Plan will be reported publicly on the National Road Safety Data Hub website.

3. What policy options are being considered?

As noted in Section 2.1, the objectives of Government action are to enable governments to achieve the targets detailed in the National Road Safety Strategy and its Action Plan by:

- reducing road trauma involving VRUs; and
- reducing safety risks to VRUs by improving the audibility of QRTVs.

The decision rule for this Impact Analysis is that the recommended option should be the option with the highest net benefit in line with the *Australian Government Guide to Policy Impact Analysis*.⁸

A core objective of the RVSA, which regulates the first supply of road vehicles to Australia, is also to set nationally consistent performance-based standards that road vehicles must comply with before being provided in Australia and provide consumers with a choice of road vehicles that meet the safety and environmental expectations of the community.

Where intervention involves the use of regulation, the Agreement on Technical Barriers to Trade encourages Australia to adopt international standards where they are available or imminent. As a contracting party to the UN 1958 Agreement, the Government has also committed to harmonise Australia's vehicle standards wherever possible with international standards adopted by the UN World Forum for the Harmonization of Vehicle Regulations (WP.29).

The options considered in this section to improve the audibility of new QRTVs supplied to Australia align with these objectives.

Option 1 is to maintain the status quo, allowing market forces to find a solution to the problem (business as usual). This is the benchmark policy option.

Option 2 is to mandate, through a new ADR, the fitment of AVAS to all new *light*⁹ QRTVs supplied to Australia. The ADR would adopt UN Regulation 138/01, but only for light vehicle categories. This was the original option canvassed in the Consultation Impact Analysis released for public comment on 28 March 2023, due to the absence of data available to support its introduction for heavy vehicles.

Option 3 is to mandate, through a new ADR, the fitment of AVAS to all new *light and heavy*¹⁰ QRTVs supplied to Australia. The ADR would align with the scope of UN Regulation 138/01, which mandates the fitment of AVAS to light and heavy vehicle categories. This option was added in response to the feedback received in response to the Consultation Impact Analysis, which called for AVAS to be mandated for heavy vehicles, as well as light vehicles.

To consider the impacts of two possible introduction dates for light vehicles (January 2025, as proposed in the Consultation Impact Analysis, and November 2025, as proposed for heavy vehicles). Two sub-options of Option 3 have been modelled:

Option 3a considers mandating, through a new ADR, the fitment of AVAS to all new *light* QRTVs supplied to Australia from January 2025, and all new *heavy* QRTVs supplied to Australia from November 2025.

Option 3b considers mandating, through a new ADR, the fitment of AVAS to all new *light and heavy* QRTVs supplied to Australia from November 2025.

⁸ OIA, Australian Government Guide to Policy Impact Analysis, Department of the Prime Minister and Cabinet, Australian Government, 17 February 2023, accessed 16 May 2023.

⁹ ADR categories MA, MB, MC and NA.

¹⁰ ADR categories MD, ME, NB and NC

The exclusion of alternative non-regulatory options in Impact Analyses considering the introduction of new international vehicle standards was agreed with the Office of Impact Analysis (then the Office of Best Practice Regulation) in late 2019. This concession was made in order to streamline the process for adopting international vehicle standards, where evidence for doing so demonstrates a net benefit to the Australian community.

In line with the scope of the RVSA, which regulates the initial supply of a road vehicle to Australia, the regulatory options considered in this Impact Analysis will only apply to new road vehicles supplied to Australia.

Once a vehicle has been supplied to the market in Australia, responsibility for regulation passes to the relevant state or territory government. Generally, states and territories require vehicles to continue to comply with ADR requirements, but it is not possible under the current legislative frameworks for national vehicle standards under the RVSA to mandate the retro-fitment of vehicle components to existing vehicles on a national basis.

QRTVs supplied to Australia prior to any enforceable ADR commencement date will also not be subject to the new regulatory requirement. These vehicles will still represent a small proportion of the entire Australian vehicle fleet.

3.1 Option 1: Business as Usual

This option relies on the market finding a solution to the problem, the community accepting the problem, or some combination of the two.

Broadly, governments will continue their efforts to reduce road trauma in Australia. Regarding the availability of AVAS on QRTVs in Australia, it is expected that voluntary uptake will increase gradually over time. The department estimates that approximately 20% of new QRTVs supplied to Australia are already fitted with an AVAS, even though it is not required by regulation. This is based on consultation with vehicle manufacturers as well as desktop analysis of QRTV models and sales volumes.

The department further estimates that in 2025, almost 30% of new QRTVs will be fitted with AVAS. However, as outlined previously, without mandating the technology, Australia is unlikely to reach 100% fitment, as some manufacturers have advised they will not fit it unless required by regulation. As such, under the status quo option, we risk foregoing the full safety benefits of the technology, and risk falling behind other countries who have already mandated it.

This option was analysed in detail in order to establish a benchmark for comparison with Options 2 and 3.

3.2 Option 2: Mandatory Standards for Light Vehicles

Under this option, the Australian Government would mandate the fitment of AVAS to new light electric vehicles supplied to the market through a new ADR under the RVSA. The new ADR would align with the technical requirements of UN R138/01, or the equivalent US Federal Motor Vehicle Safety Standard 141. As the Government does not have jurisdiction to set requirements for vehicles currently in service, this option would not require AVAS to be retrofitted to existing vehicles already on the road.

3.2.1 Background

Australia mandates approximately 60 active ADRs under the RVSA. Vehicles are approved on a model (or vehicle type) basis known as type approval, whereby the Australian Government approves a vehicle type based on test and other information supplied by the manufacturer. Compliance of vehicles built under that approval is ensured by regular audits of the manufacturer's production, design and test facilities.

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/manufacture under the RVSA.

A program of harmonising ADRs with international vehicle standards developed through the UN, began in the mid-1980s and has recently been accelerated. As Australia accounts for only around 1% of global vehicle sales, harmonised Australian requirements minimise system development costs and provide manufacturers with the flexibility to incorporate or adapt systems that have already been developed and tested for markets with similar requirements. It also enables manufacturers to leverage testing and certification frameworks adopted in other markets.

3.2.2 Proposed Scope

The internationally agreed standard for AVAS is currently UN R138/01. The regulation sets requirements for minimum sound pressure level, frequency and octave levels in low speed conditions. Its scope covers all passenger (M category) and commercial (N category) vehicles with a hybrid, electric, or hydrogen fuel cell powertrain.

UN R138/01 requires electric vehicles to be fitted with AVAS producing:

- a minimum overall sound pressure level of 50 dB(A) at 10 km/h, and 56 dB(A) at 20 km/h.
- at least two one-third octaves, with at least one below or within a 1,600 Hz one-third octave band, with each band meeting minimum sound pressure levels. This minimises the risk of the sound being masked in different conditions.
- a frequency shift in at least one tone in the frequency range, where the shift is proportional to the speed within each individual gear ratio (an average of at least 0.8% per 1 km/h). This helps to indicate whether the vehicle is accelerating or decelerating.

When reversing at low speeds (tested at 6km/h), UN R138/01 requires a vehicle to emit a sound with an overall sound pressure level of 47 dB(A). (United Nations, 2017).

See Appendix C—UN Regulation 138/01 Requirements for further details.

3.2.3 Implementation Timing

The ADRs only apply to new vehicles and typically adopt a phase-in period to give established models time to update their design. The implementation lead time of an ADR is generally no less than 18 months for models that are new to the market (new model vehicles) and 24 months for models already established in the market (all new vehicles). This lead time varies depending on the complexity of the changes required to comply with the ADR.

As AVAS is mandated in most major vehicle markets, major manufacturers are likely to have a clear understanding of steps required to comply with an ADR based on UN Regulation 138/01. For this reason, the Consultation Impact Analysis proposed and modelled the costs and benefits of an ADR mandating AVAS for light QRTVs for:

- newly approved vehicle models manufactured from 1 January 2025 and
- all new vehicles manufactured from 1 January 2026.

Further information on the costs and benefits of this option is available in Section 4 of this Impact Analysis. The modelling for this option in the Consultation Impact Analysis has been updated to incorporate new information provided during the consultation process.

3.3 Option 3: Mandatory Standards for Light and Heavy Vehicles

Following strong support for mandating AVAS for heavy vehicles in the public consultation process, a third option, to mandate AVAS for both new light and heavy QRTVs, has been included in this Impact Analysis. Broad support was received through the consultation process to mandate AVAS for heavy vehicles, including from state and territory governments and industry groups like the Truck Industry Council (TIC) and the Bus Industry Confederation (BIC).

As there are currently few heavy QRTVs on Australian roads, there is insufficient data to undertake a robust cost-benefit analysis for heavy vehicles. However, the underlying rationale for including heavy vehicles can be understood in two parts.

First, mandating AVAS for both light and heavy vehicles would deliver a nationally consistent regulatory approach. Current regulatory arrangements are inconsistent across jurisdictions and vehicle categories. For example, NSW requires AVAS for new public buses but these systems have not been included across the full spectrum of road transport. State and territory governments may decide to require AVAS to be fitted for different vehicle types, or to none at all. A national approach would provide certainty for truck and bus industries, passenger vehicle dealerships, fleet managers and consumers, providing a uniform regulatory environment across Australia. This option was supported in the department's follow-up discussions with TIC, BIC and the Federal Chamber of Automotive Industries (FCAI).

Secondly, a nationally consistent approach provides certainty for the public, particularly VRUs, regardless of vehicle size and mass. Given the anticipated safety outcomes from mandating AVAS for light vehicles, similar benefits would likely result from including heavy vehicles. Submissions from the blind and low vision community, as well as Vision Australia, suggest there would be significant safety benefits (and comfort) in ensuring all new QRTVs, regardless of size, are required to be fitted with AVAS.

A similar approach supporting Option 3, can be illustrated by the CLOCS-A program, recently adopted in Australia. CLOCS-A or Construction Logistics and Community Safety - Australia, is a national good practice approach for managing the risks and impacts associated with a construction project's on road transport and logistics activities to improve community road safety. It was developed to provide a consistent framework for industry to achieve and has been inspired by the success of the CLOCS Program established in the United Kingdom in reducing road trauma associated with construction logistics.

Industry participants of CLOCS-A are required to meet at least one of three different standards (Bronze, Silver and Gold) relating to the safety of the vehicles, drivers, logistics planning and communications of their operations. Among a range of vehicle safety specifications such as conspicuity markings, cameras, sensors and signage, mandatory standards include audible warning systems like reversing beepers and/or left-turn audible warnings. This safety-driven program recognises that auditory alerts are as crucial for pedestrian safety around construction sites and urban environments as visible safety signals.

3.3.1 Proposed Scope

Option 3 proposes to adopt an ADR mandating AVAS based on the technical requirements of UN Regulation 138/01 for all light and heavy QRTVs (ADR categories MA, MB, MC, MD, ME, NA, NB and NC). The US FMVSS 141 will be included as an alternative standard for light QRTVs.

3.3.2 Implementation Timing

A significant proportion of NC category trucks and ME category buses are manufactured, assembled or completed in Australia and there are currently no test facilities in Australia that can meet the background noise requirements to test vehicles in accordance with UN Regulation 138. For these reasons a longer implementation timeframe is proposed for heavy vehicles, starting from 1 November 2025 for newly approved models and all new heavy vehicles supplied from 1 November 2026. In addition, a simplified compliance process is proposed for NC and ME category vehicles fitted with an AVAS identical in specification to that used on another heavy vehicle model that complies with the UN Regulation.

During the public consultation process, light vehicle manufacturers raised concerns they may not be able to meet the proposed 1 January 2025 timeframe for light vehicles due to the time required to retest and update vehicle type approvals.

For this reason, two timeframes have been evaluated for Option 3 (Figure 5):

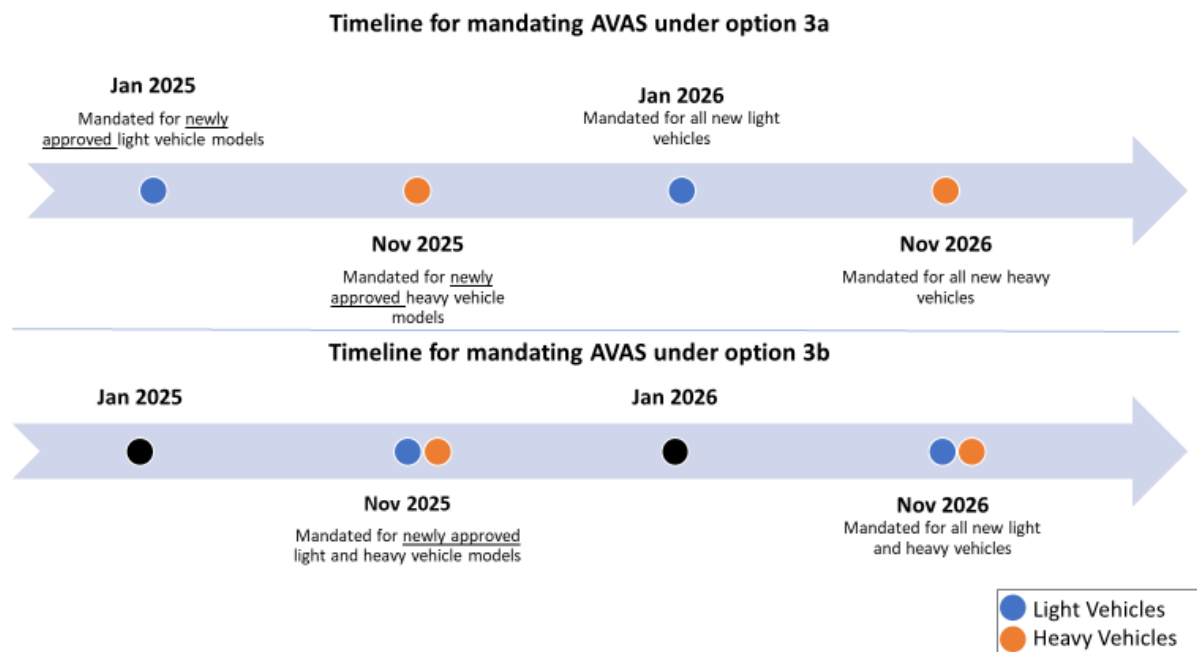
Option 3a – which would mandate AVAS for

- newly approved light (MA, MB, MC and NA category vehicles - car, SUV and light commercial vehicle) models supplied from 1 January 2025,
- newly approved heavy (MD, ME, NB and NC category - truck and bus) models supplied from 1 November 2025,
- all new light vehicles supplied from 1 January 2026; and
- all new heavy vehicles supplied from 1 November 2026.

Option 3b – which would mandate AVAS for

- newly approved light and heavy vehicle models supplied from 1 November 2025,
- all new light and heavy vehicles supplied from November 2026.

Figure 5: Proposed implementation dates for Options 3a and 3b



4. What is the likely net benefits of each option?

In this section, the benefits and costs of mandating a new ADR for AVAS for light vehicles in Australia (Option 2) and for both light and heavy vehicles (Options 3a and 3b) are analysed. The results are compared with what would happen if there was no intervention (Option 1). Further details of this analysis are provided in Appendix D—Benefit Cost Analysis.

In the case of adding specific safety features to vehicles, there will be an upfront cost (by the vehicle manufacturers) at the start, followed by a series of benefits spread throughout the life of the vehicles. This is then repeated in subsequent years as additional new vehicles are registered. There may also be other ongoing business and government costs through the years, depending on the option being considered.

The period of analysis covers the expected life of the policy option (up to 15 years of intervention) plus the time it takes for benefits to work their way through the fleet (around 35 years – the 15 year intervention period, plus an approximate vehicle lifespan of 20 years after the last vehicle supplied during the intervention period).

4.1 Benefits

The benefits for Options 2, 3a and 3b were calculated based on the expected level of fitment of AVAS to new QRTVs compared with Option 1, and the effectiveness of the technology in avoiding pedestrian crashes.

4.1.1 Fitment Rate

For Option 1, the business as usual fitment rate was based on information supplied by manufacturers or from automotive website Redbook on which models are currently fitted with an AVAS, or are likely to be fitted with an AVAS in the future. It is anticipated that while fitment will increase gradually over time, without regulation it will not reach 100% – peaking at around 84% of new vehicles sold.

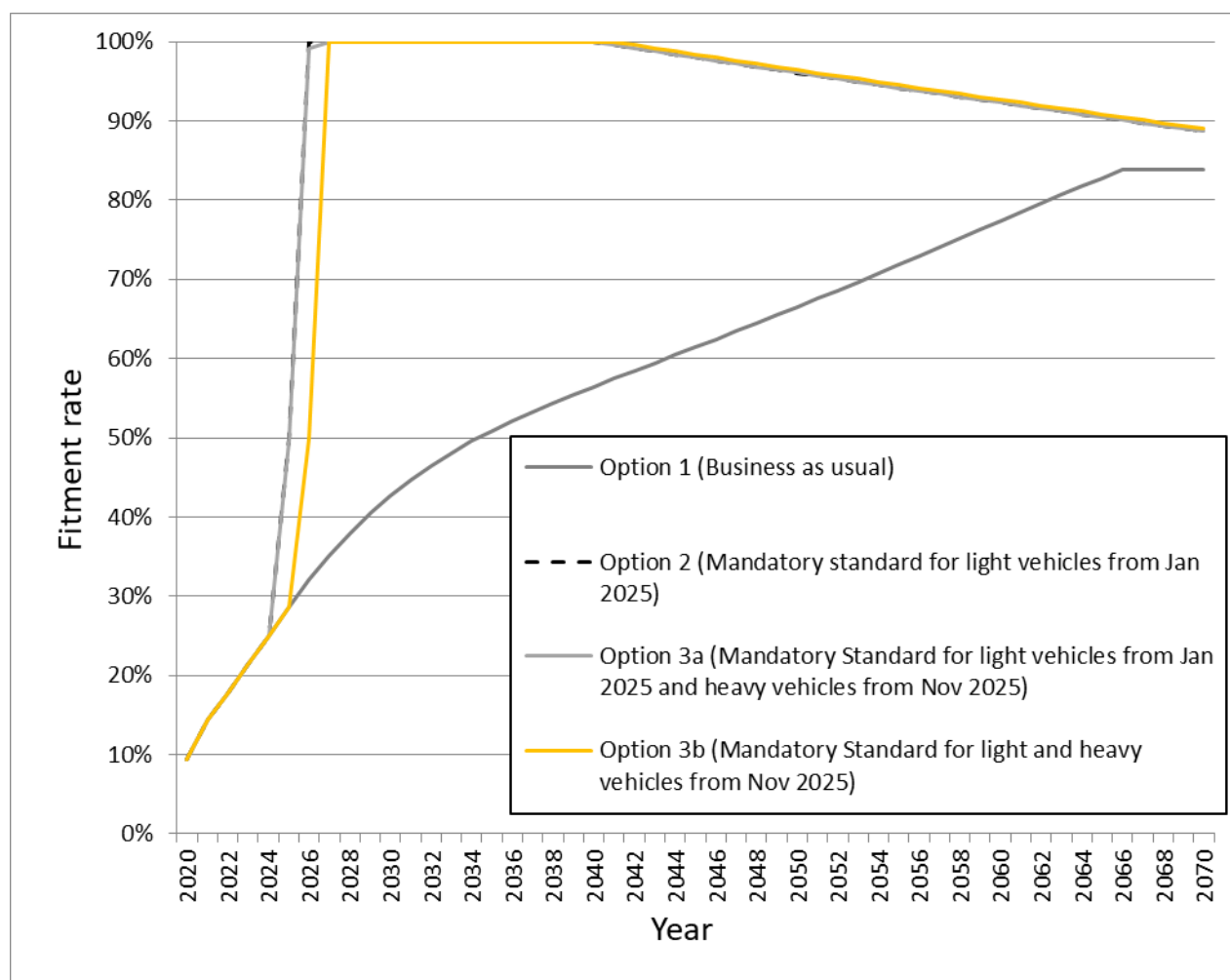
It is also noted that once a policy intervention has expired, fitment levels can fall over time to BAU levels. The decline is more profound following the end of short-term non-regulatory interventions than for long-term regulatory interventions. Though it is expected that a regulatory intervention would sustain high fitment rates well into the future, it is not guaranteed. For instance, through disruptive change or substantial transitional shift in the direction of the vehicle industry, AVAS may be of no safety benefit to vehicles manufactured several decades into the future.

Importantly, it is noted that though the benefit-cost analysis includes accumulative run-out trauma saving effects from vehicles fitted with AVAS during the 15-year intervention period for a further 35 years, AEB fitment costs and trauma savings associated with vehicles fitted with AEB after the 15-year policy intervention period are not considered in the benefit-cost analysis. The fitment rate reduction depicted following the 15-year regulatory intervention period has no effect on the analysis.

Accordingly, for Options 2, 3a and 3b, the effect of intervention is illustrated to gradually reduce to the BAU fitment rate after the policy lifespan (15 years). Although fitment rates are known to remain close to 100% after a technology is mandated, a reduction in the fitment rate back to BAU rates after a 15-year policy lifespan is illustrated.

Figure 6 shows the expected fitment rate of AVAS under Options 1, 2, 3a and 3b. The fitment rates for options 2, 3a and 3b accelerate increase from BAU levels to 100% once the proposed vehicle standard becomes mandatory from 2025-2026.

Figure 6: Expected fitment rate under Option 2, 3a and 3b (mandatory standards) relative to Option 1 (business as usual)



4.1.2 Effectiveness

To support the benefit-cost analysis for this Impact Analysis, the department engaged MUARC to report on the crash reduction benefits of introducing AVAS for electric vehicles in Australia. For its analysis, MUARC primarily used police-reported light vehicle crash data in Victoria from 2014 to 2018, which it extrapolated for Australia. The department can provide a copy of this report on request.

The department used a number of key outcomes of this report to estimate the overall effectiveness of AVAS in avoiding pedestrian crashes in Australia.

Firstly, MUARC identified the crashes that would be applicable to AVAS. Broadly, these are pedestrian crashes in low speed conditions (up to 20 km/h as set out in UN R138/01). As the available crash data did not include the speed of the vehicle at impact, MUARC identified relevant crash types based on speed zone and vehicle movement. Specifically, MUARC focused on speed zones up to 70 km/h, where the vehicle movement or driver intention was:

- turning left or right,
- leaving a driveway,
- undertaking a U-turn,
- reversing,
- parking, or
- slowing down or stopping.

Applying these criteria to the available crash data, MUARC estimated that 36.8% of all light vehicle crashes involving pedestrians occurred in conditions applicable to AVAS. Of these, 1.2% were fatal, 46.9% resulted in serious injury, and 51.9% resulted in minor injury (a ratio of 1:39:43).

Secondly, MUARC estimated around 17.7% of pedestrian crashes involving an electric vehicle in low speed conditions could be avoided if all electric vehicles in Australia were fitted with an AVAS. MUARC's analysis takes into account the expected crash reduction benefits associated with the introduction of Autonomous Emergency Braking Systems (AEBS), which will be mandatory in new light vehicles in Australia, phased in from 2023 to 2026.¹¹

To estimate the overall effectiveness of AVAS against all light vehicle crashes, the department multiplied the proportion of light vehicle crashes that are applicable to AVAS by the effectiveness of AVAS in avoiding these crashes: $36.8\% \times 18\% = 6.5\%$ overall effectiveness.

4.1.3 Reduction in Trauma

The department then used this effectiveness value along with the expected fitment rate to determine the overall reduction in road trauma that would be achieved under Option 2, 3a and 3b.

The department calculated option 2 would avoid 65 deaths, 2,585 serious injuries, and 2,863 minor injuries over the 35-year analysis period. This would amount to over \$372 million saved in avoided road trauma costs.

The department calculated option 3a would avoid 68 deaths, 2,701 serious injuries, and 2,991 minor injuries over the 35-year analysis period. This would amount to over \$389 million saved in avoided road trauma costs.

The department calculated option 3b would avoid 68 deaths, 2,675 serious injuries, and 2,962 minor injuries over the 35-year analysis period. This would amount to over \$377 million saved in avoided road trauma costs.

These estimated benefits are limited to pedestrian trauma avoided. However, the fitment of AVAS would also reduce the risk of crashes involving other vulnerable road users, such as cyclists. If the incidence of cyclist crashes in Australia was similar in proportion to that experienced in the United States (NHTSA 2017), the safety benefits of AVAS for cyclists could be of a similar magnitude to that estimated for pedestrians.

4.2 Costs

The costs for Option 2 include system development and fitment costs (for manufacturers), and ADR administration costs (for the Government). The department estimated these costs based on research, discussions with manufacturers, and previous experience with ADR development.

4.2.1 System Development Costs

The cost to fully develop an AVAS for a new vehicle model was estimated at around \$75,000 to \$150,000 for each new vehicle model supplied to Australia. This cost covers system design, logistics, production line floor area allocation, and other overheads.

However, as all light vehicles in Australia are imported, and QRTVs supplied to Australia are manufactured in countries that already mandate UN R 138/01 (or equivalent standard), the system development cost for adding an AVAS to an Australian model, would likely be substantially reduced, as the required componentry will be readily available. This means manufacturers will largely be able to adapt the AVAS

¹¹ AEBS are designed to reduce the likelihood of a crash by warning the driver and then automatically braking to reduce impact speed when a collision is imminent.

they already fit to similar models sold in other markets. For this analysis, the department has estimated development cost for Australian models would be 10% of the full system development cost suggested by industry during the public consultation process.

An additional \$15,000 per vehicle model was added to cover validation and testing, and a further \$15,000 per model for certification and regulatory expenses to obtain a type approval for the Australian market. As the proposed ADR is harmonised with UN Regulation 138, manufacturers may already have or be able to extend an existing UN type approval to obtain an equivalent type approval in Australia.

4.2.2 Fitment Costs

In 2016, the NHTSA estimated the incremental cost of fitting an AVAS would be approximately US\$55 (A\$77) for light vehicles where an AVAS has already been developed for it and US\$130 (A\$182) for vehicles without an AVAS developed. As these systems have been mandated in other markets for some time, the department anticipates the nominal cost of fitting an AVAS to an Australian vehicle will be the same. Consultations with vehicle manufacturers suggest the changes required for individual models could range from minor software updates to the addition of an AVAS speaker system, with associated wiring and harnesses. Due to insufficient data to undertake a robust cost-benefit analysis for heavy vehicles, the rough estimates of the costs and benefits of Options 3a and 3b assume the fitment cost for heavy vehicles is the same as for light vehicles, as the same technology will be required.

Again, given that all light vehicles in Australia are imported, and that most come from markets that have already mandated UN R138/01 (or equivalent standards), the department assumed, for the main analysis, that fitment costs to meet a new ADR would be at the lower end of this scale (i.e. A\$77).

Sensitivity tests were conducted using the average cost US\$93 (A\$130) and highest cost US\$130 (A\$182) estimates.

The department considered the lower end of these estimates to be appropriate because all light QRTVs supplied to the Australian market originate from a country that currently mandates AVAS. Heavy QRTVs supplied to Australia are also likely to be based on models developed and manufactured in these markets. The Truck Industry Council's submission in response to the Consultation Impact Analysis suggests there would be negligible direct cost increase to the public or industry if AVAS was mandated for heavy vehicles, but additional costs would be incurred if AVAS was not applied consistently to all vehicles supplied to Australia.

4.2.3 Government Costs

There would be an estimated cost of \$50,000 per year over the 15-year regulation period for the department to create, implement and maintain a new ADR. This includes costs to draft the ADR and provide ongoing maintenance and interpretation advice.

4.3 Benefit-Cost Analysis Results

Table 1 details the results for the benefit-cost analysis. A 7% discount rate was used for the options.

Table 1: Summary of benefits, costs, lives saved and injuries avoided for Option 1, 2, 3a and 3b (Likely Case)

Case	Gross benefits (\$m)	Net benefits (\$m)	Cost to business (\$m)	Cost to Government (\$m)	Benefit-cost ratio	Number of lives saved	Serious injuries avoided	Minor injuries avoided
Option 1 (BAU)	-	-	-	-	-	-	-	-
Option 2 (Light QRTV only from Jan 2025)	372.8	201.2	171.1	0.5	2.17	65	2,585	2,863
Option 3a (Light QRTV from Jan 2025, heavy QRTV from Nov 2025)	389.3	210.3	178.5	0.5	2.18	68	2,701	2,991
Option 3b (Light and heavy QRTV from Nov 2025)	377.3	208.4	168.4	0.5	2.23	68	2,675	2,962

As noted in Section 3.3, the estimates for Options 3a and 3b are rough estimates, based on the proportion of new heavy vehicle sales to new light vehicle sales, as insufficient data was available to quantify the specific costs and benefits for heavy vehicles. Several submissions noted that mandating AVAS for light vehicles only could increase the risk of a heavy electric vehicle being involved in an incident, by create a false sense of security for VRUs, and heavy vehicle collisions with VRUs were more likely to result in a serious injury or fatality.

Vehicle manufacturers also advised an ADR mandating AVAS for heavy vehicles would enable a nationally consistent approach to heavy QRTVs. This would avoid additional costs that may otherwise be borne by a manufacturer if they were required to comply with different requirements in each individual state and territory. These benefits could not be quantified in this Impact Analysis.

4.3.1 Sensitivity Analysis

A sensitivity analysis was carried out to determine the effects of key variables on the outcome of the benefit-cost analysis for Option 3a, as it was likely to have the highest net benefit.

While a 7% real discount rate was used, the benefit cost analysis was also tested with rates of 3% and 10% in accordance with the Australian Government Guide to Policy Impact Analysis. Table 2 shows that the benefit-cost ratio remained positive in both the low and high discount rate scenarios.

Table 2: Sensitivity analysis – changes to the real discount rate

Case	Benefit-cost ratio	Net benefits (\$m)
Low discount rate (3 per cent)	3.47	615.6
Base case discount rate (7 per cent)	2.18	210.3
High discount rate (10 per cent)	1.63	89.6

Next, the business as usual fitment rate was subjected to a sensitivity analysis, including both a high and a low fitment rate scenario (business as usual fitment curves adjusted +/- 10%), to account for variations in the market uptake of light vehicle AVAS. As shown in Table 3, the net benefits remained positive in both the high and the low fitment rate scenarios.

Table 3: Sensitivity analysis - changes to business as usual fitment rate

Case	Benefit-cost ratio	Net benefits (\$m)
Low fitment rate (-10 per cent)	2.25	242.1
Base case fitment rate	2.18	210.3
High fitment rate (+10 per cent)	2.11	178.5

Finally, the fitment cost range was varied, based on the average and highest cost estimates by the NHTSA. As shown in Table 4, the net benefits using the average cost estimate remained positive. However, if all vehicles experienced the maximum cost increase estimated by the NHTSA, there would be a net cost.

Table 4: Sensitivity analysis - changes to fitment costs

Case	Benefit-cost ratio	Net benefits (\$m)
Base case fitment cost (\$77)	2.18	210.3
Average fitment cost (\$130)	1.30	89.4
High fitment cost (\$182)	0.93	-31.6

4.4 Analysis of impacts

This section considers how the benefits and costs of Option 2, 3a and 3b may be distributed among affected parties.

4.4.1 Business

Benefits

As the requirements of the proposed ADR will increase harmonisation with UN vehicle regulations, and harmonisation across jurisdictions within Australia, vehicle manufacturers will benefit from reduced technical barriers to trade. Under the UN 1958 Agreement, UN type approvals granted by another contracting party applying this regulation will be automatically accepted by the department as complying with the equivalent ADR.

Component suppliers (mostly international) would benefit directly in terms of increased revenue from supplying additional equipment to manufacturers.

There would be an indirect benefit to businesses as a result of the reduction in the number of work days lost due to the reduced likelihood of employees being involved in road trauma involving QRTVs. This could save recruitment, training and development costs associated with the replacement of employees killed or permanently incapacitated by road trauma.

There would be negative impacts to businesses in the event that a QRTV not fitted with an AVAS is involved in a pedestrian collision, which would increase in line with the number of QRTVs not fitted with AVAS. This could include financial losses as a result of reputational damage for vehicle manufacturers, higher insurance premiums and impacts on the ability of business owners to conduct their trade if a vehicle involved in a collision is out of service.

Other benefits to business include the creation of a level playing field for all vehicle manufacturers as AVAS requirements are standardised across the new vehicle fleet.

Costs

There would be a direct cost to vehicle manufacturers that do not currently fit AVAS to Australian models (estimated to be less than \$100 per vehicle) as a result of design, development, fitment and testing costs for the additional vehicles fitted with AVAS. To the extent that market forces allow, manufacturers could pass on this increase in vehicle supply costs to new vehicle purchases through higher vehicle prices. While some manufacturers may pass on fitment costs to consumers, fitment costs for new technologies tend to decrease as the technology becomes commonplace.

4.4.2 Consumers

Benefits

There would be a direct benefit for new vehicle owners from fewer pedestrian crashes involving QRTVs. Owners would save on costs like vehicle repair and replacement, compensation, and legal costs, as well as avoid the significant mental trauma involved with these crashes.

There would also be a direct benefit for the wider Australian community. Fewer individuals, and their families and friends, would have to deal with the physical and mental trauma, medical costs and lost income of being involved in a crash.

A new ADR for AVAS would particularly benefit the blind and low vision community, by giving them greater confidence to walk on and near roads, allowing them to participate more in social and economic activities. This would have flow-on mental health benefits, particularly with respect to reduced anxiety and depression. (Liu et al 2018)

An additional benefit that cannot be quantified surrounds facilitating a more inclusive environment where blind and low vision persons can participate in a healthy social lifestyle with confidence.

Costs

There may be an indirect cost for consumers buying new vehicles, due to manufacturers passing on the costs of meeting the new ADR. However, as noted above, the extent to which this may happen is influenced by a highly competitive vehicle market in Australia.

4.4.3 Governments

Benefits

There would be an indirect benefit to governments from fewer pedestrian crashes, through reduced burden on public health systems.

There would also be an indirect benefit to the Australian Government by supporting its commitments under the *UN Convention on the Rights of Persons with Disabilities* (UN CRPD). In 2008, Australia ratified the UN CRPD, which establishes normative standards and principles for the treatment of people with disability under international human rights law.

In line with Australia's commitments under the UN CRPD, the national disability policy framework - Australia's Disability Strategy 2021–2031 – plays an important role in protecting, promoting and realising the human rights of people with disability.

The strategy identifies accessibility of transport systems as a policy priority area, necessary to ensure people with disability have economic security and enabling them to plan for the future and exercise choice and control over their lives. A new ADR for AVAS would support this priority area, by giving the blind and low vision community greater confidence to walk on and near roads.

Costs

The Australian Government would incur administrative costs to develop, implement and maintain the new ADR.

4.5 Regulatory Burden and Cost Offsets

The Australian Government Guide to Policy Impact Analysis (2023) requires that all new regulatory options are costed using the Regulatory Burden Measurement (RBM) Framework. Under the RBM Framework, the regulatory burden is the cost of a proposal to business and the community (not including the cost to government). It is calculated in a prescribed manner that usually results in it being different to the overall costs of a proposal in the benefit-cost analysis.

In line with the RBM Framework, the average annual regulatory costs for options 2, 3a and 3b were calculated for this proposal by totalling the undiscounted (nominal) cost (including fitment cost (\$77 per vehicle affected in each year), development costs (\$37,000 per year) and certification costs (\$99,000 per year) over the 10-year period 2025–2034 for options 2 and 3a (2026–2035 for option 3b) inclusive, and then dividing this total by 10.

The average annual regulatory costs are estimated to be \$16.9 million for Option 2, \$17.6 million for Option 3a and \$19.3 million for Option 3b (as more vehicles are affected in the first 10 years). There are no additional costs associated with Option 1 as it is the status quo.

The Australian Government Guide to Policy Impact Analysis further states that where a proposal leads to higher regulatory compliance burdens, departments need to investigate options to offset these burdens. It is anticipated that regulatory savings from further alignment of the ADRs with international standards will offset the additional RBM costs of this measure.

Table 5: Average annual regulatory costs for Options 2, 3a and 3b

Sector	Change in costs (\$m)		
	Option 2	Option 3a	Option 3b
Business	16.9	17.6	19.3
Community organisations	-		
Individuals	-		
Total change in costs	16.9	17.6	19.3

5. Consultation

Earlier this year, the Australian Government released for public consultation a Consultation Impact Analysis, which considered whether AVAS should be fitted to QRTVs to help reduce potential pedestrian collisions.

This Consultation Impact Analysis only proposed two options, that is Option 1: No Regulatory Intervention (business as usual) and Option 2: Introduce a new ADR aligned with United Nations Regulation No. 138/01. Hence, the responses received only considered these two policy options – that is to either mandate the fitment of AVAS to all vehicles or to let market forces increase the fitment of AVAS across the new Australian vehicle fleet.

The Consultation Impact Analysis was available for public comment from 28 March 2023 to 26 May 2023. The department sought specific feedback on:

- Support for the proposed introduction of AVAS for new light electric vehicles in Australia.
- The benefit-cost analysis, including the assumptions on effectiveness of the technology, the costs, and the benefits.
- The suitability of UN Regulation 138/01 for adoption under the ADRs, including any concerns on functional and/or performance requirements and test requirements.
- Applicable vehicle categories, implementation timeframes, alternative standards.
- Costs, benefits, and feasibility of mandating AVAS for heavy vehicles in Australia.
- Any other relevant views or information which could assist decision-making.

The department provided three ways for members of the public, industry and jurisdictions to voice their opinions which included: 1) Completing the webform and attaching the feedback form on the department's website; 2) Emailing the feedback form to the Sustainable Transport Section email address; or 3) Mailing the feedback form to the Sustainable Transport Section postal address.

The release of the Impact Analysis for public comment is an integral part of the consultation process. This provides an opportunity for businesses and road user groups, as well as other interested parties, to respond to the proposal by writing or otherwise submitting their comments to the department. Analysing proposals through the Impact Analysis process assists stakeholders in identifying the likely impacts of the proposals and enables more informed debate on policy and regulatory issues.

The Government received 392 submissions from governments, organisations, and individuals, with strong representation from the blind and low vision community. Appendix A—Summary of Submissions provides an overview of the feedback received during the public consultation period.

During the consultation period, feedback was received from members of the public, state government agencies, industry and not-for-profit organisations. A majority of the feedback strongly supported the implementation of Option 2. Specifically, individual responses from the blind and low vision community (as well as from organisations and governments) were overwhelmingly supportive of introducing AVAS sooner, as opposed to a prolonged process.

Submissions from individuals were more mixed, with around 60% supporting AVAS, and 40% not supporting it.

Of those in support, there were many stories of near collisions and collisions with 'silent' electric vehicles, from both blind and vision impaired, and sighted, pedestrians.

Individual submissions that did not support mandating AVAS were mainly concerned about the possible increase in noise pollution in urban areas. However, in a number of these submissions, individuals did not seem to be aware that the AVAS would only be active at low speeds, and would still be subject to the maximum noise limits specified in ADR 83/00.

The United States National Highway Traffic Safety Administration (NHTSA) calculated the environmental impacts of sound emissions from AVAS systems. The report concluded there would not be noticeable noise impacts to humans, however single vehicles passing in non-urban regions could be heard up to 7.5 m away.

Follow-up consultation with the bus industry stakeholders also revealed noise concerns, however these issues were limited to the internal noise that drivers would be exposed to when the vehicle is operating. Measures to address these concerns are beyond the scope of this Impact Analysis.

5.1 Previous Consultation

In addition to the public consultation on the Consultation Impact Analysis released for public comment from 28 March to 26 May 2023, consideration of mandating AVAS for new vehicles in Australia was discussed a number of times at meetings of the peak vehicle standards consultative forum, the Vehicle Standards Consultative Forum (VSCF) (formerly known as the Strategic Vehicle Safety and Environment Group [SVSEG]). VSCF consists of senior representatives of government (Australian and state/territory), the manufacturing and operational arms of the industry (including organisations such as FCAI, TIC and the Australian Trucking Association), and consumer and road user organisations (including the Australian Automobile Association).

The proposal has also been raised within the Infrastructure and Transport Ministers' Meetings (ITMM). The ITMM brings together Commonwealth, state, territory and New Zealand ministers with responsibility for transport and infrastructure, as well as the Australian Local Government Association.

5.2 How was public feedback incorporated

There were three key themes that emerged from the public consultation process that were either able to be incorporated within the revised proposal, or required follow up engagement to ascertain specific stakeholder views.

First, it was clear from some stakeholder submissions that AVAS should be mandated for heavy vehicles as well as light vehicles. Follow up engagement was conducted with TIC and BIC, who were of the view it was reasonable to expect AVAS to be fitted to heavy vehicles, as well as light vehicles. Subsequently, this Impact Analysis was updated to consider the costs and benefit of mandating AVAS for both light and heavy vehicles. In the absence of independent data on the specific costs and benefits for heavy vehicles, an estimate based on the proportion of new heavy vehicle sales to light vehicle sales has been included in the analysis (as Option 3a and 3b).

Second, feedback received from vehicle manufacturers advised that the proposed timeframe of January 2025 (for newly approved models) and January 2026 (new vehicles) may not allow sufficient time for manufacturers to update, test and recertify their vehicle models. As there is a strong desire by governments to reduce the timeframes for the implementation on new ADRs, particularly for light vehicles, Option 3a considers the costs and benefits of mandating AVAS from January 2025 for light vehicles and November 2025 for heavy vehicles.

To determine the costs and benefits of long lead time preferred by industry, an Option 3b was added to consider the costs and benefits of mandating AVAS from November 2025 for both light and heavy vehicles. As Option 3b would align with the introduction of ADR 109/01 for newly approved vehicles and the introduction of ADR 110/00 for all new hydrogen vehicles respectively, this would help reduce administrative burden, by reducing the number of applications manufacturers need to submit to update their vehicle type approvals.

Lastly, some submissions mentioned that several cost variables (i.e. fitment cost, cost to test a system to regulation and governmental costs) were underestimated. The benefit cost analyses for Options 2, 3a and 3b reflect additional information provided on development and testing costs for manufacturers, fitment costs, and updated cost estimates for fatalities and minor injuries.

6. What is the best option from those that have been considered, and how will it be implemented?

6.1 Best option considered

The decision rule for this analysis is that the recommended option should be the option with the highest net benefit in line with the *Australian Government Guide to Policy Impact Analysis*.

We have established that QRTVs travelling at low speeds pose an increased safety risk to pedestrians and other VRUs due to their reduced audibility. If QRTVs are not fitted with AVAS there is a strong likelihood that the Australian community will experience an increase in road trauma involving VRUs, particularly those who are blind or have low vision in line with number of QRTVs entering the Australian vehicle fleet.

There is a strong case for mandatory standards to improve the audibility of QRTVs supplied to Australia. As the fitment of AVAS does not provide a direct benefit to motorists and increases vehicle production costs, there is no commercial incentive for manufacturers to fit AVAS to QRTVs supplied to Australia, if it is not required by regulation. As such, the problem will not be addressed effectively by market forces alone, as there is no commercial reason to do so.

Our analysis found that there were significant benefits for the Australian community to be gained from mandating AVAS for light and heavy QRTVs supplied to Australia. These benefits would not otherwise be realised under existing policy settings (Option 1).

- If Option 2 (mandate AVAS for new light vehicle models from January 2025 and all new light vehicles supplied from January 2026) was adopted, it would avoid road trauma costs of \$372.8 million by 2060 by avoiding 65 fatalities, 2,585 serious injuries and 2,863 minor injuries. These savings outweigh any increased costs of \$171.6 million. The net present value was estimated to be \$201.2 million, with a BCR of 2.17.
- If Option 3a (mandate AVAS for new light vehicle models from January 2025 and all new light vehicles supplied from January 2026 plus new heavy vehicle models supplied from November 2025 and all new heavy vehicles supplied from November 2026) was adopted, it would avoid road trauma costs of \$389.3 million by 2060 by avoiding 68 fatalities, 2,701 serious injuries and 2,991 minor injuries. These savings outweigh any increased costs of \$179 million. The net present value was estimated to be \$210.3 million, with a BCR of 2.18.
- If Option 3b (mandate AVAS for new light and heavy vehicle models from November 2025 and all new light and heavy vehicles supplied from November 2026) was adopted, it would avoid road trauma costs of \$377.3 million by 2060 by avoiding 68 fatalities, 2,675 serious injuries and 2,962 minor injuries. These savings outweigh any increased costs of \$168.9 million. The net present value was estimated to be \$208.4 million, with a BCR of 2.18.

The Australian Government Guide to Policy Impact Analysis advises the preferred option should generally be the option with the highest net benefit. On this basis, this Impact Analysis notionally recommends implementing Option 3a, as this would deliver the greatest safety benefits in terms of avoided fatal, serious and minor injury crashes involving VRUs.

However, light vehicle manufacturers' have advised Option 3a would not allow sufficient time for manufacturers to update, test and recertify existing models that do not currently comply with the proposed ADR requirements and may be forced to suspend the delivery of affected models to Australian customers until these models can be recertified. To mitigate this risk, the department recommends implementing Option 3b, which would allow light vehicles an additional 10 months to comply with the new ADR and would align the introduction of the ADR for light vehicles with the proposed introduction of the ADR for heavy vehicles. It would also align with the introduction date of ADR 109/01 for new approved electric vehicle models and ADR 110/00 for all new hydrogen fuel cell vehicles.

6.2 Implementation of the preferred option

If the Australian Government chooses to implement Option 2, 3a or 3b, this would be done by adopting a new national vehicle standard to be known as Australian Design Rules 113/00 under the *Road Vehicle Standards Act 2018 (RVSA)*. Section 12 of the RVSA allows the responsible Minister to make new ADRs, or amend existing ADRs to make road vehicles safe to use while benefiting other road users

Table sets out the intend implementation milestones for the preferred option.

Table 6: Implementation timeline

<i>Date</i>	<i>Milestone</i>
<i>January 2024</i>	Adopt new ADR 113/00 mandating AVAS for new vehicle models supplied from 1 November 2025 and all new vehicles supplied from 1 November 2026.
<i>November 2025</i>	All newly approved vehicle models supplied for the first time from this date required to comply.
<i>November 2026</i>	All new vehicles supplied from this date required to comply.
<i>Ongoing to 2030</i>	Evaluation of the National Road Safety Strategy, Action Plan and associated measures to support its implementation (including ADR 113/00)

Table 6 highlights possible implementation risks and proposed mitigation strategies for of the preferred package of policies.

Table 6: Possible Implementation risks and proposed controls

ID	Risk Description	Business Impact	Risk Owner	Controls	Likelihood	Consequence	Risk Rating	Risk acceptable
1	Insufficient time for manufacturers to comply with ADR implementation timing.	Affected models do not comply by required dates. Type approvals suspended. Manufacturers suspend or delay the supply of affected models to Australia.	DITRDCA	ADR made as soon as possible after policy decision. Consultation on draft ADR text undertaken through the VSCF. New ADR requirements communicated to registered users of the department's Road Vehicle Regulator system and the department's website.	Possible	Moderate	Medium	Yes
2	Cost of AVAS development and fitment may be passed onto the consumer	Increased cost to manufacturers for AVAS development and fitment to models that do not currently comply.	DITRDCA	Most manufacturers will be able to adapt AVAS systems fitted to overseas models for Australian models that do not currently comply, as AVAS is already mandated in countries that supply QRTVs to Australia. For this reason, the impact on vehicle prices is expected to be less than \$100.	Likely	Minimal	Low	Yes
3	Poor compliance	Models supplied without AVAS installed. Increased risk of road trauma involving QRTVs	DITRDCA	Vehicle manufacturers are required to implement procedures to ensure conformity of production and quality management, as a condition of their type approval. Non-compliant vehicles supplied will be subject to recalls. Provisions to suspend or cancel type approvals for non-compliant vehicles.	Unlikely	Substantial	Low	Yes
4	Community concerns about noise pollution	Concerns about noise pollution raised by the community. Opposition to AVAS mandate.	DITRDCA	AVAS will only be active at low speeds (less than 20-30km/h) Vehicles fitted with AVAS will still be required to comply with maximum noise limits specified in ADR 83/00.	Possible	Minimal	Low	Yes
5	Confusion over staged implementation dates for light and heavy vehicles (if option 3a implemented)	Affected models do not comply by required dates. Type approvals suspended. Manufacturers suspend the supply of affected models to Australia.	DITRDCA	The new ADR requirements will be communicated to registered users of the department's Road Vehicle Regulator System and the department's website.	Possible	Moderate	Medium	Yes

7. How will implementation be evaluated against the success metrics?

As with most Australian Government regulations, ADRs are subject to review at least 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 vehicles and vehicle components. ADR 113/00 would be scheduled for a full review on an ongoing basis and in line with this practice.

Reviews of the ADRs ensure the ongoing effectiveness of a nationally consistent system of technical regulations, closely aligned, wherever appropriate with leading international standards such as UN Regulations. Aligning with such standards enable the rapid introduction of the latest safety devices and technological advances into the Australian market in a cost-effective manner. This new ADR for AVAS would be scheduled for a full review on an ongoing basis and in line with this practice, including an evaluation of whether the ADR will still be required in the future.

A review of ADR 113/00 would rely on data from a range of existing sources including, but not limited to:

- road trauma data collected by the department and state/territory governments and research organisations, such as MUARC.
- new research by government and non-government organisations in Australia and overseas, including the UN Working Party on Tyres and Noise.

A key mechanism for evaluating the success of implementing AVAS for new vehicles over the period to 2030 will be monitoring the success of the National Road Safety Strategy 2021-30 and its Action Plan over time, in particular whether there is a reduction in deaths and serious injuries of pedestrians once the ADR takes effect. Progress measures of the Strategy fall under two categories:

- Primary outcome indicators – measures that inform the assessment of overall progress in the reduction of road trauma
- Safety performance indicators – measures that inform the assessment of interventions in the system to address priority areas identified by the Strategy

Primary outcome indicators will be measured and reported on annually against a baseline to track progress towards the targets in the Strategy, including 'Zero deaths in city CBD areas' (most of which are vulnerable road users). Safety performance indicators inform the assessment of road safety interventions and understanding of gaps.

The Road Safety Data Working Group, which includes representatives from the Australian and all state and territory governments, is working to make data available to measure performance of the Strategy and Action Plan. This includes deaths and serious injuries of pedestrians and other VRUs, although the granular detail of vehicle type involved may not extend to record the vehicle's powertrain (i.e. whether the involved vehicle was electric, hybrid or ICE powered). Data may also not record whether the pedestrian had low vision, or was distracted at the time.

The National Road Safety Action Plan 2023-25 will be evaluated through the provision of a National Road Safety Annual Progress Report to Infrastructure and Transport Ministers' Meeting which will detail progress of its implementation.

References

- Australasian New Car Assessment Program (ANCAP) (2022), *ANCAP Safety Ratings Explained*, retrieved from <https://www.ancap.com.au/safety-ratings-explained>.
- Australian Bureau of Statistics (2020), *Motor Vehicle Census, Australia, 31 Jan 2020*. Report No. 9309.0, retrieved from <https://www.abs.gov.au/statistics/industry/tourism-and-transport/motor-vehicle-census-australia/31-jan-2020>.
- Australian Government (2023), *Australian Government Guide to Policy Impact Analysis*, retrieved from <https://oia.pmc.gov.au/resources/guidance-impact-analysis/australian-government-guide-policy-impact->.
- Australian National University (2022), *Social Cost of Road Crashes*. Report for Bureau of Infrastructure and Transport Research Economics (BITRE), retrieved from <https://www.bitre.gov.au/sites/default/files/documents/social-cost-of-road-crashes.pdf>
- Bureau of Infrastructure, Transport and Regional Economics (BITRE) (2019), *Electric Vehicle Uptake: Modelling a Global Phenomenon*, retrieved from <https://www.bitre.gov.au/publications/2019/bitre-report-151>.
- Bureau of Infrastructure and Transport Research Economics (BITRE) (2020), *Road Trauma Australia – 2019 Statistical Summary*, retrieved from https://www.bitre.gov.au/sites/default/files/documents/road_trauma_australia_2019_statistical_summary.pdf.
- Bureau of Infrastructure and Transport Research Economics (BITRE) (2021), *Road Safety Statistics – Hospitalised Injuries*, retrieved from <https://www.bitre.gov.au/statistics/safety>.
- Federal Chamber of Automotive Industries (FCAI) (2020). *New Vehicle Sales – Monthly Reports*. VFACTS National Reports.
- Lawrence, B., Fitzharris, M., Liu, S., and Newstead, S. (2020), *Enhancing the Safety of Quiet Road Transport Vehicles (QRTV) – Crash Reduction Benefits of the Fitment of Acoustic Vehicle Alerting Systems in Australia*, Clayton: Monash University Accident Research Centre.
- Liu, S., Fitzharris, M., Oxley, J., and Edwards, C. (2018). *The impact of electric/hybrid vehicles and bicycles on pedestrians who are blind or have low vision*. Clayton: Monash University Accident Research Centre.
- National Highway Traffic Safety Administration (NHTSA) (2016), *49 CFR Parts 571 and 585 - Federal Motor Vehicle Safety Standards - Minimum Sound Requirements for Hybrid and Electric Vehicles*, Federal Register / Vol. 81, No. 240 / Wednesday, December 14, 2016 / Rules and Regulations [Docket No. NHTSA–2016–0125].
- National Highway Traffic Safety Administration (NHTSA) (2017), *Updated analysis of pedestrian and pedal cyclist crashes with hybrid vehicles*, NHTSA Traffic Safety Facts, Research note, DOT HS 812 371.
- Osbourne, R., Horberry, T., Young, K. (2020). *Pedestrian distraction from smartphones*, Clayton: Monash University Accident Research Centre.
- Roy Morgan (2023) Article No 9258, 20 June 2023 [Over half a million Australians plan to buy a new electric vehicle in the next four years - Roy Morgan Research](#)
- United Nations (2017), *Uniform provisions concerning the approval of Quiet Road Transport Vehicles with regard to their reduced audibility*, UN Regulation No. 138 Revision 1, 01 series of amendments– Date of entry into force: 10 October 2017, retrieved from <https://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29regs/2017/R138r1e.pdf>.

Victorian Government – Department of Transport (2020), *Victorian Road Safety Strategy 2021–2030*, retrieved from <https://www.tac.vic.gov.au/road-safety/victorian-road-safety-strategy/victorian-road-safety-strategy-2021–2030>.

Vision Australia (2018). Media release: *Electric and hybrid cars putting pedestrians at risk*, retrieved from <https://www.visionaustralia.org/news/2019-08-23/electric-and-hybrid-cars-putting-pedestrians-risk>.

Appendix A—Summary of Submissions

Organisations			
Name	About	Support / Not Support	Commentary
Vehicle industry organisations			
Federal Chamber of Automotive Industries (FCAI)	Represents importers and distributors of light passenger and light commercial vehicles and motorcycles to the Australian market	Support	<ul style="list-style-type: none"> Proposes a longer lead time, of two years for new models and a further two years for all models, after final publication of ADR Supports adoption of UN R138/01 and allowing the US standard FMVSS 141 as an alternative Considers some of the estimated administrative costs in the Impact Analysis are understated
Truck Industry Council (TIC)	Represents truck manufacturers, importers and distributors in Australia. Its members represented 99 per cent of all truck sales in 2022	Support	<ul style="list-style-type: none"> Strongly supports mandating AVAS for all heavy electric vehicles (trucks and buses), noting there would be negligible direct costs to the public or industry Nearly 70 per cent of heavy electric vehicles offered by TIC members already have, or can be fitted with AVAS Concerns that any delays may lead to jurisdictions mandating AVAS separately and inconsistently (e.g. NSW requiring AVAS within its bus contracts), which has safety implications
Bus Industry Confederation (BIC)	Represents Australian bus and coach manufacturers and suppliers on national policy and regulation issues	Support	<ul style="list-style-type: none"> More than 50 per cent of electric buses sold in Australia have AVAS fitted, or are pre-wired for future fitment AVAS is often requested by both state government and many private bus customers If AVAS is mandated for heavy vehicles, requests some concessions be made for certification testing in Australia

			<ul style="list-style-type: none"> The impact of increasing noise on transport workers and environmental amenity should be considered
International Organization of Motor Vehicle Manufacturers (OICA)	Represents the international automotive industry. Its membership consists of 36 national trade associations, including both the FCAI and TIC	Support	<ul style="list-style-type: none"> Important step towards improving the safety of vulnerable road users Welcomes adoption of the already established UN R138/01
Electric Vehicle Council (EVC)	Peak national body for the electric vehicle industry in Australia, representing electric car, bus and truck manufacturers, importers, operators, charging infrastructure suppliers, battery reuse and recycling companies, financiers, and network providers	Support	<ul style="list-style-type: none"> Considers an 18 to 24-month transition period (as proposed in the impact analysis) appropriate, seeing many light electric vehicles in Australia already have AVAS fitted Committed to engaging with the Government and heavy vehicle manufacturers to support progressing mandating AVAS for heavy electric vehicles
Australian Electric Vehicle Association (AEVA)	Volunteer-run organisation aimed at advancing the case for full electrification of our transport networks. It primarily represents current and aspiring electric vehicle owners	Support	<ul style="list-style-type: none"> Supports mandating AVAS in principle, but wants drivers to have the ability to turn the system off
Revora	Electric refrigerated truck body builder	Support	<ul style="list-style-type: none"> Considers UN R138/01 strikes a good balance between making enough noise for pedestrians, while retaining the benefits of quieter vehicles AVAS should also apply to heavy vehicles. Notes the majority of trucks operate in urban environments and there is expected to be a significant increase in the number of electric trucks in the near future
Blind and low vision and other community organisations			
Blind Citizens Australia	Peak national representative organisation of and for the over 500,000 people in	Support	<ul style="list-style-type: none"> Emphasises the wider social benefits of mandating AVAS, particularly for the blind and low vision community

	Australia who are blind or vision impaired		<ul style="list-style-type: none"> • The increased weight of electric vehicles (because of batteries) makes them an even greater pedestrian safety risk • AVAS should also apply to heavy electric vehicles
Vision 2020 Australia	Peak national body for the eye health and vision care sector, working with and representing almost 50 member organisations	Support	<ul style="list-style-type: none"> • More than 500,000 people in Australia with vision loss • Mandating AVAS will help people with vision loss to maintain their independence • AVAS should also apply to heavy electric vehicles, noting the risk of injury to pedestrians is greater
Vision Australia	Leading national provider of blindness and low vision services. Vision Australia is a member of several government service and advisory bodies, including Vision 2020 Australia	Support	<ul style="list-style-type: none"> • Long campaigned for mandating AVAS in Australia, noting the increase in electric vehicles will have a catastrophic impact on the safety of the blind and low vision community • Timeframe for implementation should be brought forward (to 2024 to 2025) • AVAS should apply to heavy vehicles at the same time as light vehicles, otherwise the inconsistency could increase the safety risk for the blind and low vision community • Submission includes 130 additional responses from community members expressing support for AVAS
See Differently with the Royal Society for the Blind	South Australia's primary low vision service provider, advocating for a client base of more than 7,000 people who are blind or vision impaired. Member of Vision 2020 Australia	Support	<ul style="list-style-type: none"> • Without AVAS, the safety risk to people living with blindness or low vision will continue to increase • Mandating AVAS aligns with Australia's commitments under the UN Convention of the Rights of Persons with Disabilities

Youth Empowering Peers (YEP) Group, Association for Children with Disability Tasmania (ACD Tas)	A disability specialist family organisation	Support	<ul style="list-style-type: none"> Supports mandating AVAS in principle, but suggests the type of sound used should be considerate of people who may be triggered by/sensitive to sound
Motoring organisations			
Australian Automobile Association	Peak organisation representing Australia's motoring clubs	Support	<ul style="list-style-type: none"> Supports the proposed implementation timeframe of 2025 to 2026 AVAS should be mandated for heavy vehicles, following further industry consultation
Road and vehicle safety organisations			
Australasian New Car Assessment Program (ANCAP)	Australia and New Zealand's independent voice on vehicle safety. ANCAP crash tests cars and conducts performance assessments on safety features and technologies	Support	<ul style="list-style-type: none"> Supports the proposed implementation timeframe of 2025 to 2026, noting manufacturers are unlikely to have difficulty implementing AVAS given its widespread adoption overseas Pedestrians in Australia may be at greater risk of injury from low speed impacts than pedestrians in other markets, as Australia has not implemented the international standard for pedestrian impact protection
Australasian College of Road Safety	The Australasian region's peak membership association for road safety with a vision of eliminating death and serious injury on the road	Support	<ul style="list-style-type: none"> AVAS should also be mandated for heavy vehicles. Australian statistics show pedestrians are too often the casualty in crashes with heavy vehicles, particularly heavy rigid trucks
Monash University Accident Research Centre (MUARC)	Australia's largest accident and injury prevention research organisation	Support	<ul style="list-style-type: none"> Considers the fitment costs used in the Impact Analysis are overestimated, and the serious injury costs significantly underestimated. Provides data to support this

			<ul style="list-style-type: none"> • AVAS should also apply to heavy vehicles, noting the higher bonnet height and geometry profile of larger vehicles create greater risk for pedestrians • The safety risk from electric vehicles impacts all pedestrians and cyclists, not just those with vision impairment
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Other

Victoria Walks	A walking health promotion body primarily funded by VicHealth and other state and local government organisations to get more people walking every day	Support	<ul style="list-style-type: none"> • Mandating AVAS will have safety benefits for all pedestrians, particularly the blind and low vision community. For blind and vision impaired people, the ability to walk safely is fundamental to their capacity to participate in society and live productive lives • AVAS should apply to heavy vehicle as well, given the greater size and weight of heavy vehicles make them more lethal if they hit someone walking, even at low speed
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Future Smart Strategies	Offers strategic advice on business-to-business relations, business innovation, advocacy and sustainability	Not Support	<ul style="list-style-type: none"> • Considers a better way to prevent pedestrian collisions is through mandating driver assist systems
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Governments

State or Territory / Local Government	Support / Not Support	Commentary
New South Wales	Support	<ul style="list-style-type: none"> • AVAS should also apply to heavy vehicles. NSW crash data from 2013 to 2022 shows heavy vehicles had a greater representation of fatal and serious injuries compared with light vehicles. Heavy vehicles are also often used at low speeds, such as buses and delivery vehicles
Queensland	Support	<ul style="list-style-type: none"> • Timeframe for implementation should be brought forward earlier than the proposed 2025 to 2026, particularly considering AVAS is already mandated in most overseas markets • Jurisdictions should develop schemes to drive retro-fitment of AVAS

Victoria	Support	<ul style="list-style-type: none"> • Timeframe for implementation should be brought forward earlier than the proposed 2025 to 2026 • AVAS should apply to heavy vehicles. Heavy vehicles make up 13.6 per cent of fatal crashes that involve a pedestrian crossing or entering the road or driveway while they only account for 3.5 per cent of all registered vehicles in Victoria
East Gippsland Shire Council Disability Advisory Committee	Support	<ul style="list-style-type: none"> • The issues raised in the Impact Analysis are significant to the Disability Advisory Committee as it aims to challenge barriers faced by people with disability and promote access and inclusion

Individuals			
Total Support	Key Commentary – Support	Total Not Support	Key Commentary – Not Support
370 (approx. 60%)	<ul style="list-style-type: none"> • Strong representation from blind and low vision community (including family and friends). AVAS will allow this community, who rely heavily on walking and public transport for mobility, to maintain independence, without which there may be physical and mental decline • Emphasised the importance of AVAS for other vulnerable road users, like children, the elderly, distracted pedestrians and cyclists • Many stories of near collisions and collisions with ‘silent’ electric vehicles, from blind and vision impaired as well as sighted pedestrians • AVAS should also apply to heavy vehicles 	208 (approx. 40%)	<ul style="list-style-type: none"> • A main benefit of electric vehicles is that they are quiet. Concerns that mandating AVAS would take away this benefit and would add to noise pollution in urban areas • Suggestions for alternative solutions include mandating advanced collision avoidance systems in all cars, and for blind and vision impaired people to use technology that can detect approaching vehicles

Appendix B—Government Actions to Address Road Trauma

All levels of government are currently working to reduce road trauma in Australia. Key initiatives are outlined below, with a focus on initiatives that are helping to improve vulnerable road user safety.

National Vehicle Standards

The Australian Government administers the *Road Vehicle Standards Act 2018* which requires that all new road vehicles comply with national vehicle standards, known as the Australian Design Rules, before they can be offered to the market for use in transport in Australia. The ADRs set minimum national standards for vehicle safety, emissions and anti-theft performance.

Recent ADRs for technologies that assist in mitigating crashes, such as advanced braking systems, electronic stability control, and advanced emergency braking, will deliver reductions in road trauma, including for trauma involving vulnerable road users.

National Road Safety Strategy 2021-30

In May 2021, infrastructure and transport ministers approved the National Road Safety Strategy (NRSS) 2021–30. The NRSS represents the commitment of all levels of government to deliver significant reductions in road trauma over the next decade and progress towards ‘Vision Zero’, or zero deaths and serious injuries on our roads by 2050. The NRSS includes trauma reduction targets for the decade to 2030 of at least 50 per cent reduction in actual annual deaths to fewer than 571 and at least a 30 per cent reduction in actual annual serious injuries to fewer than 29,000. The NRSS identifies nine priority areas for reducing harm on our roads, including improving vehicle safety and prioritising vulnerable road users.

National road safety action plans provide a detailed roadmap for governments to implement the NRSS. In December 2022, infrastructure and transport ministers agreed to the National Road Safety Action Plan 2023–2025. It sets out the key actions all governments will undertake to 2025, in pursuit of the agreed priorities identified in the NRSS. Under the vehicle safety priority, the Australian Government has committed to legislating AVAS for electric vehicles, subject to the outcomes of this Impact Analysis process.

As part of the commitment to Vision Zero, success will be demonstrated by targeting:

- Zero deaths and serious injuries by 2050;
- Zero deaths of children 7-years and under by 2030; and
- Zero deaths in city CBD areas by 2030

Nine priorities were identified towards achieving Vision Zero and of importance to this IA are the following priorities:

- Vulnerable road users – providing safe road access for all road users especially children, inexperienced drivers/riders and older road users.
- Vehicle Safety – pursuing technological improvements and uptake of safer vehicles through prioritisation and adoption of proven technological improvements for all vehicle types through new ADRs as quickly as possible;
- Heavy vehicle safety – supporting the safe movement of freight and passengers and reduce harm to all road users through regulation and promotion of heavy vehicle safety technologies; and

The National Road Safety Action Plan 2023-25 specifically commits to legislating a new ADR on AVAS for electric vehicles.

State and Territory Government Action

State and territory governments target identified vehicle safety concerns through investment in research projects, education campaigns and strategic partnerships. Most jurisdictions have committed to Vision Zero through their road safety strategies. Vulnerable road user safety features prominently within the strategies. For example, the Victorian Road Safety Strategy 2021–2030 has overarching goals to ‘improve outcomes for vulnerable and unprotected road users who are involved in a crash’ and ‘ensure unprotected and vulnerable road users are supported by the road system, not impacted by it’. (Victorian Government, 2020)

Australasian New Car Assessment Program

The Australasian New Car Assessment Program (ANCAP) is an independent vehicle safety authority, that works in partnership with 23 member organisations, including governments.

ANCAP publishes safety ratings for a range of new passenger, sports utility and light commercial vehicles entering the Australian and New Zealand markets, using a rating system of 0 to 5 stars. These ratings are continually reviewed to keep pace with technology developments and to ensure that star ratings reward the most effective technologies.

Vehicles are evaluated against four key areas, one of these being vulnerable road user protection. This area assesses the design of the front of a vehicle, based on how well it minimises injury risk to a struck pedestrian. It also assesses a vehicle’s ability to actively avoid or mitigate impacts with pedestrians or cyclists. (ANCAP, 2022). Note that AVAS has not yet been adopted within the ANCAP rating system.

National Funding for Road Safety Initiatives

The Australian Government allocates dedicated funding for a number of non-infrastructure road safety programs. For example, through the May 2023 Budget, the Australian Government has committed \$43.6 million to deliver the National Road Safety Action Grants Program (NRSAGP) over four years from 2022-23. The NRSAGP provides non-infrastructure grants to deliver the Australian Government’s implementation of the National Road Safety Action Plan 2023-25 priorities through five focus areas:

- Community Education and Awareness, including workplace road safety
- Vulnerable Road Users
- First Nations road safety
- Technology and Innovation
- Research and Data

The first initiative funded under the grants program was the \$6 million Safe Roads for Safe Cycling Program, being delivered by the Amy Gillett Foundation. The program supports long-term road safety benefits by improving cycling safety knowledge, resources and tools.

Appendix C—UN Regulation 138/01 Requirements

UN Regulation 138/01 applies to electrified M (passenger) and N (goods carrying) category vehicles which can be propelled in the normal mode, in reverse or at least one forward drive gear, without an internal combustion engine operating in respect to their audibility.

For the purposes of this regulation, electrified vehicles are defined “a vehicle with a powertrain containing at least one electric motor or electric motor-generator.” These include:

- Pure Electric Vehicles (PEV) – vehicles with an electric motor as its sole mean of propulsion,
- Hybrid Electric Vehicles (HEV) – vehicles with a powertrain containing at least one electric motor or electric motor generator and at least one internal combustion engine as propulsion energy converters, and
- Fuel Cell Vehicles (FCV) - vehicles with a fuel cell and an electric machine as propulsion energy converters.

UN Regulation 138/01 requires vehicles to comply with minimum sound requirements in:

- a constant speed test performed at 10 km/h,
- a constant speed test performed at 20 km/h, and
- a reversing test performed at 6 km/h.

Tests may be performed indoors or outdoors, in motion or with the vehicle speed simulated by an external signal to the AVAS with the vehicle in standstill condition. Vehicles may emit a sound when stationary, but are not permitted to have a ‘pause’ function.

Table 7 outlines the minimum sound level requirements for each of these tests.

Table 7: Minimum sound level requirements for AVAS in db(A)

Frequency in Hz	Constant Speed Test (10 km/h)	Constant Speed Test (20 km/h)	Reversing Test
160	45	50	-
200	44	49	-
250	43	48	-
315	44	49	-
400	45	50	-
500	45	50	-
630	46	51	-
800	46	51	-
1,000	46	51	-
1,250	46	51	-
1,600	44	49	-
2,000	42	47	-
2,500	39	44	-
3,150	36	41	-
4,000	34	39	-
5,000	31	36	-
Overall	50	56	47

A separate test performed at speeds varying from 5 km/h to 20 km/h is also performed to measure frequency shifts to signify acceleration and deceleration. The following methods may be used for this test:

- Test of the complete vehicle in motion on an outdoor test track.
- Test of the complete vehicle in standstill condition on an outdoor test track with simulation of the vehicle movement to the AVAS by an external signal generator.
- Test of the complete vehicle in motion in an indoor facility on a chassis dynamometer.
- Test of the complete vehicle in standstill condition in an indoor facility with simulation of the vehicle movement to the AVAS by an external signal generator.
- Test of the AVAS without a vehicle in an indoor facility with simulation of the vehicle movement to the AVAS by an external signal generator

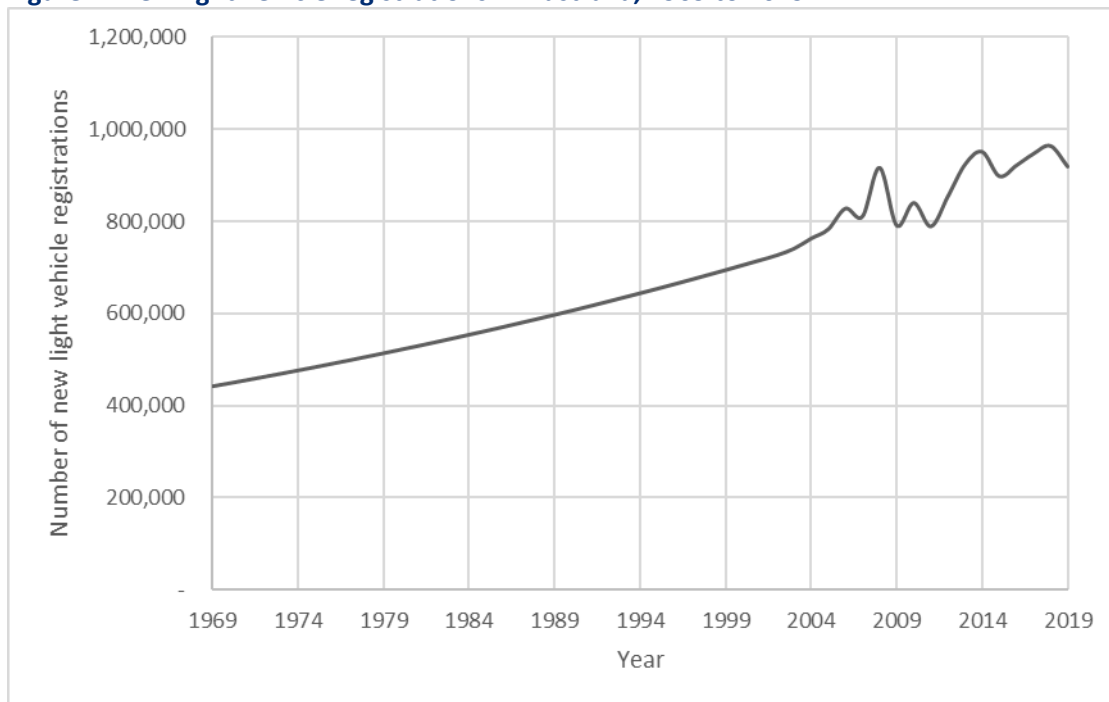
Appendix D—Benefit Cost Analysis

The model used in this analysis was the Net Present Value (NPV) model. The estimated benefits and costs for Option 2 (mandatory standard for light QRTVs) were summed over time. The further the cost or benefit occurred from the nominal starting date, the more they were discounted. This allowed all costs and benefits to be compared equally, no matter when they occurred. Due to limited data specific to heavy vehicles, the same methodology was also used for Options 3a and 3b, with the number of vehicles adjust in line with the proportion of new heavy vehicles to new light vehicle sales.

The analysis was broken up into the steps outlined below.

8. The number of new light vehicles registrations was established for each year between 1969 and 2020 inclusive, utilising available Australian Bureau of Statistics Motor Vehicle Census (report series 9309.0) data (Australian Bureau of Statistics, 2020), and registrations per capita for years prior to availability of census data (Figure 7):

Figure 7: New light vehicle registrations in Australia, 1969 to 2019



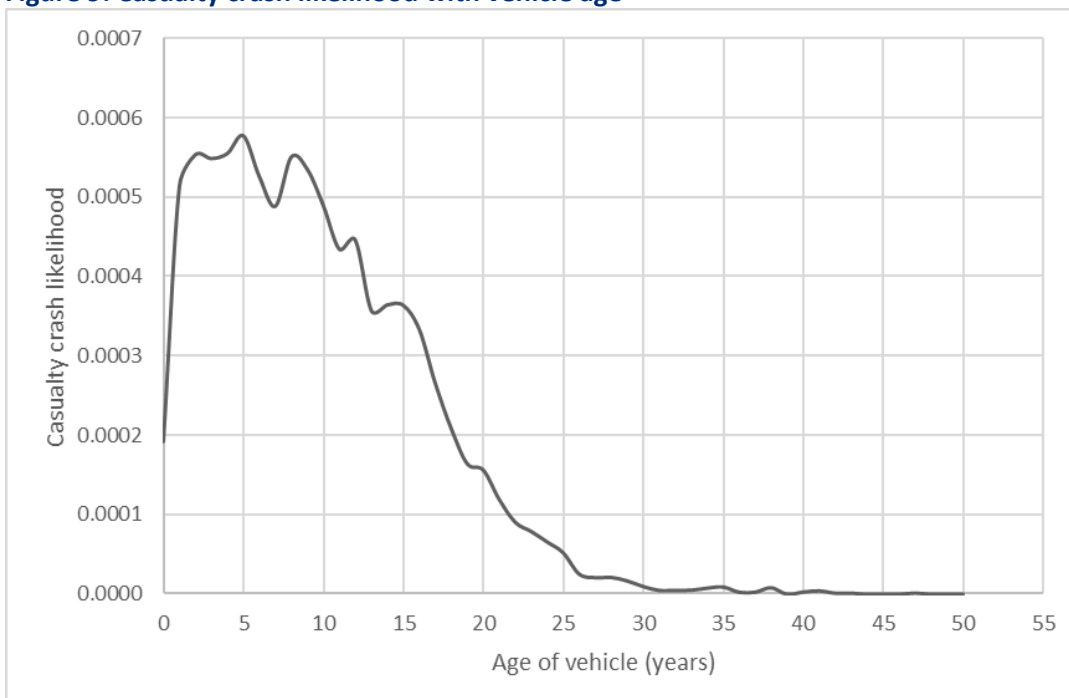
9. Data from MUARC (2020) was used to determine the typical pedestrian crash frequency by age for light vehicles (Figure 8).

Figure 8: Pedestrian crash frequency by age of vehicle



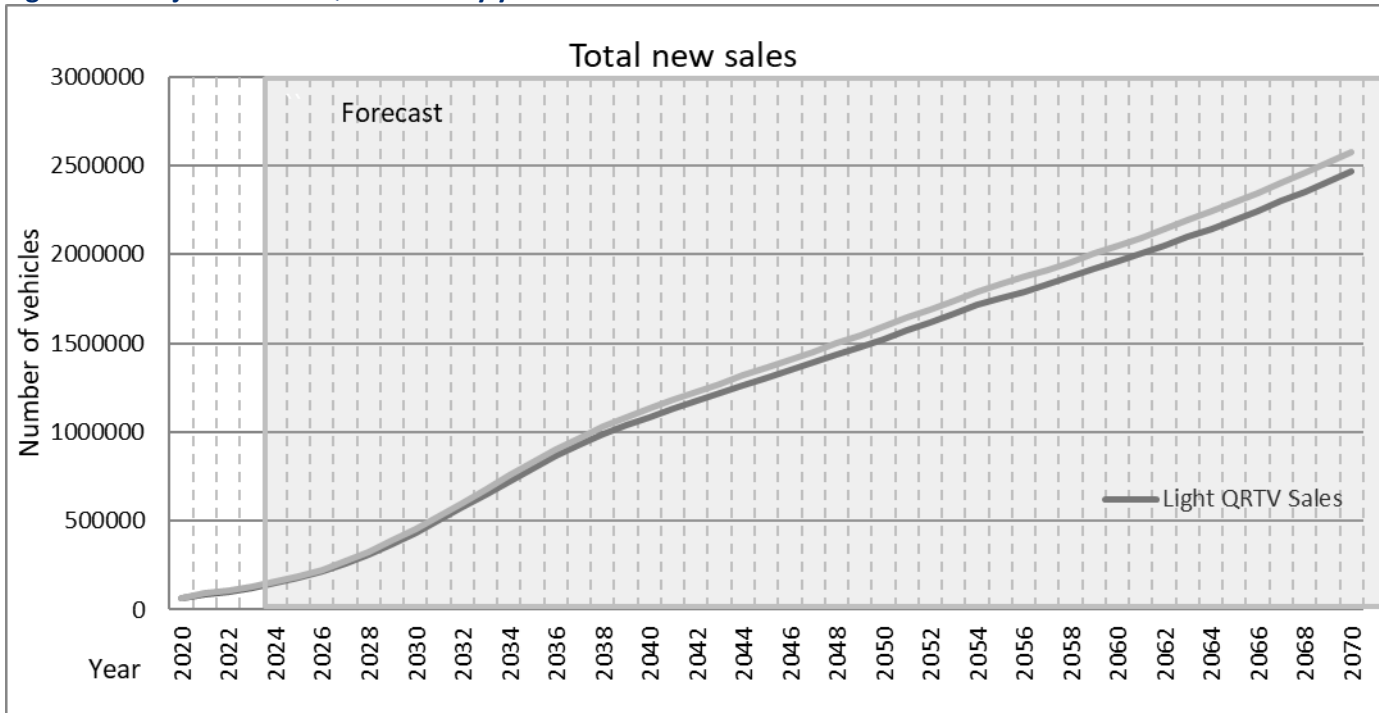
10. The data from steps 1 and 2 were used to determine the likelihood of a vehicle of a given age being involved in a casualty crash over the course of one year as a function of number of registered vehicles of a given age (Figure 9).

Figure 9: Casualty crash likelihood with vehicle age



11. Recent QRTV sales projections for the relevant vehicle categories were established (Figure 10):

Figure 10: Projected New QRTV sales by year

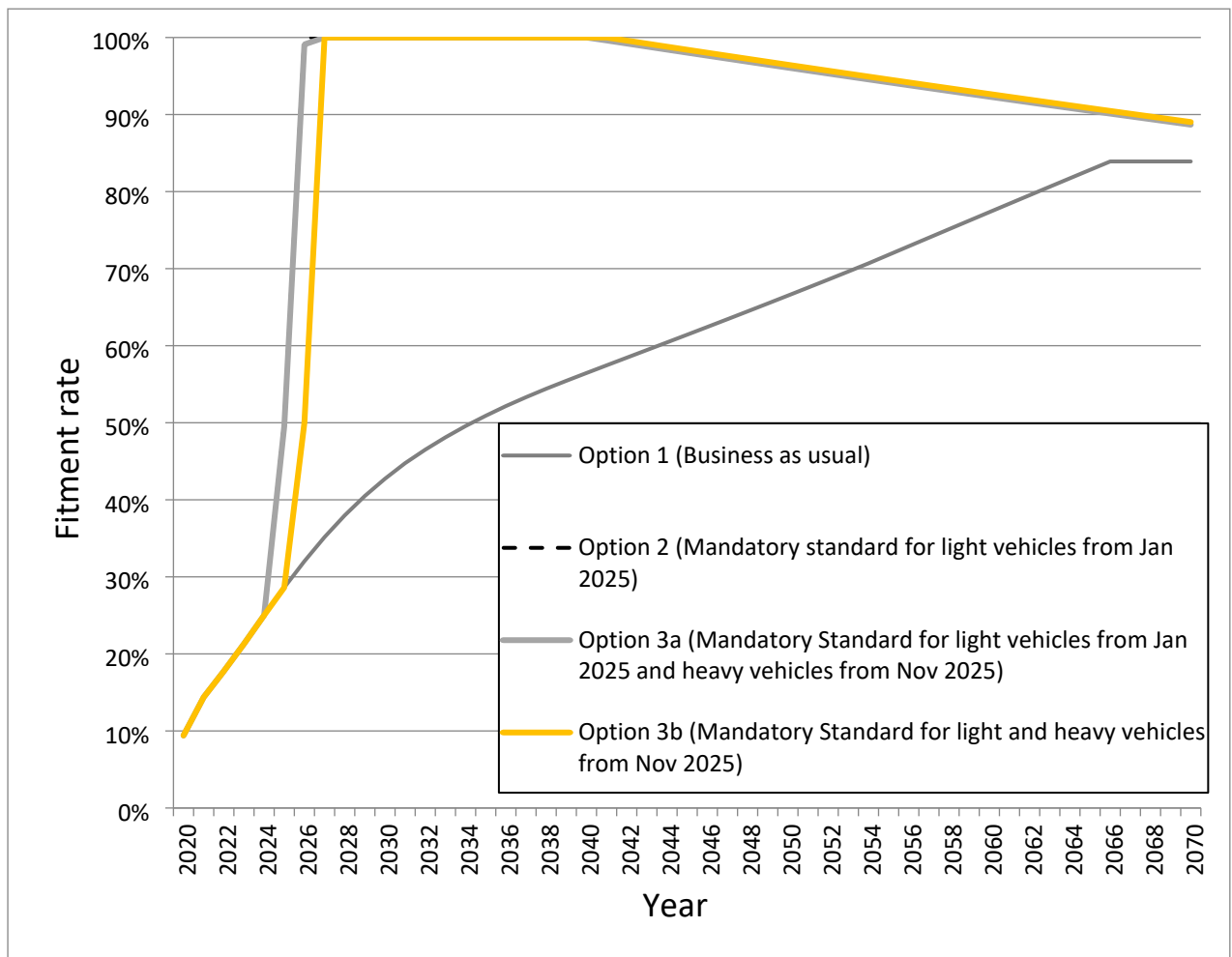


Short to medium term forecast sales were derived from industry data of past sales (VFACTS), growth factors approximated using data from the Australian Bureau of Statistics. Electric vehicle uptake was estimated in accordance with BITRE (2019).

To estimate hybrid vehicle sales, all new vehicle sales from 2054 were assumed to be electric vehicles (consistent with Lawrence et al 2020). Hybrid vehicle sales were assumed to increase gradually from current levels to a level where hybrids account for all non-plug-in electric vehicle sales from 2054.

12. The projected increased fitment rate for electric vehicles at sale under Option 2 was established (Figure 11).

Figure 11: Projected AVAS fitment rate under Option 1, 2, 3a and 3b



13. From sales data (step 4) and fitment data (step 5), the fitment increase under Option 2 was determined (Table 8).

Table 8: Increase in fitment of AVAS due to Option 2, 3a and 3b

Year	Fitment increase Option 2	Fitment increase Option 3a	Fitment increase Option 3b
2025	38,162	39,040	
2026	146,531	151,098	40,494
2027	168,447	176,027	176,027
2028	192,887	201,567	201,567
2029	219,710	229,597	229,597
2030	248,226	259,396	259,396
2031	278,544	291,078	291,078
2032	307,751	321,600	321,600

Year	Fitment increase Option 2	Fitment increase Option 3a	Fitment increase Option 3b
2033	336,736	351,889	351,889
2034	364,976	381,400	381,400
2035	390,566	408,142	408,142
2036	413,372	431,973	431,973
2037	432,918	452,400	452,400
2038	449,394	469,616	469,616
2039	461,745	482,523	482,523
2040	467,579	493,149	493,149
2041	471,417	497,332	502,051
2042	473,566	499,742	504,626
2043	474,269	500,637	505,683
2044	473,643	500,140	505,345
2045	471,763	498,332	503,693
2046	468,745	495,335	500,853
2047	464,560	491,117	496,793
2048	459,236	485,711	491,543
2049	452,788	479,130	485,121
2050	445,161	471,319	477,469
2051	436,351	462,272	468,583
2052	426,341	451,974	458,447
2053	415,155	440,449	447,086
2054	402,751	427,653	434,459
2055	385,588	409,841	416,769
2056	367,544	391,110	398,165
2057	348,595	371,438	378,622
2058	328,707	350,786	358,102
2059	307,842	329,117	336,568

14. From the fitment increase data in step 6, the likely additional fitment costs over the intervention policy period (15 years) were established (Table 9).

Table 9: Additional fitment cost for Option 2, 3a and 3b

Year	Option 2 (\$)	Option 3a (\$)	Option 3b (\$)
2025	2,938,448	3,006,047	-
2026	11,170,093	11,518,201	3,086,843
2027	12,712,297	13,284,351	13,284,351
2028	14,411,162	15,059,665	15,059,665
2029	16,251,074	16,982,372	16,982,372
2030	18,176,645	18,994,594	18,994,594
2031	20,192,730	21,101,403	21,101,403
2032	22,086,973	23,080,887	23,080,887
2033	23,925,567	25,002,217	25,002,217
2034	25,672,738	26,828,012	26,828,012
2035	27,198,041	28,421,953	28,421,953
2036	28,498,275	29,780,698	29,780,698
2037	29,547,386	30,877,018	30,877,018
2038	30,365,128	31,731,559	31,731,559
2039	30,887,686	32,277,632	32,277,632

15. From the first year of intervention (2025), the number of crashes affected by the increased fitment was determined for each year over a 35-year period (Table 10, 10 and 11). The 35-year analysis period covers the 15-year intervention period, followed by 20 years for the life of the vehicle. The crashes affected each year are the product of the likelihood of crash at the vehicle's age (from step 3) and the increased fitment of AVAS at sale (from step 5), summed as they infiltrate the fleet over time.

Table 10: Expected reduction in casualty crashes under Option 2

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Crashes avoided	
1	7																																			7	
2	20	28																																			48
3	21	75	32																																		129
4	21	81	86	37																																	225
5	21	80	93	99	42																																336
6	22	81	92	107	113	48																															463
7	20	84	93	106	121	127	54																														606
8	19	77	97	107	120	137	143	59																													759
9	21	72	88	111	122	136	154	158	65																												927
10	20	81	82	101	127	138	153	170	173	70																											1114
11	19	78	93	94	115	143	154	169	186	187	75																										1314
12	17	72	90	106	107	130	161	171	185	202	201	79																									1519
13	17	64	82	103	121	121	146	177	187	200	216	212	83																								1729
14	14	65	73	94	117	136	136	162	194	202	214	228	222	86																							1945
15	14	52	75	84	107	133	153	150	177	210	216	227	239	231	89																						2157
16	14	53	60	86	95	121	149	169	164	192	225	229	237	248	237	91																					2371
17	13	53	61	69	98	108	136	164	185	178	205	238	240	246	255	242	91																				2584
18	10	49	61	70	78	111	121	150	180	201	191	217	250	249	253	261	244	92																			2787
19	8	39	56	70	80	89	124	134	165	195	215	202	227	259	256	259	263	246	92																		2976
20	6	30	45	64	80	90	99	137	146	178	209	227	211	236	266	262	261	264	246	92																	3150
21	6	24	35	51	73	90	101	110	150	158	191	221	238	219	242	272	264	262	265	246	92																3310
22	5	23	28	40	58	83	101	112	120	163	169	202	231	247	225	248	274	265	263	265	245	91															3457
23	3	17	26	32	46	66	93	112	123	130	174	179	212	240	254	230	250	276	265	262	264	243	90														3587
24	3	13	20	30	36	52	74	102	122	133	139	184	188	220	247	260	232	251	276	265	261	262	241	89													3701
25	3	12	15	23	34	41	58	82	112	133	142	147	193	195	226	252	262	233	251	276	264	260	260	239	88												3800
26	2	10	13	17	26	39	46	64	89	122	142	150	154	200	200	231	254	263	234	251	275	263	258	257	235	87										3882	
27	1	8	11	15	20	30	44	50	70	97	130	150	158	160	206	205	233	255	263	234	250	273	260	255	253	232	85									3947	
28	1	4	9	13	17	22	33	48	55	76	104	138	157	164	165	210	207	234	256	263	233	249	271	258	251	249	227	83								3995	
29	1	3	4	10	14	20	25	37	53	60	81	110	144	163	168	168	212	208	234	256	262	231	247	268	254	247	245	222	81							4027	
30	1	3	4	5	11	16	22	28	40	57	64	86	115	150	168	172	170	213	208	234	255	261	229	244	264	250	242	239	216	79						4045	
31	0	2	4	4	6	13	18	24	30	43	61	68	90	119	154	171	173	171	213	208	233	253	258	227	241	260	245	237	233	210	75					4046	
32	0	1	3	4	5	6	15	20	27	33	47	65	71	94	122	157	173	174	171	213	207	232	251	256	224	237	255	240	231	226	201	72				4031	
33	0	0	2	3	5	5	7	16	22	29	35	49	68	74	96	125	158	174	174	171	212	206	230	248	252	220	232	249	234	224	217	192	68			3998	
34	0	0	0	2	4	5	6	8	18	24	31	37	52	70	76	98	126	159	174	174	170	211	204	227	245	248	216	227	243	227	215	207	182	64		3950	
35	0	0	0	0	2	4	6	6	9	19	26	33	39	54	72	77	99	127	160	174	174	169	209	202	224	241	243	211	221	236	217	205	196	172	60	3888	

Table 11: Expected reduction in casualty crashes under Option 3a

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Crashes avoided	
1	7																																			7	
2	20	29																																			49
3	22	78	34																																		133
4	21	84	90	39																																	234
5	22	83	97	103	44																																349
6	23	84	96	111	118	50																															482
7	20	87	98	110	127	133	56																														632
8	19	79	101	112	126	143	149	62																													792
9	21	74	92	116	127	142	161	165	68																												967
10	21	83	86	106	132	144	160	178	181	73																											1163
11	19	81	97	98	121	150	161	176	195	196	78																										1371
12	17	74	94	111	112	136	168	178	193	211	210	83																									1586
13	17	66	86	108	126	127	153	185	195	209	226	222	87																								1806
14	14	67	76	99	123	143	142	169	203	211	224	239	232	90																							2031
15	14	54	78	87	112	139	160	157	185	220	226	237	250	241	93																						2253
16	14	55	63	90	100	127	155	177	172	200	235	239	248	260	248	95																					2477
17	13	55	64	72	102	113	142	172	194	186	214	249	251	257	267	253	96																				2699
18	10	50	64	73	82	116	126	157	188	210	199	227	261	260	264	273	255	96																			2912
19	8	40	59	73	84	93	130	140	172	204	224	211	237	271	267	270	275	257	96																		3110
20	6	31	47	67	83	94	104	143	153	186	218	238	221	247	278	273	273	276	257	96																	3292
21	6	25	37	53	76	94	106	115	157	165	199	231	249	229	253	284	276	274	277	257	96																3459
22	5	24	29	42	61	86	106	117	126	170	177	211	242	258	235	259	287	277	274	276	256	95															3612
23	4	18	27	33	48	69	97	117	128	136	182	187	221	251	265	241	261	288	277	274	275	254	94														3748
24	3	14	21	31	38	54	77	107	128	139	146	192	196	229	258	271	243	262	289	277	273	274	252	93													3868
25	3	12	16	24	36	43	61	85	117	139	149	154	201	204	236	263	273	244	263	288	276	271	271	249	92												3970
26	2	10	14	18	27	41	48	67	93	127	148	157	161	209	209	241	266	275	244	263	287	275	269	268	246	91										4057	
27	1	8	12	16	21	31	45	53	73	101	136	157	165	168	215	214	243	267	275	244	262	286	272	266	265	242	89									4125	
28	1	4	9	13	18	23	35	50	58	79	108	144	164	171	172	220	216	244	267	275	243	260	283	269	263	261	237	87								4175	
29	1	3	4	10	15	20	26	38	55	63	85	115	151	171	176	176	222	217	245	267	274	242	258	280	266	258	256	232	85							4209	
30	1	3	4	5	12	17	23	29	42	60	67	90	120	156	175	179	177	223	217	244	266	272	240	255	276	261	253	250	226	82						4227	
31	0	3	4	4	6	14	19	25	32	45	64	71	94	124	161	179	181	178	223	217	244	265	270	237	252	272	256	248	243	220	79					4228	
32	0	1	3	4	5	7	15	21	28	35	49	67	74	98	128	164	181	182	179	223	216	242	262	267	234	247	266	250	241	236	210	75				4212	
33	0	0	2	3	5	5	7	17	23	30	37	51	71	77	100	131	166	182	182	178	222	215	240	259	263	230	243	261	244	234	227	201	71			4178	
34	0	0	0	2	4	6	6	8	18	25	32	39	54	73	79	103	132	166	182	182	178	221	213	237	256	259	226	237	254	237	225	216	191	67		4128	
35	0	0	0	0	2	4	6	7	9	20	27	34	41	56	75	81	104	132	167	182	181	177	219	211	234	252	254	221	231	246	227	214	205	180	63	4063	

Table 12: Expected reduction in casualty crashes under Option 3a

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	Crashes avoided	
1	0																																			0	
2	0	8																																		8	
3	0	21	34																																	55	
4	0	22	90	39																																151	
5	0	22	97	103	44																															267	
6	0	22	96	111	118	50																														398	
7	0	23	98	110	127	133	56																													547	
8	0	21	101	112	126	143	149	62																												715	
9	0	20	92	116	127	142	161	165	68																											891	
10	0	22	86	106	132	144	160	178	181	73																										1081	
11	0	22	97	98	121	150	161	176	195	196	78																									1293	
12	0	20	94	111	112	136	168	178	193	211	210	83																								1515	
13	0	18	86	108	126	127	153	185	195	209	226	222	87																							1741	
14	0	18	76	99	123	143	142	169	203	211	224	239	232	90																						1968	
15	0	14	78	87	112	139	160	157	185	220	226	237	250	241	93																					2199	
16	0	15	63	90	100	127	155	177	172	200	235	239	248	260	248	95																				2423	
17	0	15	64	72	102	113	142	172	194	186	214	249	251	257	267	253	96																			2647	
18	0	13	64	73	82	116	126	157	188	210	199	227	261	260	264	273	258	97																		2868	
19	0	11	59	73	84	93	130	140	172	204	224	211	237	271	267	270	278	259	97																	3078	
20	0	8	47	67	83	94	104	143	153	186	218	238	221	247	278	273	275	279	260	97																3271	
21	0	7	37	53	76	94	106	115	157	165	199	231	249	229	253	284	278	277	280	259	97															3446	
22	0	6	29	42	61	86	106	117	126	170	177	211	242	258	235	259	289	280	277	279	259	96														3605	
23	0	5	27	33	48	69	97	117	128	136	182	187	221	251	265	241	264	291	280	277	278	257	95													3750	
24	0	4	21	31	38	54	77	107	128	139	146	192	196	229	258	271	245	265	291	280	276	277	255	94												3875	
25	0	3	16	24	36	43	61	85	117	139	149	154	201	204	236	263	276	246	265	291	279	274	275	252	93											3983	
26	0	3	14	18	27	41	48	67	93	127	148	157	161	209	209	241	268	277	247	265	290	278	272	272	249	92										4074	
27	0	2	12	16	21	31	45	53	73	101	136	157	165	168	215	214	245	270	278	247	264	289	275	269	268	245	90									4148	
28	0	1	9	13	18	23	35	50	58	79	108	144	164	171	172	220	218	247	270	278	246	263	286	272	266	264	241	88								4204	
29	0	1	4	10	15	20	26	38	55	63	85	115	151	171	176	176	224	219	247	270	277	244	261	283	269	262	259	235	86							4242	
30	0	1	4	5	12	17	23	29	42	60	67	90	120	156	175	179	179	225	219	247	269	275	242	258	280	265	257	253	230	83						4263	
31	0	1	4	4	6	14	19	25	32	45	64	71	94	124	161	179	183	180	225	219	246	268	273	240	255	275	260	251	247	223	80					4268	
32	0	0	3	4	5	7	15	21	28	35	49	67	74	98	128	164	182	184	180	225	219	245	265	270	237	251	270	254	245	240	214	76				4255	
33	0	0	2	3	5	5	7	17	23	30	37	51	71	77	100	131	167	183	184	180	224	217	243	263	267	233	246	264	248	238	230	204	73			4225	
34	0	0	0	2	4	6	6	8	18	25	32	39	54	73	79	103	133	168	184	184	180	223	216	240	259	263	229	241	258	241	228	220	194	69			4178
35	0	0	0	0	2	4	6	7	9	20	27	34	41	56	75	81	104	134	168	184	183	179	221	213	237	255	258	224	235	250	231	218	209	184	65		4115

16. From the number of crashes affected determined in step 8, the trauma alleviated by year was determined from effectiveness for each trauma type and the technology impact (Table 13).

Table 13: Expected reduction in fatal and serious and minor injury crashes under Option 2, 3a and 3b

Year	Fatal crashes avoided Option2	Serious injury crashes avoided Option 2	Minor injury crashes avoided Option 2	Fatal crashes avoided Option 3a	Serious injury crashes avoided Option 3a	Minor injury crashes avoided Option 3a	Fatal crashes avoided Option 3b	Serious injury crashes avoided Option 3b	Minor injury crashes avoided Option 3b
2025	0.01	0.22	0.25	0.01	0.23	0.25	-	-	-
2026	0.04	1.46	1.61	0.04	1.50	1.66	0.01	0.24	0.26
2027	0.10	3.92	4.34	0.10	4.05	4.49	0.04	1.66	1.84
2028	0.17	6.87	7.61	0.18	7.13	7.90	0.12	4.62	5.11
2029	0.26	10.24	11.33	0.27	10.65	11.79	0.21	8.14	9.01
2030	0.36	14.10	15.61	0.37	14.69	16.26	0.31	12.13	13.43
2031	0.47	18.47	20.45	0.49	19.25	21.32	0.42	16.68	18.47
2032	0.58	23.14	25.63	0.61	24.14	26.73	0.55	21.79	24.13
2033	0.71	28.24	31.27	0.74	29.47	32.63	0.69	27.17	30.08
2034	0.86	33.97	37.61	0.89	35.45	39.25	0.83	32.96	36.50
2035	1.01	40.04	44.34	1.05	41.80	46.28	0.99	39.42	43.64
2036	1.17	46.30	51.27	1.22	48.35	53.53	1.17	46.18	51.14
2037	1.33	52.72	58.37	1.39	55.05	60.95	1.34	53.06	58.75
2038	1.50	59.29	65.65	1.56	61.92	68.56	1.51	60.00	66.43
2039	1.66	65.75	72.80	1.73	68.68	76.05	1.69	67.04	74.23
2040	1.82	72.28	80.04	1.91	75.51	83.60	1.86	73.85	81.77
2041	1.99	78.76	87.21	2.08	82.27	91.10	2.04	80.68	89.33
2042	2.14	84.96	94.08	2.24	88.76	98.28	2.21	87.43	96.80
2043	2.29	90.73	100.46	2.39	94.79	104.96	2.37	93.84	103.90
2044	2.42	96.04	106.34	2.53	100.34	111.10	2.52	99.71	110.41
2045	2.55	100.91	111.73	2.66	105.44	116.75	2.65	105.06	116.32
2046	2.66	105.38	116.69	2.78	110.11	121.92	2.77	109.90	121.69
2047	2.76	109.35	121.08	2.88	114.26	126.52	2.88	114.30	126.55
2048	2.85	112.82	124.93	2.98	117.89	130.54	2.98	118.12	130.79
2049	2.92	115.82	128.25	3.05	121.03	134.01	3.06	121.41	134.44
2050	2.99	118.33	131.03	3.12	123.65	136.92	3.13	124.20	137.52
2051	3.04	120.33	133.23	3.17	125.74	139.22	3.19	126.45	140.02
2052	3.07	121.78	134.85	3.21	127.26	140.91	3.23	128.16	141.91
2053	3.10	122.77	135.93	3.24	128.29	142.05	3.26	129.30	143.17
2054	3.11	123.30	136.52	3.25	128.85	142.66	3.28	129.94	143.88
2055	3.11	123.34	136.57	3.25	128.89	142.72	3.28	130.10	144.05
2056	3.10	122.86	136.04	3.24	128.39	142.16	3.27	129.72	143.63
2057	3.08	121.87	134.94	3.21	127.36	141.02	3.25	128.80	142.61
2058	3.04	120.42	133.33	3.18	125.83	139.33	3.21	127.35	141.01
2059	2.99	118.51	131.22	3.13	123.85	137.13	3.17	125.43	138.88

Year	Fatal crashes avoided Option 2	Serious injury crashes avoided Option 2	Minor injury crashes avoided Option 2	Fatal crashes avoided Option 3a	Serious injury crashes avoided Option 3a	Minor injury crashes avoided Option 3a	Fatal crashes avoided Option 3b	Serious injury crashes avoided Option 3b	Minor injury crashes avoided Option 3b
Total	65	2585	2863	68	2701	2991	68	2675	2962

17. The cost savings due to loss of life avoided were estimated using the statistical value of a life recommended by Office of Impact Analysis in 2023 (\$5.4 million) and the totals established in step 9. The typical cost of a serious and minor injury was established using methods outlined in BITRE Report 102, but adjusted to reflect willingness to pay to be consistent with the approach taken for quantifying the statistical value of a life.

18. Finally, Table 14 below summarises the figures from the above analysis.

Table 14: Summary of benefit-cost analysis for Option 2 relative to Option 1

Case	Gross benefits (\$m)	Net benefits (\$m)	Cost to business (\$m)	Cost to Government (\$m)	Benefit-cost ratio	Number of lives saved	Serious injuries avoided	Minor injuries avoided
Option 1 (Business as usual)	-	-	-	-	-	-	-	-
Option 2 (Light vehicles from Jan 2025)	372.8	201.2	171.1	0.5	2.17	65	2,585	2,863
Option 3a (Light vehicles from Jan 2025, heavy vehicles from Nov 2025)	389.3	210.3	178.5	0.5	2.18	68	2,701	2,991
Option 3b (light and heavy vehicles from Nov 2025)	377.3	208.4	168.4	0.5	2.23	68	2,675	2,962

Appendix E—Acronyms and Abbreviations

AEB/AEBS	Autonomous (Advanced) Emergency Braking (System)
ADR	Australian Design Rule
AVAS	Acoustic Vehicle Alerting System
BITRE	Bureau of Infrastructure and Transport Research Economics
dB(A)	A-weighted sound pressure level
EU	European Union
FMVSS	Federal Motor Vehicle Safety Standard
FCV	Fuel Cell Vehicle
GVM	Gross Vehicle Mass
HEV	Hybrid Electric Vehicle
ICEV	Internal Combustion Engine Vehicle
ITSOC	Infrastructure and Transport Senior Officials' Committee
MUARC	Monash University Accident Research Centre
NHTSA	National Highway Traffic Safety Administration
NRSS	National Road Safety Strategy
PEV	Pure Electric Vehicle
QRTV	Quiet Road Transport Vehicle
RBM	Regulatory Burden Measurement
RVSA	Road Vehicle Standards Act 2018
UN	United Nations
UN CRPD	United Nations Convention on the Rights of Persons with Disabilities
US	United States
VRU	Vulnerable Road Users
VSCF	Vehicle Standards Consultative Forum (formerly Strategic Vehicle Safety and Environment Group (SVSEG))
WP.29	United Nations World Forum for the Harmonization of Vehicle Regulations

Appendix F—Glossary of Terms

Benefit-Cost Ratio: The ratio of expected total (gross) benefits to expected total costs (in terms of their present monetary value) for a change of policy relative to business as usual

Bus (or Omnibus): A passenger vehicle having more than nine seating positions, including that of the driver

Certification: Assessment of compliance to the requirements of a regulation/standard. Can relate to parts, sub-assemblies, or a whole vehicle

Crash: Any apparently unpremeditated event reported to police, or other relevant authority, and resulting in death, injury or property damage attributable to the movement of a road vehicle on a public road

Discount Rate: A rate of interest used to translate costs which will be incurred and benefits which will be received across future years into present day values

Fatal Crash: A crash for which there is at least one death

Gross Vehicle Mass: The maximum laden mass of a motor vehicle as specified by the manufacturer.

Hospitalised Injury: A person admitted to hospital from a crash occurring in traffic. Traffic excludes off-road and unknown location

Light Vehicle: For the purposes of this Impact Analysis, a passenger vehicle with nine seats or less or goods carrying vehicle with a gross vehicle mass up to 3.5 tonnes. These include:

MA Category Vehicle A passenger vehicle, not being an off-road passenger vehicle or a forward-control passenger vehicle, having up to 9 seating positions, including that of the driver.

MB Category Vehicle A passenger vehicle, not being an off-road passenger vehicle, having up to 9 seating positions, including that of the driver, and in which the centre of the steering wheel is in the forward quarter of the vehicle's 'Total Length

MC Category Vehicle A passenger vehicle having up to 9 seating positions, including that of the driver and being designed with special features for off-road operation.

NA Category Vehicle A goods vehicle with a *Gross Vehicle Mass* not exceeding 3.5 tonnes.

Heavy Vehicle: For the purposes of this Impact Analysis, a passenger vehicle with more than nine seats or goods carrying vehicle with a gross vehicle mass over 3.5 tonnes. These include:

MD Category Vehicle An omnibus with a *Gross Vehicle Mass* not exceeding 5.0 tonnes.

ME Category Vehicle An omnibus with a *Gross Vehicle Mass* exceeding 5.0 tonnes.

NB Category Vehicle A goods vehicle with a *Gross Vehicle Mass* exceeding 3.5 tonnes but not exceeding 12.0 tonnes.

NC Category Vehicle A goods vehicle with a *Gross Vehicle Mass* exceeding 12.0 tonne

Net Benefit: The sum of expected benefits (in monetary terms), less expected costs associated with a change of policy relative to business as usual

Net Present Value (NPV): The difference between the present economic value (determined using an appropriate discount rate) of all expected benefits and costs over time due to a change of policy relative to business as usual.

Road Crash Fatality: A person who dies within 30 days of a crash as a result of injuries received in that crash

Type Approval: Written approval of an authority/body that a vehicle type (i.e., model design) satisfies a specific technical requirement