Australian Government

Department of Infrastructure, Transport, Regional Development and Communications

Regulation Impact Statement

Reversing Aids

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Executive Summary

Reversing Collisions Involving Pedestrians

The impact of road trauma is significant, costing the Australian economy over $29 billion per annum. In terms of numbers, reversing collisions involving a reversing vehicle and a pedestrian or another vulnerable road user (cyclist or motorcyclist) do not feature strongly in the statistics. However, the frequency of such collisions tends to be underestimated as the majority of these collisions and injuries sustained are often outside the scope of official road injury record systems, which focus on public roads. Furthermore, while these crash types do not lead to destructive outcomes typically seen on public roads, the vulnerability of some of the pedestrians impacted, generally children and the elderly, result in significant trauma and associated costs. This is the specific road vehicle safety problem that has been considered in this Regulation Impact Statement (RIS).

Most reversing collisions occur at low speed locations and on private property, such as car parks, schools, and around the home, with 70 per cent taking place when people are parking or reversing in a driveway. Reversing collisions also occur on public roads where vehicles perform low-speed manoeuvres such as entering or leaving parking spaces, turning corners and other situations where there are obstructions to a clear view behind a reversing vehicle.

Pedestrians are the largest single road user group and comprise 13 per cent of all road fatalities in Australia. Local research shows nine per cent of all pedestrian injuries are a result of reversing collisions, which amounts to approximately 252 pedestrian injuries annually (MUARC, 2017). The risk of a pedestrian being struck by a vehicle increases in urban areas where high pedestrian activity and traffic densities converge. Unlike vehicle-to-vehicle collisions, where occupants can be substantially protected by vehicle safety systems, pedestrians have little to no protection when struck by a vehicle. Accidents occurring as a result of a vehicle reversing often affect small children and the elderly who are particularly vulnerable to fatality and severe or permanent injury when hit.

Some of the reasons for reversing collisions include that pedestrians often fail to see the reversing vehicles, fail to anticipate its manoeuvres, or are unable to get out of the vehicle's path, whereas drivers generally fail to see the pedestrian before the collision. In the case of young children, they fail to recognise and respond to potential risks in their environment in addition to their short stature, which may also diminish their ability to see moving vehicles given impeded vision by parked cars or other obstacles.

Moreover, while serious injury or death caused by reversing vehicles happens relatively rarely in comparison with other road crash types, other factors combine to create a particularly distressing situation for the parties involved, as well as the broader community due to the age and vulnerability of the victims and the driver often being a close family member.

Reversing Aids

Research has shown that the physical environment, education, awareness and vehicle design are instrumental in mitigating accidents from reversing collisions. Road safety experts and vehicle manufacturers agree that technologies, such as devices that increase the driver's awareness or vision of vulnerable road users behind a vehicle, can help reduce incidences of people being killed or injured by vehicles reversing. Reversing aids include devices such as sensors, cameras and rear-vision mirrors.

The Department of Infrastructure, Transport, Regional Development and Communications (the department) works to prioritise and encourage adoption of proven technological improvements for all vehicles through the development of national road vehicle standards known as the Australian Design Rules (ADRs). The department is active in the development of internationally agreed standards for new vehicle technologies, referred to as United Nations (UN) Regulations that form the basis of the ADRs. Harmonising ADRs with these UN Regulations provides Australian consumers with access to vehicles meeting the latest global levels of safety and innovation at the lowest possible cost.

Reversing detection systems will be mandatory in the European Union (EU) from 6 July 2022 for new models and 7 July 2024 for all models. In Australia, fitment rates have been positively impacted over the last decade by manufacturer initiatives and consumer choice. In 2017, fitment rates for reversing detection systems was 66 per cent (Fildes et al., 2017). The fitment rates include reversing aids fitted in new vehicles and retrofitted to vehicles after supply to the market resulting in substantial variability in capability, usage and performance across the Australian vehicle fleet.

In June 2021, the United Nations (UN) released a new international standard, UN Regulation No. 158 titled 'Uniform provisions concerning the approval of devices for reversing motion and motor vehicles with regard to the driver's awareness of vulnerable road users behind vehicles' to avoid pedestrians and cyclists being hit by the rear of the vehicle when reversing. Harmonising reversing technology requirements ensures consistency in driver expectations of system capability and usage. This will also provide a level playing field for all manufacturers as requirements are standardised across the new vehicle fleet. As with other technologies covered by UN Regulations, harmonised minimum requirements will enhance the usability and effectiveness of reversing aids independent of familiarity with a manufacturer or a brand.

This consultation RIS considers two options to increase the fitment of reversing detection systems to reduce reversing collisions in Australia. Option 1: No intervention (business as usual); and Option 2: Introduce a new ADR aligned with United Nations Regulation No. 158. The results of the benefit-cost analysis over a 45-year period for each of these options (assuming an intervention policy period of 15 years and 30 years past the period of intervention to capture the benefits of the last lot of vehicles to be fitted with reversing detection systems when the intervention stops.) are summarised below in Table A and B.

Policy interventions often come at a cost. This RIS obliges us to assess the benefit of the proposed intervention against the burden imposed. If that burden is greater than the benefit, we should look for alternatives or reconsider the need to intervene at all. 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 is the Benefit-cost ratio (BCR). This is a measure of efficiency of the proposed intervention. For net benefits to be positive, this ratio must be greater than one. A higher BCR in turn means that for a given cost, the benefits are paid back many times over (the cost is multiplied by the BCR).

Table A: Summary of net benefits, costs and benefit-cost ratio for each option.

	Vehicle Type	Net Benefits	Cost to Business	Cost to Government	Benefit Cost Ratio
Option 1: No intervention	-	-	-	-	-
Option 2: Introduce a new ADR aligned with United Nations Regulation No. 158	LPVs	$19,219,836	$27,007,770	$455,395	**1.70**
	LCVs	$13,785,679	$7,485,996	$455,395	**2.74**
	HVs	$5,564,150	$10,034,771	$455,395	**1.53**
	Total	**$38,569,665**	**$44,528,537**	**$1,366,185**	

Table B: Summary of fatalities and injuries avoided over for each option

	Vehicle Type	Number of Lives Saved	Severe Injuries Avoided	Minor Injuries Avoided
Option 1: No intervention	-	-	-	-
Option 2: Introduce a new ADR aligned with United Nations Regulation No. 158	LPVs	8	216	96
	LCVs	2	66	30
	HVs	2	58	26
	Total	**12**	**340**	**152**

Option 2, regulation through the introduction of a new ADR aligned with the new UN Regulation No. 158, indicated a total of 12 lives saved, and 340 severe injuries and 152 minor injuries avoided. This Option yielded the highest savings of approximately $38.6 million and a high benefit-cost ratio range of 1.53 – 2.74. These are conservative estimates.

Public Comment

In line with the *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)*, this consultation RIS is published for a six-week public comment period. A summary of the feedback and department responses will be included in the Final RIS.

The implementation timeframe proposed for consultative purposes is:

- March 2024 for new model vehicles
- March 2026 for all new vehicles

Recommended Option

In accordance with the *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020),* the policy option offering the greatest net benefit is the recommended option. Option 2: Introduce new ADR aligned with UN R158 offers the greatest net benefit. Under this option, the UN Regulation for reversing aids to prevent reversing collisions (UN Regulation No. 158) would be mandated for new light passenger vehicles, commercial vehicles and heavy vehicles. These vehicles include ADR categories for passenger vehicles MA, MB and MC; omnibuses MD and ME; and goods vehicles NA, NB and NC. The relevant ADR categories are summarised in Appendix 1 - Vehicle Categories. The final implementation dates will be determined as part of the ADR by the Australian Government.

The RIS Process

This consultation RIS has been written in accordance with the Australian Government RIS requirements. In the subsequent nine chapters, the seven assessment questions set out in the *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)* have been addressed. In addition, measurement of regulatory burden and cost offsets are considered. The seven RIS questions addressed are:

1. What is the problem you are trying to solve?
2. Why is government action needed?
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?
7. How will you implement and evaluate your chosen option?

1. What is the Problem?

1.1 Introduction

Trauma caused by light vehicles occurs more frequently than crashes associated with other vehicle types such as heavy vehicles and motorcycles. This is mainly because light vehicles make up around 75 per cent of the Australian vehicle fleet. There are more crashes in urban areas due to larger population, traffic complexity and density. Collisions caused by a vehicle reversing often occur in an urban setting and affect vulnerable groups, such as small children and the elderly, more severely. Furthermore, even though the trauma mostly happens at low speeds the collision can cause serious injury and death due to the vulnerability of those groups. While a reversing vehicle causing serious injury or death is a relatively rare occurrence, a number of factors combine to make such trauma particularly distressing not only to the parties directly involved but also the broader community due to the age and vulnerability of the victims, and the driver often being a close family member.

Research has shown that the physical environment, education, awareness and vehicle design are instrumental in mitigating such trauma. Road safety experts and vehicle manufacturers agree that technologies, such as devices that increase the driver's awareness or vision of vulnerable road users behind a vehicle, can help reduce incidences of people being killed or injured by reversing vehicles. Manufacturer initiatives and consumer choices have resulted in high voluntary fitment rates in new vehicles of reversing aids. However, the lack of a mandatory standard means that the capability, usage and performance of technologies vary substantially across the Australian vehicle fleet.

1.2 The Cost of Road Trauma in Australia

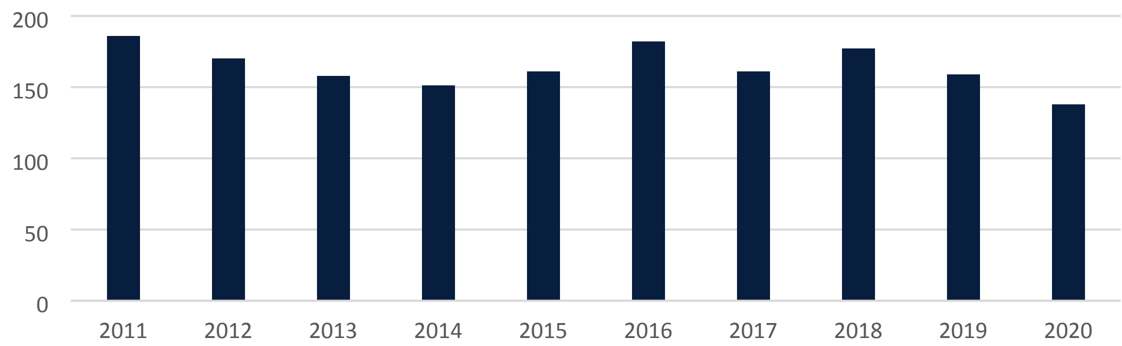
The impact of road crashes on society is significant. Individuals and families affected by road crashes must deal with pain and suffering, medical costs, lost income, higher insurance premium rates and vehicle repair costs. There is also a personal cost that cannot be measured. For society as a whole, road crashes result in substantial costs in terms of lost productivity, property repair and healthcare expenses. The cost to the Australian economy is broadly borne by the general public, businesses and government and has been estimated to be over $29 billion per annum (ECON, 2017). This translates to an average cost of $1,170 per annum levied upon every person in Australia.

1.3 Pedestrian Trauma Rates

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, along with motorcyclists and pedal cyclists, 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 per cent of all road fatalities in Australia (BITRE, 2015). Local research shows nine per cent of all pedestrian injuries are a result of reversing collisions which amounts to approximately 252 pedestrian injuries annually (MUARC, 2017). Whilst light vehicle occupant fatalities declined by 15 per cent in the ten years to 2019, the fatality rate of vulnerable road users has not significantly changed over the decade (see Figure 1) with only a 5.1 per cent reduction observed (BITRE, 2020). The majority of pedestrian fatalities (75.8 per cent) involve a light vehicle striking a pedestrian (BITRE, 2015). The recent noticeable reduction in pedestrian trauma for two consecutive years (2019-2020) may be attributed to the impact of the COVID pandemic on road transport. During the second quarter of calendar year 2020, estimated vehicle kilometres travelled (VKT) declined by 22 per cent and fatalities declined by 14.0 per cent. In the 3rd and 4th quarters of 2020, both VKT and deaths increased to historical trend levels. Compared to calendar 2019, there were 6.7 per cent fewer fatalities in 2020.

Figure 1: Pedestrian fatalities 2011 - 2020 (BITRE, 2020)



1.3.1 International Research of Pedestrian Trauma Rate caused by Reversing Collisions

In France, reversing collisions account for 7 per cent of pedestrian accidents in public settings, with 73 per cent of those involved being pedestrians aged over 60 years (Brenac and Fournier, 2018). Similar findings were observed in studies undertaken in Sweden and Finland. These considered pedestrian fatalities as a whole including reversing collisions, with pedestrians aged 65 years or older over-represented among those severely or fatally injured (Kroyer, 2015). The risk of fatal injuries was found to increase when the person was over 75 years old (Malin, 2020). This research also found that the risk of fatalities was higher in those aged 25 years or younger, with Kroyer (2015) noting that an increased risk of severe injuries is observed in the youngest age group, from 0 – 6 years old. This is a result of the short stature of children that can contribute to an increased risk for serious and fatal head injuries due to the alignment of the car bumper (Rouse and Schwebel, 2019). Kroyer (2015) also noted that injury threshold varies between individuals; for example, a light collision or light impact might not cause any injuries to an adult pedestrian, where the same impact might cause severe injuries to an older and less physically strong person.

Most reversing collisions occur because pedestrians fail to see the reversing vehicle, fail to anticipate its manoeuvres, or are unable to get out of the vehicle's path, whereas drivers generally fail to see the pedestrian before the collision (Brenac and Fournier, 2018). Research in the United States of America by Rouse and Schwebel (2019) identified three risk factors that contribute to injury risk for young children in areas with low traffic speeds, such as car parks. Firstly, young children struggle to recognise and respond to potential risks in their environment – young children might not understand the meaning of reverse lights on a car, or be able to anticipate and react to the direction, distance, and speed of cars moving around them. Secondly, children's short stature may also diminish their ability to see moving vehicles given impeded vision by parked cars or other obstacles. Thirdly, young children lack the cognitive skills required to engage in safe pedestrian behaviour, even in settings with slow-moving traffic. Research undertaken in Japan by Matsui and Oikawa (2019) identified that vehicle impact speed affects the frequency of pedestrian fatalities, because pedestrian fatalities occur even when reversing at low travel speeds.

Both Matsui and Oikawa (2019) and Brenac and Fournier (2018) found that improved driver visibility can contribute to reducing pedestrian fatalities and injury rates in reversing collisions, but noted that the occurrence of such accidents cannot be fully eliminated. This is confirmed by Australian findings discussed in Section 1.4 below.

1.3.2 Social Impact of Reversing Collisions

Despite the low number of deaths per year attributed to reversing collisions, the social impacts on families and the wider community are immeasurable. This is especially the case when it involves the death of a child, as children take on great symbolic importance in terms of parent's generativity and hope for the future (Christ et al., 2003). In Australia, the seriousness of reversing collisions is evidenced by a foundation set up to provide a support network for families affected by low-speed vehicle run over accidents. The foundation works to prevent and reduce unintentional injury or death of children and adults in such accidents (Georgina Josephine Foundation, 2021). As most of these deaths and injuries are preventable, but frequently happen when a parent or close relative is driving without seeing the child behind the vehicle, the cost in psychological terms for the family are high and often leads to extensive grief and frequently a breakdown of the family unit (Griffin et al., 2014).

There is substantial evidence that the grief of parents following the loss of a child is more intense and prolonged than that of other losses. In instances when the child dies suddenly through accidental death, parental grief is complicated by post-traumatic stress reactions from the nature of the circumstances (Raphael, 2006). This is reflected in research conducted by Fisher et al. (2020) concluding that bereavement by sudden deaths can lead to increased grief severity and depression compared to those bereaved by natural causes. Christ et al. (2003) found that in addition to grief, parents of children who die suffer a broad range of lifelong difficult mental / psychological symptoms and physical symptoms. Further, guilt and self-blame is especially pronounced as the parent's role and competence as the child's caregiver, protector and mentor is severely threatened by untimely death.

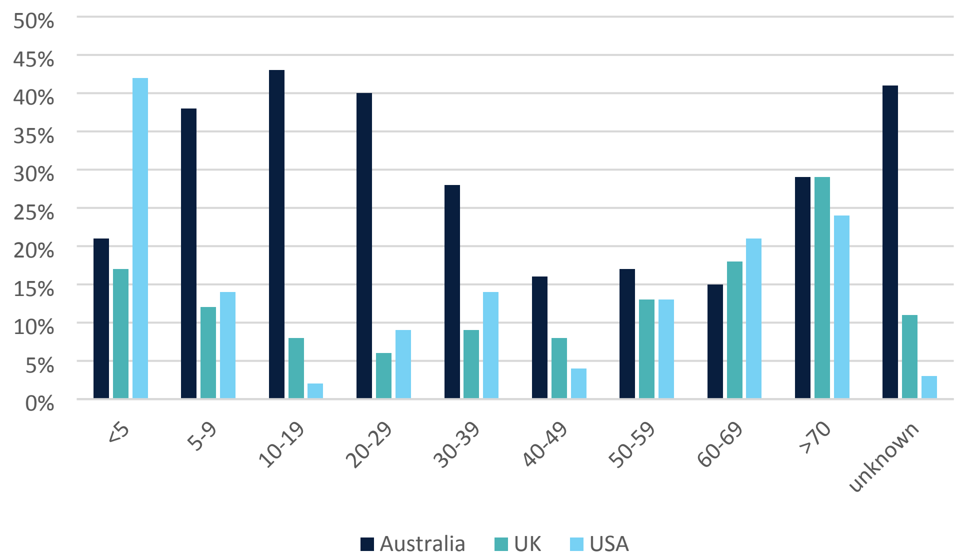
1.4 Extent of the Problem in Australia

Reversing collisions involving a vehicle and a pedestrian or another vulnerable road user, i.e. cyclist or motorcyclist, are generally rare occurrences with very low number of cases reported each year. This is reflected in a study undertaken by Monash University Accident Research Centre (MUARC) in Victoria identifying that only 6 per cent of all pedestrians were killed by reversing vehicles (Cassell et al., 2011). However, the prevalence of such collisions tends to be underestimated as the majority of these collisions and injuries sustained are often outside the scope of official road injury record systems which focus on public roads (Keall et al., 2018). Further confounding a more accurate estimation of the size of the problem is that reversing collisions, referred to as low speed vehicle run-over crashes in MUARC (n.d.), are not well defined, and therefore identifying and coding these crash types is difficult (MUARC, n.d. and Griffin et al., 2011).

This finding is supported by the lack of data for reversing collisions involving pedestrians in national databases, such as the Australian Fatal Road Crash Database (FRCD), maintained by the Victorian Institute of Forensic Medicine (VIFM) and the Australian Road Deaths Database published by BITRE. The same conclusion applies to most state and territory databases maintained by their transport agencies, such as the VicRoads Road Crash Information System (RCIS). Hence, the true magnitude of reversing collisions is difficult to quantify.

The findings in Figure 2 show that there was a strong relationship between the injured pedestrian's age and their collision injury severity: for Australia (and the US), very young children and older people were killed and seriously injured more often. This pattern was less clear for the UK, although pedestrians aged 60 years and older generally had similarly high rates of Killed and Serious Injury (KSI) rates across all countries.

Figure 2: Per cent of all pedestrians KSI in reversing collisions by age and country (2010 - 2012) (MUARC, 2017)



1.4.1 Locations for Reversing Collisions

Walking behind a reversing vehicle in car parks or driveways are common circumstances in which pedestrians were injured, as indicated by research undertaken by Cassell et al. (2010). This is similar to findings from the Transport Accident Commission (TAC) in Victoria, which concluded that 70 per cent of reversing collisions occur when people are parking or reversing from a driveway (TAC, 2018). Deaths also occur on public roads in speed zones of 50 – 60 km/h where vehicles perform all kinds of low-speed manoeuvres such as entering or leaving parking spaces, turning corners, and other situations where there are obstructions to a clear view behind a reversing vehicle (BITRE, 2012).

Of concern to parents and the wider community is the extent to which low speed locations such as car parks, schools, sports grounds and around the home, considered by many to be a safe haven, pose a threat to child safety (See Figure 1). Research has shown that children have been killed or seriously injured after being run-over by a motor vehicle performing low-speed manoeuvres, including reversing and forward motion, in these locations (BITRE, 2012). Both people and vehicles are factors influencing motor vehicle accidents around the home, as well as home design features, which create risks for children by exposing them to the movements of vehicles through unfenced driveways and doors (BITRE, 2012).

1.4.2 Reversing Collisions Involving the Elderly

Australian research confirms international findings that reversing collisions predominantly impact vulnerable population groups, especially the elderly that are over-represented in pedestrian fatalities and have an increased risk of severe injury, have higher recovery times and likelihood of long-term disability (Oxley et al., 2020). Although older pedestrians are generally safe and cautious in their travel behaviour, the effects of ageing on sensory, visual perceptual and cognitive abilities may increase their risk on the road (Oxley et al., 2020).

A study of traffic-related pedestrian injury undertaken by MUARC (see Figure 3) that analysed all pedestrian fatalities including reversing collisions as a subset of the fatalities, determined that 34 per cent of elderly pedestrian fatalities and hospital admissions were in the age group 75 years or older and the number of fatalities was highest in the age group 80-84 years (15 per cent of all pedestrian deaths), followed by the age group 75-79 years (12 per cent) and the age group 85+ years (8 per cent) (Cassell et al., 2011).

Figure 3: Elderly pedestrian fatalities and hospital admissions (Cassell et al., 2011)

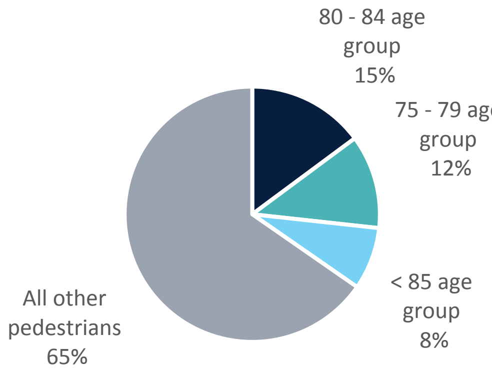


Figure 4: Fatality rate of elderly pedestrians in comparison with all age groups (Cassell et al., 2011)

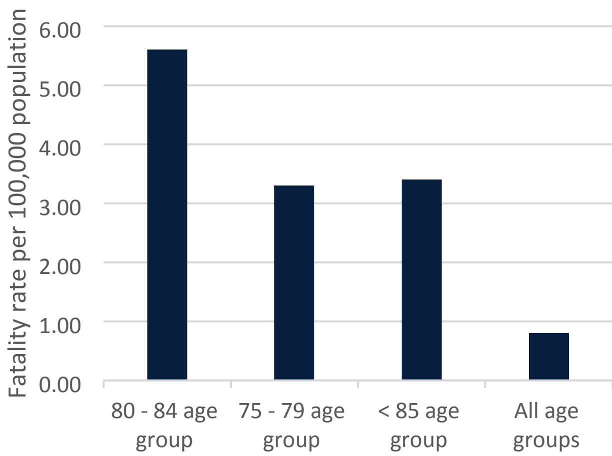


Figure 4 above shows the fatality rate was also the highest in pedestrians aged 80-84 years (5.6 per 100,000) followed by 85+ years (3.4 per 100,000) then persons aged 75-79 years (3.3 per 100,000) (Cassell et al., 2011). This is similar to findings by Oxley et al., (2020) which found that the risk of fatality is 25 per cent for pedestrians aged up to 60 years and 70 per cent for pedestrians aged 60+ years.

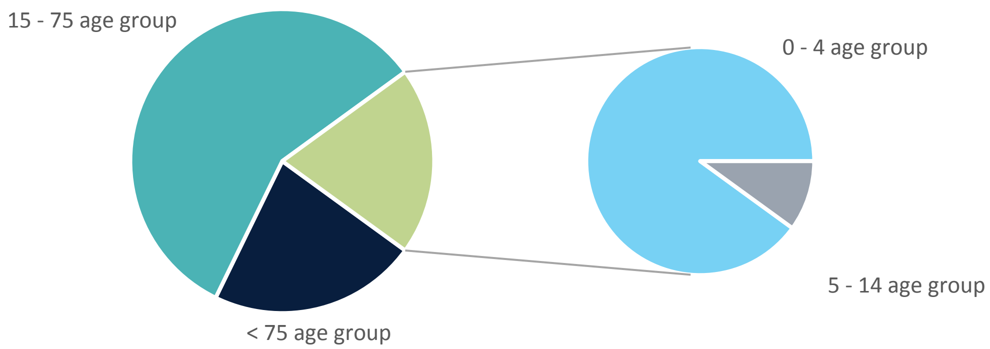
Moreover, hospital admission rates were highest among pedestrians aged 80-84 years and those aged 85 years and older, followed by those aged 75-79 years (Cassell et al., 2010). This is similar to the findings from Oxley et al. (2020) noting that people aged 70 years and older have the greatest risk of injury at 1.6 times higher than young adults (16-39 years), where they make up 15 per cent of all injury cases. Among hospital admissions in Victoria for pedestrian injuries, the head, face and neck (35 per cent) and lower extremity (35 per cent) were the most commonly injured body regions where the major injury types were fractures (46 per cent) and intercranial injuries (14 per cent) (Cassell et al., 2010). The total hospital costs of pedestrian injury admissions over the three years 2006-2008 was $18.3 million ($6.1 million per year) and the average cost of pedestrian admission was $8,525 ($11,561 in 2020 dollar terms) compared with an average cost of $4,721 ($6,402 in 2020 dollar terms) for all causes of unintentional injury combined (Cassell et al., 2010). Cassell et al. (2010) found that the average length of stay of hospital admissions was 4.9 days which grew with increasing age and that the injury severity appeared related to the mass of the vehicle involved in the pedestrian collision. This is similar to results presented by Oxley et al. (2020) which stated that half of hospital admissions were less than 2 days in duration, but 32.5 per cent were for 2-7 days, 14.8 per cent were stays of 8-30 days and 1.9 per cent for hospitalisations extended for more than a month.

1.4.3 Reversing Collisions Involving Children

Reversing collisions, referred to as low speed vehicle run-overs in Griffin et al. (2011), were considered in 1996 to be the largest cause of death after pool drowning for children aged 1- 4 years old (Griffin et al., 2011). A confounding concern is that the driver of the vehicle is usually a parent, relative or family friend. It has been suggested that in 85 per cent of cases the driver may have been unable to see the child behind the vehicle and did not know that the child was close to the vehicle, assuming the child was being looked after elsewhere (Kidsafe Victoria, 2020).

Children comprise 20 per cent of all pedestrian fatalities caused by reversing collisions (Fildes et al., 2014). Children under 5 years old are at the greatest risk – accounting for 90 per cent (see Figure 4) of children killed and 70 per cent of those seriously injured, where many children who survive these incidents sustain severe and permanent injuries (BITRE, 2012).

Figure 5: Pedestrian fatalities by road user age group (BITRE, 2012)



From 1999 to 2009, the incidence of reversing collision events (referred to as low speed vehicle run-overs in Griffin et al. (2014)) among 0 – 15 year olds increased over time (Griffin et al., 2014). The incidence of hospitalisations resulting from reversing collisions decreased over the 11-year period but incidence of non-admissions increased, and in addition no change was observed with the incidence of fatalities (Griffin et al., 2014).

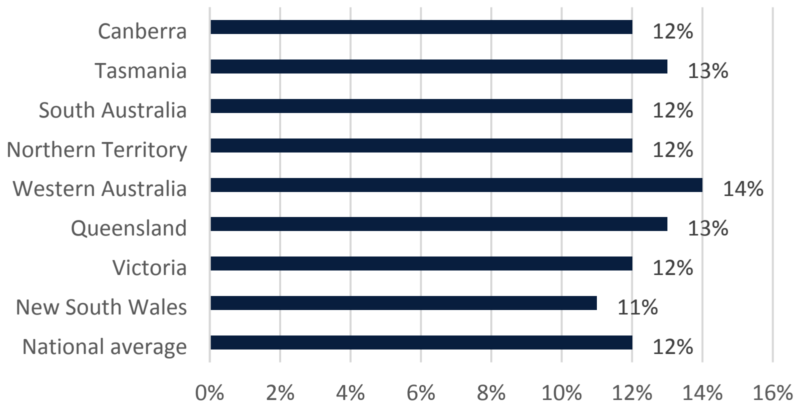
BITRE (2012) reported that 66 pedestrians aged 0 to 14 years were killed in the ten-year period from 2001 – 2010 and 483 seriously injured in the eight-year period from 2002/2003 to 2009/2010 due to being hit by a four-wheeled motor vehicle moving around a home. The fatality rate of pedestrians aged 0 – 4 years was highest (1.0 per 100,000), then aged 5 – 14 years (0.5 per 100,000) (BITRE, 2012). The injury rate of pedestrians aged 5 – 14 years was highest (16.8 per 100,000), then followed by 0 – 4 years (14.3 per 100,000) (BITRE, 2012). Children and their families may not fully recover from serious injuries from reversing collisions, either physically or psychologically (BITRE, 2012). Preventable injuries to children are a significant burden on society and a considerable cost to the health care system, with hospitalisation in

Australia costing approximately $504 million per annum for transport-related injuries (Mitchell et al., 2018) which translates to a cost of $516.5 million per annum in 2020.

1.4.4 Collisions while Reversing

The AAMI Crash Index reveals Australia's most common type of motor vehicle accident. The data looks at claims from one of the largest insurance companies. The 2018 Crash Index showed that collisions while reversing was one of the top five most common types of accidents in Australia at 12 per cent of all crashes (AAMI, 2019). Figure 6 shows the national and jurisdictional average of collisions while reversing as a percentage of all crashes.

Figure 6: Reversing collisions by jurisdiction



1.4.5 Recommended Preventative Measures

Keall et al. (2018) stated that obscured vision from the vehicle represents a major risk factor, noting that vehicles rated with better forward and rearward visibility are less likely to hit a pedestrian. A study of visual ergonomics for a wide range of vehicle types found that even amongst vehicles with a wide visual coverage, a 60 centimetre long test cylinder was visible in the driver's rear mirror only when it was more than 3 metres from the rear of the vehicle, and that it was usually necessary to place the cylinder between 5-10 metres behind the vehicle before it was detectable (Neeman et al. (2002)). It further found that children ranging in height from 66-104 centimetres were not easily detectable at closer proximities by drivers viewing the rear-view mirror.

Fildes et al. (2014) and Fildes et al. (2017) emphasised that the most frequent cause of reversing collision occurred because the driver or the pedestrian failed to look properly during a reversing manoeuvre. They recommended improvements in visibility in addition to providing auditory backing alert on vehicles. The recommended improvements address a contributing factor to pedestrian deaths, i.e. the driver's unsafe or dangerous behaviour including lack of awareness or general failure to keep proper lookout especially when reversing (Cassell et al., 2011).

The design of the vehicle to minimise blind spots and technologies that expand the driver's field of vision are important measures to mitigate and prevent reversing collisions (Neeman et al., 2002). Reversing aids, such as cameras and sensors, reduce the likelihood of reversing collisions and assist parking manoeuvres. The best reversing cameras can cut down on dangerous blind spots and make backing out of the driveway much safer if there are children, small pets or other obstacles present. They also increase visibility of objects that cannot be seen in a conventional rear-view mirror (Fildes et al., 2014). Installing reversing camera systems can reduce reversing collisions by 41 per cent and vehicles with parking sensors are 31 per cent less likely to be involved in a reversing collision (TAC, 2018).

It is possible to fit reversing aids as aftermarket modifications to vehicles in-service, although new vehicles are increasingly fitted with such technologies, with 66 per cent of passenger vehicles fitted as of 2015 (Fildes et al., 2017). However, voluntary fitment of aftermarket technologies is not considered the best way to address the problem. This is chiefly because the performance of these technologies is unknown due to uncertainty about system functionality, whether it is functioning as intended, i.e. properly synchronised and calibrated with the Original Equipment Manufacturer (OEM) systems in the vehicle, given that each aftermarket system has manufacturer specific discrepancies, as well as the overall quality of the system.

Improvements in vehicle safety features to reduce the incidence of reversing collisions are increasingly being adopted in the new vehicle fleet. The Australasian New Car Assessment Program (ANCAP) refers to these safety features as Reversing Collision Avoidance technologies. They include reversing Autonomous Emergency Braking (AEB), Blind Spot Monitoring (BSM) and Emergency Brake Assist. To achieve a 5-star ANCAP safety rating, a vehicle must achieve a sufficiently high score in all tests and feature advanced safety assist technologies (ANCAP, 2020), which could include those mentioned above. Manufacturers increasingly fit safety technologies, such as reversing AEB and Reversing Collision Avoidance on higher-end models. However, these safety features may not be available on more affordable market entry models, and without an agreed benchmark their performance may vary considerably across all vehicle models and brands.

1.5 Government Actions to Address Pedestrian Trauma from Reversing Vehicles

Governments at all jurisdictional levels take actions to address vulnerable road user trauma from reversing vehicles. They include both regulatory and non-regulatory measures, such as public education campaigns, market forces and fleet purchasing policies. Despite such schemes, significant levels of vulnerable road user trauma remains (see Figure 1). It is important to note the reduction in pedestrian trauma since the first quarter of 2020. This may be attributed to the impact of the COVID pandemic on road transport due to lockdowns. During the second quarter of calendar year 2020, estimated vehicle kilometres travelled (VKT) declined by 22 per cent and fatalities declined by 14.0 per cent. In the 3rd and 4th quarters of 2020, both VKT and deaths increased to historical trend levels. Compared to calendar year 2019, there were 6.7 per cent fewer fatalities in 2020.

1.5.1 National Funding for Road Safety Initiatives

Through the Office of Road Safety, the Australian Government allocates dedicated funding for a number of road safety programs. For example, the Road Safety Innovation Fund and the Road Safety Awareness and Enablers Fund provide $12 and $4 million respectively over four years from 2019-2020 to support road safety research and the development of new road safety technologies, and road safety awareness, education and collaboration initiatives, including for the protection of vulnerable road users, such as pedestrians, cyclists and children.

Funding through the Road Safety Awareness and Enablers Fund has been given to promote driveway safety through the Georgina Josephine Foundation by conducting radio advertisements promoting education and encouraging awareness around low speed vehicle run-over incidents effecting children. The target audience is parents and carers of young children and the general motoring public.

Funding through the Road Safety Innovation Fund has been given, amongst others, to:

- HeroSeraph Pty Ltd to research, develop and test a system to detect mobility impaired pedestrians on and in the vicinity of the roadway to increase their safety and promote inclusivity; and
- Little Blue Dinosaur Foundation Limited to learn more about the trends, causes and factors that lead to road trauma in children and then implement trial programs to combat the rise and aim to reduce road trauma to zero.

1.5.2 State and Territory Government Action

State and territory governments target identified vehicle safety concerns such as reversing collisions, pedestrian and driveway safety through investment in research projects, education campaigns and strategic partnerships. Most jurisdictions have committed to 'Towards Zero' through their road safety strategies. The guiding vision is that no person should be killed or seriously injured on Australia's roads: Safe road use, safe people, safe speeds and safe vehicles are the four cornerstones of this vision. Recognising that road safety is a complex issue, the strategies cover a range of actions, including campaigns that target:

- Driver distraction awareness
- Safe driving
- School and community road safety education and
- Drivers to consider new and proven vehicle technology when purchasing a new vehicle.

Specific initiatives that target vulnerable road users in reversing vehicle situations, include:

Northern Territory:

- Government vehicle purchasing policy requires vehicles to have minimum of 5 critical safety features in addition to the 5-star ANCAP rating, one of these is reverse camera/sensors.
- Fact sheets on driveway safety.

Victoria:

- Government vehicle purchasing policy requires vehicles to have minimum of 5 critical safety features in addition to the 5-star ANCAP rating, one of these is reverse camera/sensors.
- Kidsafe Victoria, which is partly funded by the Victorian Government, focus on driveway safety as one of their key features to keep children safe.

New South Wales:

- Transport for NSW has funded the Georgina Josephine Foundation to do a series of media campaigns (TV advertising, online advertising, radio advertising and YouTube educational videos) to provide driveway safety advice to parents, carers and drivers (TfNSW, 2019). The objectives of the campaign are to raise awareness of the safety risks that driveway environments pose to young children, facilitate the use of strategies and countermeasures to help prevent driveway safety incidents and to discourage the use of driveways as play areas (TfNSW, 2019).

Western Australia:

- Launched a media campaign focusing on keeping children safe on the roads, including in driveways in 2020.
- Announced funding in September 2021 for the Constable Care Foundation to develop and deliver to schools, Aurora's House, a new safety school experience to educate children on driveway safety and vehicles reversing across footpaths.

Queensland:

- Released a guideline in 2021 for treating motor conflicts between vehicles and path users at access driveways. The guideline can be used to assess risk at existing sites and at sites where a new access driveway, or active transport infrastructure is proposed.
- Previous initiatives by the department have focused on information campaigns via social media. Between September 2018 and March 2019 a social media campaign was conducted in conjunction with the Family and Child Commission about child safety. Three of the six social media posts were dedicated to reversing on driveways. These posts had a combined reach of 735,000 people. Since then, two additional posts were dedicated to reversing and driveway safety. A post in March 2020 reached 300,000 people, while a follow up post in September 2020 reached 90,500k people. All these posts were boosted (paid) social media posts distributed across Facebook, Twitter and Instagram with the majority of reach generated by Facebook.

1.5.3 National Vehicle Standards

The Australian Government administers the *Road Vehicle Standards Act 2018* (RVSA), which requires that all new road vehicles, whether they are manufactured in Australia or are imported, comply with national vehicle standards known as the Australian Design Rules (ADRs), before they can be offered to the market for use in transport in Australia. The ADRs set minimum national standards for vehicle safety (including reversing aids), emission and anti-theft performance in addition to the use of technological measures to enhance object detection.

Rear-Vision Mirrors

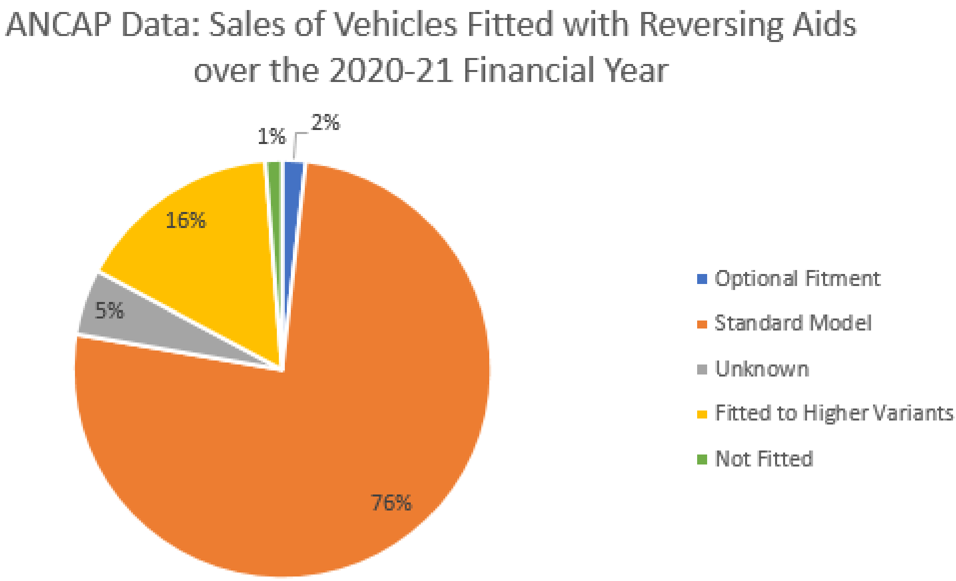
It has long been recognised that assisting the driver improve their visual ergonomics in all types of vehicles and eliminating objects fitted to the interior or exterior of the vehicle that are responsible for significant blind spots in the driver's field of view are important mitigating measures. Rear vision mirrors have been a feature of vehicles from an early date and a national standard has applied since the early 1990s. Australian Design Rule 14/02 – Rear Vision Mirrors (ADR 14/02) is the current version and applies to all road motor vehicles (ADR Category L, M and N). This standard is harmonised with the United Nations Regulation No. 46/05 (UN R46/05).

ADR 14/02 primarily serves to specify requirements for rear vision mirrors and other devices which provide the driver with a clear and reasonably unobstructed view to the rear. This relates to devices used to observe the traffic area in the rearward direction adjacent to the vehicle which cannot be observed by direct vision. The Regulation applies to compulsory and optional devices for indirect vision, for instance mirrors and devices for indirect vision other that mirrors such as camera-monitor systems. The requirement is focused on mirrors and other devices for indirect vision to be fitted in such a way that would not cause the driver to misinterpret the nature of the image perceived, either through changing the field of vision as measured or vibrating.

1.5.4 Australasian New Car Assessment Program (ANCAP)

ANCAP is an independent vehicle safety authority that publishes consumer education information covering 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 and are displayed with a date stamp in order to keep pace with technology developments and to ensure that star ratings reward the most effective technologies. Some vehicles with an older date stamped rating will not have been tested to the latest, most stringent, test protocols. ANCAP works in partnership with 23 member organisations, including the Australian Commonwealth, State and Territory governments.

Where international standards are yet to be developed, or there is not a strong case for implementation in Australia, non-regulatory programs such as ANCAP can be an effective alternative to improve safety. The Government provides substantial funding to ANCAP for this purpose. Government support for ANCAP has been a long standing element in the Safe Vehicles key theme of the NRSS 2011-20 which is continued in the draft Strategy 2021-30. It ensures ANCAP continues to encourage and promote voluntary uptake of the latest vehicle safety technologies ahead of regulation. This is shown below through the increased fitment of reversing aid technologies in vehicles sold over 2020-21 (76% of standard/base model vehicles and 16% of higher variants) as obtained from ANCAP.



1.6 Conclusion

There is a strong commitment by federal, state, territory and local governments to improve road safety in Australia. Nevertheless, the rate of pedestrian trauma from reversing collisions by vehicles remains unacceptably high, despite government goodwill and action.

Current government intervention through the requirements of ADR 14/02 is ineffective in significantly reducing or preventing reversing collisions. Research discussed above at 1.4.4 suggests that increasing the driver's awareness and visibility of vulnerable road users (especially children) behind the vehicle through modern reversing aids to increase rearward awareness and expand visibility would improve road safety outcomes.

2. Why is Government Action Needed?

Australian businesses, governments and road user groups work assiduously towards reducing trauma caused by vehicles. Nevertheless, the impact – economic and psychological – of reversing collisions remain significant. Devices that increase the driver's awareness of vulnerable road users behind the vehicle when reversing can mitigate such trauma. Different technologies have been available and fitted to vehicles over the last decade, partly due to awareness campaigns and advocacy activities by consumer groups, including KidSafe and ANCAP. However, while fitment rate of reversing aids has increased, the design, performance capability and usability varies across vehicle models in the Australian fleet. Where voluntarily fitted systems lack standard capability, consumers are at a disadvantage because they may not know the performance capability of their particular vehicle and gaps remain in the opportunity for reversing aids to reduce vehicle trauma. Regulation is necessary to standardise minimum reversing aid performance requirements and driver interfaces. Furthermore, by setting a standard minimum performance level, regulation can provide cost-effective and maximised fitment in the new Australian vehicle fleet.

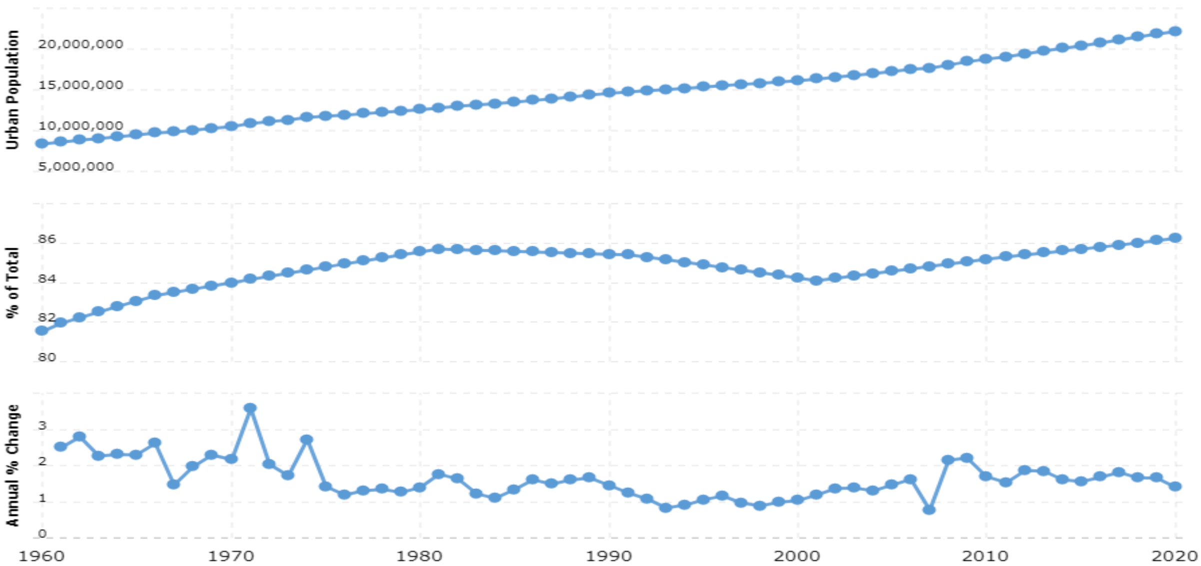
Examining a case for government intervention to increase the fitment of reversing aids may at first appear to be of limited value. Generally, existing high voluntary fitment rates tend to reduce the need to intervene in the market, particularly through regulation. On the other hand, there can be strong advantages to intervention by regulation even at such high voluntary fitment rates. Particularly valuable is certainty about the capability and performance of the safety systems.

2.1 Consumer Knowledge

Government action may be needed where the market fails to provide the most efficient and effective solution to a problem.

Despite the fact that road trauma is an Australian and global concern, there are still unanswered questions about how the number of accidents in urban areas scales with the population size or the population density of a given region. In recent decades the number of motor vehicles in use in Australia has risen from 12.5 million in 2001 to 19.7 million in 2020 (ABS, 2021) leading to an increased exposure to traffic for most people. This motorisation has grown hand in hand with urbanisation. Figure 9 shows that since the late 1950s, the urban population in Australia has increased rapidly, so that in 2020, almost 90 per cent of the population live in urban areas (ABS, 2019).

Figure 7: Urban population growth in Australia (ABS, 2019)



Road vehicles today are complex machines which operate in a high risk environment, leading to numerous deaths and injuries each year. Vehicles are made of multiple, complex and sophisticated mechanical, electrical and electronic components and the average consumer is often unaware of the function of each component and its contribution to the functioning of the vehicle as a whole. For example, a consumer is unlikely to be able to assess the crashworthiness of the vehicle because the structural design determines the degree of occupant protection, with many important components, e.g. side intrusion bars, concealed and overall structural integrity influenced by the mechanical properties, e.g. yield strength, stiffness etc., of materials used, as well as the design geometry, e.g. thickness, width etc., and weld properties. A recent example of a new safety feature being introduced to the Australian fleet with varying performance outcomes is Advanced Emergency Braking (AEB). ANCAP conducted testing on a number of vehicle makes and models summarising that the performance outcomes varies (ANCAP, 2020).

It is therefore difficult for consumers to obtain the information and understanding required to evaluate a vehicle's safety performance and make an informed decision about the appropriate vehicle to purchase. Without any intervention, the consumer would need to inform themselves of all those components to make the best choice. Moreover, some vehicle safety technologies emphasise externalities and might not be prioritised or seen as necessary by consumers, who are likely to focus on their own safety over pedestrian safety.

There is some help available for the consumer to assist with the choice of purchasing a new vehicle, including from ANCAP. Through their five-star rating program ANCAP has incentivised vehicle manufacturers and consumers to prioritise vehicle safety which means that manufacturers provide additional safety features in some vehicles. However, while the current five-star rating program does include reversing collision avoidance technologies, a consumer may not be aware of the performance capabilities of those, such as Reversing AEB, Blind Spot Monitoring or Reversing Collision Avoidance.

To provide a suitable and sufficient risk assessment of vehicles, governments around the world have converged over the past 20-30 years and have collectively leaned towards the use of a combination of regulatory, i.e. mandatory standards, and non-regulatory, e.g. New Car Assessment Programs (NCAPs), performance based tests, as the primary policy to improve safety for vehicle occupants and vulnerable road users.

2.2 Most Effective Vehicle Technology Interventions

Awareness campaigns and advocacy activities focusing on preventing reversing collisions can be effective. However, vehicle technology is more reliable in directly mitigating such collisions by reducing the physical and cognitive demand on drivers by means to enhance their attention to their environment.

The last two decades have seen an increase in the fitment of devices that improves the driver's awareness of their surroundings, such as cameras and sensors. In addition to the driver, these devices detect when a vehicle is getting close to another object or person when reversing.

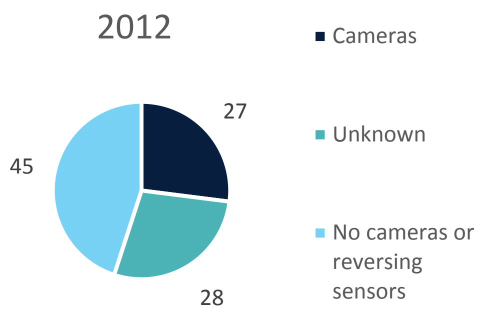
As set out in chapter 1, reversing collisions often have a large impact on the parties involved and the broader community due to fatalities and severe injuries inflicted on very young children and the elderly. The actual number of such collisions may not be frequent but they have assumed a high profile in the general population and often attract significant media coverage. Reversing aids are considered a promising vehicle technology for reducing such trauma. This view is supported in the international vehicle standards development community (WP.29) with the making of a new UN regulation to improve a driver's awareness of vulnerable road users behind vehicles.

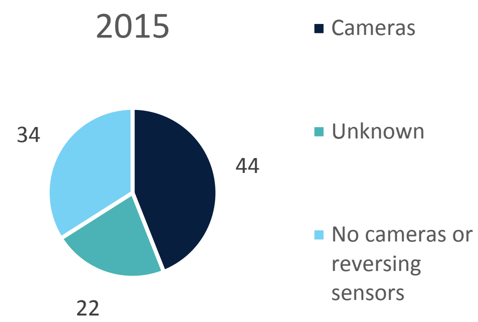
2.3 Availability and Uptake of Reversing Technologies

Some manufacturers have limited new safety systems to flagship models or variants, leaving high-volume entry-level models with less sophisticated safety technologies (Nicholson, 2020). However, fewer OEMs are restricting important new safety features to pricier models which means that safety systems are now extended to standard model vehicles. For example, previously reversing cameras were only found on higher-end models whereas now they are standard on vehicles within a more affordable price range (Nicholson, 2020).

The Royal Automobile Club of Victoria (RACV) reports that the number of reversing cameras in new passenger cars in Australia has been steadily growing with the fitment rate increasing from 27 per cent to 44 per cent between 2012 and

2015 and subsequently the number of vehicles with no reversing technologies (cameras or reversing sensors) fell from 45 per cent to 34 per cent (Fildes et al., 2017). Given the rising availability of reversing cameras on new vehicles, it is expected that the current fitment rate is relatively high for both reversing cameras and parking sensors. As of 2020, a range of safety technologies, including reversing cameras, has been available from which to select to achieve an ANCAP 5-star rating.





The Australian Government implemented mandatory standards for rear-vision mirrors (ADR 14/02) in 1992/93. Any recent amendments to the requirements in UN R46 (assuming alignment with the ADRs) will see manufacturers fitting additional devices for indirect vision in addition to mirrors to give drivers an increased field of vision to the rear of the vehicle. This provides a further net benefit in terms of trauma reductions to consumers as manufacturers are willing to include additional safety technologies to enhance the vehicle’s active safety performance capability.

2.4 Conclusion

The reasons why government should intervene in the market and introduce a new regulation to mandate the fitment of devices for reversing motion in new vehicles have been demonstrated in this and the previous section. In the first section it was demonstrated that despite numerous initiatives by road safety advocates and governments, there are still an unacceptably high rate of people getting killed and seriously injured, especially amongst small children and the elderly. The availability of international standards that Australia can adopt makes it viable to examine the possible introduction of a new regulation to mitigate and prevent such crashes.

3. Policy Options Considered

Two options to reduce the trauma of vulnerable road users from reversing collisions were considered; a non-regulatory option of no intervention and a regulatory option. The exclusion of other alternative options for this regulatory impact assessment considering the introduction of a new vehicle standard was agreed with the Office of Best Practice Regulation in early 2020.

3.1 Available Options

3.1.1 Option 1: No Intervention

Maintain the status of the existing ADR 14/02 and let market forces provide a solution to the problem.

3.1.2 Option 2: Introduce new ADR aligned with UN R158

Mandate a new national road vehicle standard requiring all new light and heavy vehicles provided under the RVSA to fit devices for means of rear visibility and detection that would improve the driver's awareness of vulnerable road users behind vehicles when reversing, based on UN R158.

3.2 Discussion of the Options

3.2.1 Option 1: No Intervention

The Business as Usual (BAU) option represents maintenance of the existing requirements for rear-vision mirrors / indirect vision devices that are set out in ADR 14/02. These have been in force under various arrangements since the early 1970s.

The BAU case primarily relies on the market fixing the problem, the community accepting the problem, or some combination of the two. The absence of a mandatory standard would continue to depend on the effect of information campaigns and ANCAP consumer education to encourage consumers to buy vehicles fitted with reversing aids as standard. The effect of current business and government fleet purchasing policies as well as state and territory government action to prevent reversing collisions is also included in the BAU option.

It has not been possible to obtain accurate data for the voluntary fitment of reversing aids in new vehicles. However, a relatively high fitment rate is estimated in combination with retrofitting of these devices to vehicles in-service. Significant benefits associated with increased voluntary fitment rate of reversing aids as aftermarket modifications in light vehicles are mentioned in Chapter 1 with the existing fitment rate being sufficient to ensure a widespread adoption of these technologies on selected vehicles.

Hence, this option is considered feasible and will be analysed further.

3.2.2 Option 2: Introduce new ADR aligned with UN R158

Australia has a strong history of government actions aimed at increasing the production, availability and consumer uptake of safer vehicles and Australian consumers have come to expect high levels of safety in their vehicles. The Australian Government's intervention to reduce road trauma through such initiatives aims to balance the expectations for safety with the importance of the most efficient and effective means of bringing vehicles to the Australian marketplace at the lowest possible cost. To achieve significant net safety and environmental benefits for the community, actions need to be taken by the Australian Government in accordance with its international obligations to endeavour to align its vehicle standards with international regulations.

The Australian Government would introduce a new ADR under the RVSA based on UN R158. This ADR would apply to the approval and installation of devices for reversing motion (conventional mirrors, rear-view camera system, detection systems or other devices) that would improve the driver's visibility and awareness of vulnerable road users behind vehicles when reversing. As the ADRs only apply to new vehicles supplied to the market, implementation of this option would not affect vehicles already in-service.

3.2.2.1 Background

The UN World Forum for the Harmonization of Vehicle Regulations (WP. 29) is a worldwide regulatory forum that provides the legal framework to establish regulatory instruments concerning motor vehicles and allows for the introduction of innovative vehicle technologies to the market while continuously improving global vehicle safety.

Australia is one of the Contracting Parties (member countries of the United Nations) to the UN Regulations annexed to the 1958 Agreement1 and will be obliged to accept vehicles that comply with the requirements of the new international standard UN Regulation No. 158 (UN R158) titled 'Uniform provisions concerning the approval of devices for reversing motion and motor vehicles with regard to the driver's awareness of vulnerable road users behind vehicles'. The UN Regulations are recognised as the peak international standards available for vehicle safety performance requirements. Most Contracting Parties applying type approval certification systems, such as Australia, would consider UN Regulation under any examination of the case to mandate domestically. This allows for conformity in vehicle production and the mutual recognition of type approvals by the Contracting Parties.

A program of harmonising the ADRs with international standards, as developed through the UN, began in the mid-1980s and has recently been accelerated. Harmonising with UN requirements provides consumers with access to vehicles meeting the latest levels of safety and innovation, at the lowest possible cost. The Australian Government has the capability and experience to adopt, whether by acceptance as alternative standards or by mandating, both UN Global Technical Regulations (GTR) and UN Regulations into the ADRs.

Harmonised Australian requirements would minimise costs associated with reversing technologies development, provides manufacturers the flexibility to incorporate or adapt systems that have already been developed and tested for markets with the same requirements. It would also enable leveraging of testing and certification frameworks already conducted in other markets.

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

The ADRs apply equally to new imported vehicles and new vehicles manufactured in Australia. No distinction is made on the basis of country of origin/manufacture. This is the case under the RVSA, and as implemented since the introduction of the *Motor Vehicle Standards Act 1989*.

3.2.2.2 Summary of UN Regulation No. 158

UN R158 sets performance requirements for reversing aids fitted to vehicles to enhance the driver's vision or awareness when reversing. It was endorsed as a UN Regulation by WP.29 in June 2021. The Regulation introduces requirements for light passenger vehicles, light commercial vehicles, busses and heavy vehicles, vehicles categories M and N corresponding to ADR subcategories MA, MB, MC, MD, ME, NA, NB and NC. The specific purpose of the requirements is to detect objects behind the vehicle that are at least 80 cm tall and 30 cm wide in an area ranging from 20 cm to 1 meter behind the vehicle. The Regulation provides for two main technologies: ultra-sonic sensors and rear-view cameras. In the case of cameras, the Regulation establishes the requirement to ensure visibility of the area from 30 cm to 3.5 meters

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[1] Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be fitted and/or used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the basis of these Prescriptions of March 1958

behind the vehicle. It requires that at least one means of vision or awareness shall be provided to the driver during a backing event.

3.2.2.3 Implementation Timing

The ADRs only apply to new vehicles and typically use a phase-in period to give models that are already established in the market time to change 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 that are already established in the market (all new vehicles), but this varies depending on the complexity of the change and the requirements of the ADR.

The proposed applicability dates under this option are:

- March 2024 for new model vehicles
- March 2026 for all new vehicles

Final implementation dates will be determined by the Government as part of the relevant ADR, following consultation by the department with industry on implementation dates.

4. Likely Net Benefits of Each Option

The policy options outlined in Section 3.1 of the RIS namely; Option 1: No intervention and Option 2: Introduce new ADR aligned with UN R158 were considered viable to analyse further. The result of Option 2 is compared with what would happen if there was no government intervention that is Option 1: No intervention. The overall period of analysis is for the expected life of the policy option, which is around 15 years for regulation and fleet purchasing policies, in addition to the time it takes for benefits to work their way through the fleet, around 26-30 years past the period of intervention to capture the benefits of the last lot of vehicles to be fitted with reversing detection systems when the intervention stops.

4.1 Benefit-Cost Analysis

4.1.1 General

Benefit-cost analysis (BCA) is a useful tool for evaluating the feasibility of implementing new technology, but it does not replace the decision process itself. The model used in this analysis is the Net Present Value (NPV) model. Using this model, the flow of benefits and costs are reduced to one specific moment in time. The time period for which benefits are assumed to be generated is over the life of the vehicle(s). Net benefits include whether the returns (benefits) on a project outweigh the resources outlaid (costs) and indicate what, if any, this difference is. Benefit-cost ratios (BCRs) are a measure of the efficiency of the project. For net benefits to be positive, this ratio must be greater than one. A higher BCR in turn means that for a given cost, the benefits are paid back many times over (the cost is multiplied by the BCR). For example, if a project cost $1m but results in benefits of $3m, the net benefit would be 3-1 = $2m while the BCR would be 3/1 = 3.

In the case of modelling the fitment of additional reversing aids to vehicles, there would be an upfront cost to manufacturers/consumers when the vehicles are first built, in the design of the systems and fitting of the components. Once the vehicles are in use there would be a series of benefits spread throughout the life of the vehicles as the cost of crashes and trauma are reduced. This pattern would be repeated in subsequent years as new vehicles are registered and old vehicles leave the fleet. There may also be ongoing business and government costs through the years, depending on the option being considered.

To achieve compliance with the legislation, it is assumed in the BCA that manufacturers will at least fit parking sensors towards the rear in their new vehicles.

Included benefits focus on the safety benefit from expected reductions in trauma as derived from lives saved and injuries avoided. It should be noted that other benefits, alleviation of grief, anguish and property damage, for example, would also occur but have not been monetised in this RIS. The net benefit and the benefit-cost ratio for each option are therefore conservative estimates.

4.1.2 Benefits

For Option 1, there are no benefits (or costs) as this is the business as usual case.

For Option 2, the benefits were estimated based on the difference between the expected business as usual (BAU) level of compliance, and the level of compliance expected under implementation of regulation – 100 per cent applicable for vehicles once regulation is in force and fully phased-in.

The fitment rate of reversing aids in new passenger vehicles in Australia for the BAU case was obtained from research undertaken by MUARC and the University of Otago (Fildes et al., 2017). RACV reported that the number of reverse cameras in new LPVs in Australia has been steadily growing with the fitment rate increasing from 27 per cent to 44 per cent between 2012 and 2015 and subsequently the number of vehicles with no reversing technologies (cameras or reversing sensors) fell from 45 per cent to 34 per cent (Fildes et al., 2017).

As there was no data available on the fitment rate of reversing aids for LCVs and HVs, the following assumptions were made. It was assumed that the fitment rate at 2012 was almost non-existent, the maximum fitment rate for the year

2020 is 20 per cent across the HV fleet, with an expected fitment rate of 50 per cent by 2037 due to the importation of Japanese models fitted with these technologies. For LCVs, it was assumed that the fitment rate is halfway between the fitment rate of LPVs and HVs, where the fitment rate for LPVs at 2012 was assumed 30 per cent and the maximum fitment rate in 2020 was assumed 70 per cent across the LCV fleet.

Figures 10, 11 and 12 below shows the forecasted percentage of LPVs, LCVs and HVs fitted with reversing technologies over time under the no intervention (BAU case) and if government intervention occurred. The maximum fitment rate through no intervention (BAU case) is 95 per cent of the LCV and LPV vehicle fleet and 50 per cent of the HGV fleet. Without regulation, manufacturers may not fit reversing aids as standard on all future models they produce. Similarly, when purchasing vehicles, some consumers may not purchase vehicles based primarily on safety benefits, especially when the safety benefit does not directly affect any vehicle occupants.

If Option 2 (government intervention) of mandating the installation of reversing aids through regulation is decided, we can expect to see a 100 per cent fitment rate, assuming full compliance.

Effectiveness of the fitment of reversing aids

For the benefit-cost analysis, it is assumed that manufacturers will most likely make their vehicles compliant with the reversing aid legislation through the fitment of the parking sensor at a minimum. Effectiveness estimates for the BAU reversing aids in reducing the likelihood of injuries resulting from reversing collisions were obtained from research conducted by MUARC – in the case of reversing parking sensors only, the effectiveness is 0.69 (Keall et al., 2018).

Figure 8: Percentage of new LPVs fitted with detection systems (such as reversing sensors) under market-driven conditions as BAU case and under government intervention in Australia

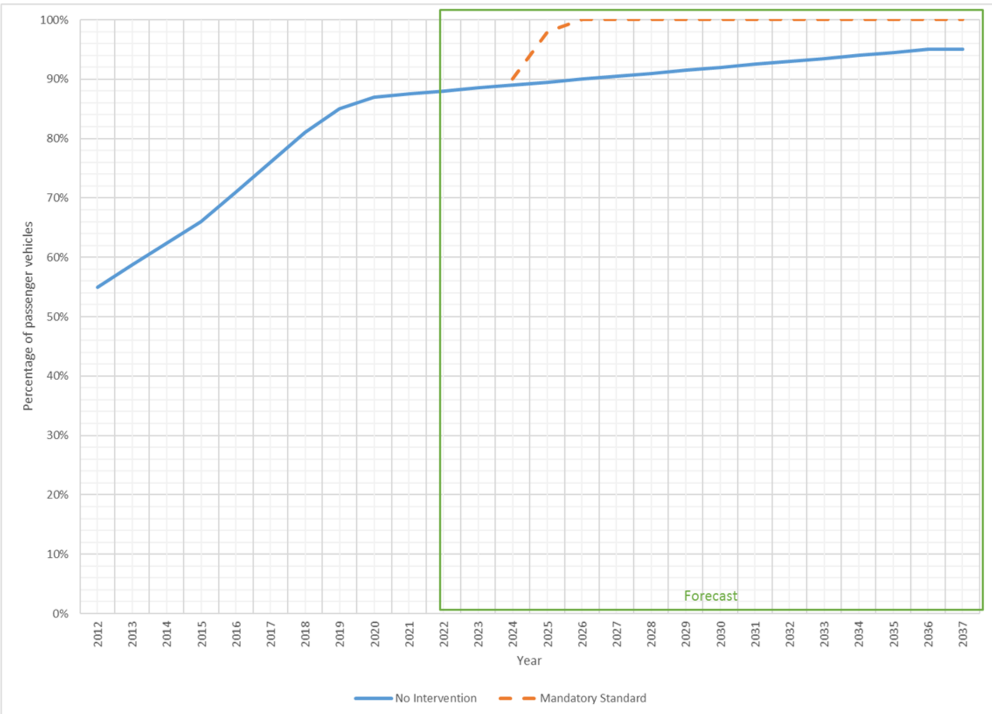


Figure 9: Percentage of new LCVs fitted with detection systems (such as reversing sensors) under market-driven conditions as BAU case and under government intervention in Australia

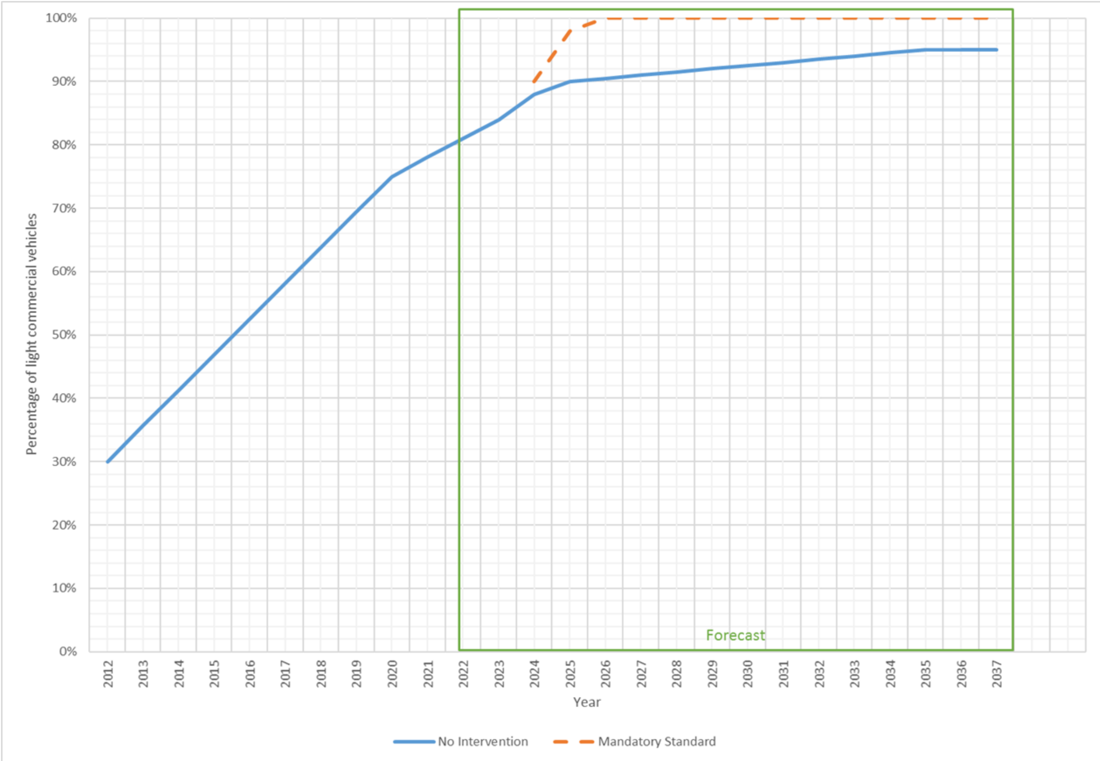
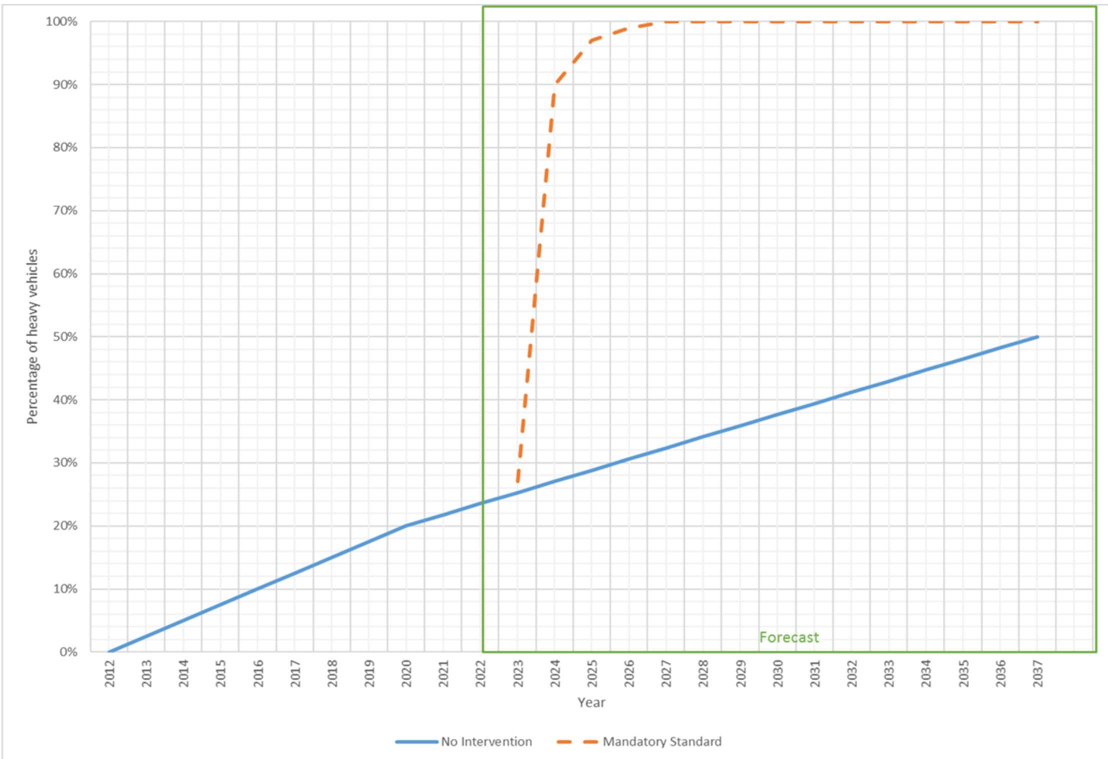


Figure 10: Percentage of new HVs fitted with detection systems (such as reversing sensors) under market-driven conditions as BAU case and under government intervention in Australia



4.1.3 Costs

4.1.3.1 Scope / Applicability

System development costs

Presently there are no ADRs for reversing aids to be tested against. Reversing aids are currently available to be fitted to new vehicles before supply to the market and/or retrofitted to vehicles as an aftermarket modification. These technologies are not spread across the whole vehicle fleet and are only fitted based on consumer demand. It was assumed that the testing of systems to meet performance requirements in UN R158 would be an estimated cost of $10,000 per new model certified each year to mandatory standards.

Costs to fit the systems

Additional fitment costs to vehicles were derived from the wholesale price of reversing sensors available in the market in 2021. It was assumed there would be an estimated cost of $40 for a reversing sensor system per vehicle that would otherwise not have the technology. This cost should not be large enough to affect significantly the range of the vehicle models supplied to the Australian market.

Other business costs

The cost of regulation compliance, including submission of forms / applications and conformity of production audits are based on the department's experience in administering such a system to be $1,500 per new model certified each year to any mandatory standard.

Government costs

It was assumed there would be an estimated annual cost of $50,000 to governments to create, implement and maintain a regulation, as well as state and territory jurisdictions to develop processes for its in-service use such as vehicle modification requirements. This includes the initial development cost as well as ongoing maintenance and interpretation advice. The value of this cost was based on the department's experience.

Table 1: Summary of costs associated with government intervention

Item	Estimated Costs	Cost Impact
Fitment of system	$40 per vehicle	Business
Testing of system to a regulation	$10,000 per model	Business
Regulation compliance	$1,500 per model	Business
Implementing and maintaining regulation	**$50,000 per year**	**Government**

4.1.4 Benefit-Cost Analysis Results

Appendix 3 – Benefit Cost Analysis – Details of Results shows the calculations for the benefit-cost analysis. A summary for the results are provided in Table 2 below. A 7 per cent discount rate was used.

Table 2: Summary of net benefits and costs over 45 years and fatalities and injuries avoided over 37 years under government intervention for LPVs, LCVs and HVs.

Vehicle Type	Net Benefits	Cost to Business	Cost to Government	BCR	Number of Lives Saved	Severe Injuries Avoided	Minor Injuries Avoided
LPVs	$19,219,836	$27,007,770	$455,395	1.70	8	216	96
LCVs	$13,785,679	$7,485,996	$455,395	2.74	2	66	30
HVs	$5,564,150	$10,034,771	$455,395	1.53	2	58	26

4.1.5 Sensitivity Analysis

A sensitivity analysis was carried out to determine the effect on the outcome of various discount rates to the benefit-cost analysis. The costs were considered to be reasonably accurate, being provided through appropriate industry and government sources.

An uncertainty that could adversely affect the options was the assumed 7 per cent discount rate of the benefits and costs. A real discount rate of 3 per cent and 10 per cent were used as a sensitivity check for the BCA. Table 3 below shows that the net benefits are positive under all three discount rates.

Table 3: Impact of changes to the real discount rate on net benefits and the benefit cost ratio for LPVs, LCVs and HVs

Discount Rate	LPVs		LCVs		HVs	
	Net Benefits	BCR	Net Benefits	BCR	Net Benefits	BCR
Low discount rate (3%)	$43,069,913	2.14	$20,062,966	2.99	$10,475,678	1.76
Base case discount rate (7%)	$19,219,836	1.70	$13,785,679	2.74	$5,564,150	1.53
High discount rate (10%)	$10,359,406	1.47	$10,717,349	2.58	$3,545,508	1.40

4.2 Economic Aspects – Impact Analysis

Impact analysis considers the magnitude and distribution of the benefits and costs that have been calculated. It also looks at the impact of the option on the affected parties.

4.2.1 Identification of Affected Parties

In the case of reversing aids, the parties affected by the options are:

Business / Consumers

- Vehicle manufacturers or importers;
- Component suppliers;
- Vehicle owners; and
- Vehicle operators.

The business / consumer parties are represented by several interest groups. Those relevant to the topic of this RIS include the:

- Federal Chamber of Automotive Industries (FCAI), that represents the automotive sector and includes vehicle manufacturers, vehicle importers and component manufacturers / importers;
- Federation of Automotive Products Manufacturers (FAPM), that represents automotive component manufacturers / importers;
- Australian Automobile Association (AAA), that represents vehicle owners and operators (passenger cars and derivatives) through the various automobile clubs around Australia (RACV, RACQ, RAA, NRMA etc.);
- The Australian Livestock and Rural Transporters Association (ALRTA), that represents road transport companies based in rural and regional Australia;
- The Australian Road Transport Suppliers Association (ARTSA), that represents suppliers of hardware and services to the Australian road transport industry;
- The Australian Trucking Association (ATA), that represents trucking operators, including major logistics companies and transport industry associations;
- The Bus Industry Confederation (BIC), that represents the bus and coach industry;
- Commercial Vehicle Industry Association Australia (CVIAA); that represents members in the commercial vehicle industry;
- Heavy Vehicle Industry Australia (HVIA), that represents manufacturers and suppliers of heavy vehicles and their components, equipment and technology; and
- The Truck Industry Council (TIC), that represents truck manufacturers and importers, diesel engine companies and major truck component suppliers.

Governments

- Australian / State and Territory governments and their represented communities
- National Heavy Vehicle Regulator, that regulates heavy vehicles in-service.

4.2.2 Impact of Viable Options

There were two options that were considered feasible for further examination; Option 1: No intervention and Option 2: Introduce a new ADR aligned with UN R158. This section looks at the impact of these options in terms of quantifying expected benefits and costs, and identifies how these would be distributed within the community. This is discussed below and then summarised in Table 4 below.

Option 1: No intervention

In this option the government does not intervene, with market forces instead providing a solution to the problem.

As this option is the business as usual case, there are no new benefits or costs allocated. The benefits and costs of Option 2 are calculated relative to this business as usual case, so that what would have happened anyway in the marketplace is not attributed to any proposed intervention.

Option 2: Introduce new ADR aligned with UN R158

This option mandates standards under the RVSA for devices for reversing motion to avoid reversing collisions for LPVs, LCVs and HVs based on an international standard developed by the UN.

As this option involves direct intervention to compel a change in the safety performance of vehicles supplied to the marketplace, the benefits and costs are those that would occur over and above those determined in Option 1. The mandatory fitment of reversing cameras / electromagnetic parking sensors would no longer be a commercial decision within this changed environment.

4.2.2.1 Benefits

Business

There would be no direct benefit to businesses as a result of a reduction in road trauma caused by vehicles that are sold fitted with reversing aids due to the Australian Government mandating a standard.

There would be an indirect benefit to businesses as a result of the reduction in the number of work days lost due to employees being injured in reversing collisions. There would also be a minor reduction in recruitment, training and development costs associated with the replacement of employees (who are in age groups other than very young or elderly) killed or permanently incapacitated by reversing collisions.

However, there would be significant negative impacts to businesses in the event that a vehicle used for commercial purposes is involved in a reversing collision. This can include financial losses as a result of reputational damage for vehicle manufacturers in addition to affecting the ability of business owners to conduct their trade as the involved vehicle within the corporate fleet can be impounded / destroyed.

Other benefits to business include the creation of a level playing field for all vehicle manufacturers as requirements of the technology are standardised across the new vehicle fleet. This leads to less speculation amongst manufacturers about minimum performance of their specific technology and potentially disappointing consumer expectation if a particular technology is lacking in the vehicle preferred on other grounds.

Consumers

There would be a direct benefit to vehicle owners, their immediate family and the wider community as a result of a reduction in trauma because vehicles would be fitted with reversing aids. Deaths and injuries due to a reversing collision, especially in vulnerable population groups (children and the elderly), would be reduced, lessening the impact on the personal lives of road users, as well as on insurance and other related systems. This benefit was able to be quantified in terms of the benefit-cost ratios determined to be 1.47 – 2.14 for LPVs, 2.58 – 2.99 for LCVs and 1.4 – 1.76 for HVs.

There was an estimated saving of 8 lives, 216 serious injuries and 96 minor injuries over the period of 37 years for LPVs in addition to 2 lives, 66 serious injuries and 30 minor injuries over the period of 37 years for LCVs and 2 lives, 58 serious injuries and 26 minor injuries over the period of 37 years for HVs. See Table 4 below.

Governments

Mandating a standard for reversing aids would provide an indirect benefit to governments through a reduction in road trauma due to avoidance of reversing collisions and provide overall well-being for the community. This benefit was able to be quantified in terms of costs reduced and would be shared between governments and the community.

There would be a monetised benefit of $10.4 – $43.1m, $10.7m – $20.1m and $3.5m – 10.5m over a 15-year life of regulation and 30-year vehicle fleet life (45 years total) for LPVs, LCVs and HVs respectively, making it an overall benefit of $24.6m – $73.7m.

4.2.2.2 Costs

Business / Consumers

There would be a direct cost to businesses / consumers as a result of fitment and testing costs for new vehicles sold with reversing aids. This cost is able to be quantified by the manufacturer and would be passed onto the consumer by businesses.

Testing and fitment would cost between $21.4m – $36.7m, $6.1m – $9m and $8.1m – $12.7m over an assumed 15-year life of regulation for LPVs, LCVs and HVs respectively.

Governments

There would be a cost to governments for developing, implementing and administering a regulation (standard) that requires vehicles to meet the proposed minimum level of safety performance. This would cost approximately $0.4m – $0.6m over an assumed 15-year life of regulation.

4.3 Summary of Benefit-Cost Analysis Results

Table 4: Summary of the benefits and costs of reversing aid technologies over a 45-year period of analysis (15-year life of policy / intervention and 30-year period where the remaining cohort of vehicles fitted with reversing aids in the fleet gradually exit due to crashes or by reaching the end of their service life)

	Option 2: Introduce new ADR aligned with UN R158		Option 1: No Intervention	
	Net Benefits	**Costs**	**Gross Benefits**	**Costs**
Light Passenger Vehicles (LPVs)				
Businesses	None	$21.4m – $36.7m	n/a	n/a
Consumers	Reduced road trauma $10.4m – $43.1m		n/a	n/a
Government		$0.4m – $0.6m	n/a	n/a
Lives Saved	8		n/a	
Severe Injuries Prevented	216		n/a	
Minor Injuries Prevented	96		n/a	
BCR	1.47 – 2.14		n/a	
Light Commercial Vehicles (LCVs)				
Businesses	None	$6.1m – $9m	n/a	n/a
Consumers	Reduced road trauma $10.7m – $20.1m		n/a	n/a
Government		$0.4m – $0.6m	n/a	n/a
Lives Saved	2		n/a	
Severe Injuries Prevented	66		n/a	
Minor Injuries Prevented	30		n/a	
BCR	2.58 – 3		n/a	
Heavy Vehicles (HVs)				
Businesses	None	$8.1m – $12.7m	n/a	n/a
Consumers	Reduced road trauma $3.5m – $10.5m		n/a	n/a
Government		$0.4m – $0.6m	n/a	n/a
Lives Saved	2		n/a	
Severe Injuries Prevented	58		n/a	
Minor Injuries Prevented	26		n/a	
BCR	1.4 – 1.76		n/a	

5. Regulatory Burden and Cost Offsets

The *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)* requires that all new regulatory options are costed using the Regulatory Burden Measurement Framework (RBM). The RBM is a different measure to the full cost benefit analysis as it does not capture the benefits of reduced injury and fatality rates for consumers and the wider community. The average annual regulatory costs were established by calculating the total undiscounted (nominal) cost (including development and fitment costs) for each option over the 10-year period 2024-2034 inclusive, and dividing by 10.

The average annual regulatory costs under the RBM for the two viable options: Option 1: No intervention (Business as Usual) and Option 2: Introduce new ADR aligned with UN R158 are set out below. There are no costs associated with Option 1. The average annual regulatory costs associated with Option 2 is estimated to be approximately $2.9 million, $0.9 million and $1.1 million for LPVs, LCVs and HVs respectively.

Table 5: Regulatory burden and cost offset estimate table – Option 1 (Business as Usual)

Change in costs	Cost to Businesses	Cost to Community Organisations	Cost to Individuals	Total Change in Costs
Total by Sector	-	-	-	-

Table 6: Regulatory burden and cost offset estimate table – Option 2 (Government Action)

Change in costs	Cost to Businesses	Cost to Community Organisations	Cost to Individuals	Total Change in Costs
Total by Sector	**$2,941,447 (LPVs)** **$865,606 (LCVs)** **$1,111,216 (HVs)**	-	-	**$2,941,447 (LPVs)** **$865,606 (LCVs)** **$1,111,216 (HVs)**

The *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)* sets out principles for Australian Government policy makers. One of these principles is that policy makers should consult in a genuine and timely way with affected businesses, community organisations and individuals, as well as other policy makers to avoid creating cumulative or overlapping regulatory burdens. This involves using the RBM Framework to estimate the regulatory compliance burden and to quantify offsets presented in the RIS. Where it is not possible to offset regulatory burdens in the affected sector, offsets should be more broadly targeted within the relevant portfolio. It is anticipated that regulatory savings from further alignment of the ADRs with international standards (UN Regulations) will offset the additional RBM costs of this measure.

6. Consultation

6.1 General

Development of ADRs under the RVSA is the responsibility of the Vehicle Safety Policy and Partnerships Branch of the department. Development of ADRs is carried out in consultation with representatives of the Australian Government, state and territory governments, manufacturing and operating industries, road user groups and experts in the field of road safety.

The department undertakes public consultation on significant proposals. Depending on the nature of the proposed changes, consultation could involve the Technical Liaison Group (TLG), Strategic Vehicle Safety and Environment Group (SVSEG), Infrastructure and Transport Senior Officials' Committee (ITSOC) and the Infrastructure and Transport Minister's Meeting (ITMM).

- TLG consists of technical representatives of government (Australian and state / territory), the manufacturing and operational arms of the industry (including organisations such as the Federal Chamber of Automotive Industries (FCAI) and the Truck Industry Council (TIC) and representative organisations of consumers and road users (particularly through the Australian Automobile Association (AAA) and the Australian Trucking Association (ATA)).
- SVSEG consists of senior representatives of government (Australian and state / territory), the manufacturing and operational arms of the industry and of representative organisations of consumers and road users (at a higher level within each organisation as represented in TLG).
- ITSOC consists of the chief executives of Australian and State / Territory departments of infrastructure, transport and road vehicle administrations.
- ITMM consists of Australian, State / Territory and New Zealand Ministers with responsibility for infrastructure and / or transport matters.

SVSEG and TLG are the principal consultative forums for advising on ADR proposals. Membership of the SVSEG and TLG is shown at Appendix 4 – Strategic Vehicle Safety and Environment Group and Technical Liaison Group.

6.2 Public Consultation

The publication of an exposure draft of the proposal 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 RIS process assist stakeholders in identifying the likely impacts of the proposals and enables more informed debate on any issues.

In line with the *Australian Government Guide to Regulatory Impact Analysis Second edition 2020*, this consultation RIS is published for a six-week public comment period. A summary of public comment input and departmental responses will be included in the Final RIS that is used for decision making by the responsible minister. This RIS will be published on the department's website and distributed to the SVSEG and TLG consultative forums outlined above.

Comment is sought on the following:

- Support for the recommended option.
- Views on the assumptions used for the benefit-cost analysis, including data to support actual effectiveness of the technology, the costs or the assumed benefits.
- The suitability of UN R158 for adoption under the ADRs, including any comments on functional and/or performance requirements, test requirements or implementation, such as the applicable vehicle categories and timing.
- Any other relevant views or information that could assist decision making.

7. What is the Best Option?

The impacts of the following options to estimate the benefits and costs from fitting reversing aid technologies on new vehicles have been examined:

- Option 1: No intervention
- Option 2: Introduce new ADR aligned with UN R158

7.1 Net Benefits

Net benefit (total benefits minus total costs in present value terms) provides the best measure of the economic effectiveness of the options. *The Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)* states that the policy option offering the greatest net benefit should always be the recommended option.

Policy interventions often come at a cost. This RIS obliges us to assess the benefit of the proposed intervention against the burden imposed. If that burden is greater than the benefit, we should look for alternatives or reconsider the need to intervene at all. 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 is the Benefit-cost ratio (BCR). This is a measure of efficiency of the proposed intervention. For net benefits to be positive, this ratio must be greater than one. A higher BCR in turn means that for a given cost, the benefits are paid back many times over (the cost is multiplied by the BCR).

Option 1: No benefits and costs as this is the business as usual case.

Option 2: Under the base case discount rate (7 per cent) introduction of a new ADR aligned with UN R158 had the highest net benefit of the options examined at $19.2m, $13.8m, $5.7m for LPVs, LCVs and HVs respectively over a period of around 45 years, including the assumed 15-year period of regulation followed by a period of around 30 years where the remaining cohort of vehicles fitted with reversing aids in the fleet gradually exit due to crashes or by reaching the end of their service life.

7.2 Benefit Cost Ratios

Option 2 had the highest BCR of 1.7, 2.74, and 1.53 for LPVs, LCVs and HVs under the base case discount rate (7 per cent).

7.3 Casualty Reductions

Option 2 would provide the greatest trauma reduction with 8 lives saved and 216 serious injuries avoided for LPVs, 2 lives saved and 66 serious injuries avoided for LCVs and 2 lives saved and 58 serious injuries avoided for HVs.

7.4 Recommendation

This consultation RIS identified the road safety problem in Australia relating to reversing collisions. The primary countermeasure recommended to prevent or reduce the severity of such collisions are reversing aids. There is already a significant voluntary uptake of this technology as noted earlier in this RIS through the supply of new vehicles and as aftermarket modifications retrofitted to vehicles in-service.

With the recent development of a new international standard for reversing aids, namely UN R158 (Reversing Motion), there is an opportunity to review what can be done to further reduce the trauma associated with these types of crashes in Australia. Introducing a new ADR and establishing a requirement for mandatory fitment of reversing aids in the new vehicle fleet will accelerate fitment rate and force standardisation of system performance requirements among vehicle manufacturers and / or manufacturers of reversing aids. Where international standards for a technology does not exist or where an ADR is not implemented, organisations such as ANCAP help increase the fitment rate of new technologies. It is a requirement now for a new vehicle to have reversing aids to receive a 5-star ANCAP rating.

The BCR for Option 2 is higher than the typical value of around 2.0 for a vehicle safety regulatory proposal. Overall, the positive net benefits and higher than average BCR are because:

- A relatively high proportion of road users (pedestrians) killed in reversing collisions are in vulnerable population groups, namely the elderly and children under 5 years old (note: the median age is around 24 years, so the life years lost are much higher than for all road crashes);
- Highly effective design solutions / countermeasures are available; and
- The incremental cost of the countermeasures (i.e. reversing cameras and / or reversing sensors) most likely used to meet the performance requirements is very low (assumed $40 wholesale price for the majority of vehicle models).

Furthermore, the cost associated with fitment of reversing aids would be minimised through closely aligning with the requirements prescribed in UN R158. This provides vehicle manufacturers flexibility to use systems that have already been developed and tested by their suppliers (manufacturers of reversing aids) without additional costs incurred from research and development. It is highly feasible for manufacturers to meet this regulation given the latest capability of in-vehicle technology in addition to the widespread availability of these technologies in the market.

Option 2 offers the important advantage to all road users of guaranteeing 100 per cent fitment of reversing aids as standard to all new vehicles sold. There would be no guarantee that non-regulatory measures, such as Option 1 would deliver an enduring result, or that the predicted fitment rate of such technologies would be reached and maintained. Monitoring the market in the absence of a mandatory standard would bring added complications such as defining what the performance criteria should be, setting the lower limit in the market at which point intervention would have to be reconsidered, and determining what minor digressions, if any, would be tolerated.

According to the *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)* the policy option offering the greatest net benefit should be the recommended option. Option 2 represents an effective and robust option that would guarantee an ongoing provision of reversing collision avoidance measures in the new light and heavy vehicle fleet in Australia. Therefore, Option 2 is the recommended option.

7.5 Scope of the Recommended Option

UN R158 applies to vehicles of UN categories M (power-driven vehicles having at least four wheels and used for the carriage of passengers), and N (power-driven vehicles having at least four wheels and used for the carriage of goods). This translates to Australian vehicle categories MA (passenger car), MB (forward-control passenger vehicle), MC (off-road passenger vehicle), MD (light omnibus), ME (heavy omnibus), NA (light goods vehicle), NB (medium goods vehicles) and NC (heavy goods vehicles).

7.6 Timing of the Recommended Option

The indicative implementation timetable for consultative purposes is:

- March 2024 for applicable new model vehicles
- March 2026 for all applicable new vehicles

8. Implementation and Evaluation

New ADRs or amendments to the ADRs are determined by the responsible minister under Section 12 of the RVSA. As Australian Government regulations, ADRs are subject to review every ten years, as resources permit. This ensures that they remain relevant, cost effective and do not become a barrier to the importation of safer vehicles and vehicle components. This new ADR would be scheduled for a full review on an ongoing basis and in line with this practice.

As noted in this consultation RIS, an ADR for reversing aids would be fully harmonised with the newly developed UN R158. Following public consultation of the RIS, the final implementation dates will be determined as part of the ADR, following consultation by the Department with industry and decision by the Minister.

9. Conclusion and Recommended Option

Reversing collisions presents a significant concern due to the relatively high injury risk from the close proximity and the impact to a vulnerable road user from the rear of the vehicle. A predominantly high proportion of vulnerable road users killed or seriously injured in reversing collisions are in particularly vulnerable population groups, namely the elderly and children, especially those under 5 years old. This is attributed to limited rearward visibility and lack of driver awareness of the vulnerable road user when reversing. The number of fatalities and serious injuries are most likely underestimated because they frequently occur on private roads, such as carparks or driveways which is outside the scope of official road injury record systems, that focuses on public roads (Keall et al., 2018).

Australia has previously adopted ADR 14/02 – Rear Vision Mirrors as a national standard for all road vehicles, which is aligned with the international standard UN R46/05. ADR 14/02 specifies requirements for rear vision mirrors and other indirect vision devices to provide the driver with a clear and reasonably unobstructed view to the rear. However, the ADRs do not specifically address risk factors contributing to reversing collisions as there is no mandate for the fitment of reversing aids, such as rear view camera systems to new vehicles.

Voluntary efforts by manufacturers and consumer organisations to increase the fitment of reversing aids, such as reversing cameras and sensors, on new vehicles and in-service as an aftermarket modification, have not significantly reduced the likelihood of reversing collisions. Moreover, these initiatives are largely unregulated and have insufficient impact on the entire fleet. Specific concerns arising from aftermarket modifications include uncertainties as to whether the system is functioning as intended (properly synchronised and calibrated with the existing system in the vehicle) and whether the overall quality of the system is effective given the system has manufacturer specific discrepancies. There are also no existing performance criteria to which the reversing aids must demonstrate compliance. Hence, the introduction of an ADR would not only increase fitment rates across the entire vehicle fleet but would also demand improvements in existing technologies and, as a result, increase the effectiveness of the technology as a safety measure to reduce road trauma.

This consultation RIS examined the case for Australian Government intervention to improve future light and heavy vehicle countermeasures to reduce trauma caused by reversing collisions. It identifies significant benefits through implementation of a mandatory standard, which would not otherwise be realised through the business as usual approach.

The benefit-cost analysis found that there was a case for the mandatory fitment of reversing aid technologies for light and heavy vehicles through government intervention in the form of a new ADR based on the newly developed UN R158. The analysis showed that government intervention would result in an estimated 8 lives saved and 216 serious injuries avoided for LPVs, 2 lives saved and 66 serious injuries avoided for LCVs and 2 lives saved and 58 serious injuries avoided for HVs.

The likely benefit-cost ratio is 1.7, 2.74 and 1.53 for LPVs, LCVs and HVs respectively, which is relatively high. The likely net benefits estimated are approximately $19.2m, $13.8m, $5.7m for LPVs, LCVs and HVs respectively.

According to the *Australian Government Guide to Regulatory Impact Analysis Second Edition (2020)*, the policy option offering the greatest net benefit should be the recommended option. Therefore, Option 2: Introduce a new ADR aligned with UN R158 is the recommended option. Under this option, the fitment of reversing aid technologies would be mandated for LPVs, LCVs and HVs as a result of the performance requirements of a new ADR.

This consultation RIS will be released for a six-week public comment period. The feedback received during the public consultation will be considered and included in the Final RIS to be published by the Office of Best Practice Regulation.

The indicative implementation timetable for consultative purposes is:

- March 2024 for applicable new model vehicles (M and N category vehicles)
- March 2026 for all applicable new vehicles (M and N category vehicles)

The Australian Government would absorb much of the cost of administering the ADR through the new vehicle certification under the *Road Vehicle Standards Act 2018.*

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Appendix 1 – Vehicle Categories

A two-character vehicle category code is shown for each vehicle category. This code is used to designate the relevant vehicles in the national standards, as represented by the ADRs, and in related documentation.

Passenger Vehicles (other than Omnibuses)

PASSENGER CAR (MA)

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.

FORWARD-CONTROL PASSENGER VEHICLE (MB)

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.'*

OFF-ROAD PASSENGER VEHICLE (MC)

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

(a) Unless otherwise *'Approved'* has 4 wheel drive; and
(b) has at least 4 of the following 5 characteristics calculated when the vehicle is at its *'Unladen Mass'* on a level surface, with the front wheels parallel to the vehicle's longitudinal centreline, and the tyres inflated to the *'Manufacturer's'* recommended pressure:
    (i) *'Approach Angle '*of not less than 28 degrees;
    (ii) *'Breakover Angle'* of not less than 14 degrees;
    (iii) *'Departure Angle'* of not less than 20 degrees;
    (iv) *'Running Clearance'* of not less than 200 mm;
    (v) *'Front Axle Clearance', 'Rear Axle Clearance'* or *'Suspension Clearance'* of not less than 175 mm each.

Omnibuses

A passenger vehicle having more than 9 seating positions, including that of the driver.

An omnibus comprising 2 or more non-separable but articulated units shall be considered as a single vehicle.

LIGHT OMNIBUS (MD)

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

HEAVY OMNIBUS (ME)

An omnibus with a *'Gross Vehicle Mass'* exceeding 5.0 tonnes

Goods Vehicles

A motor vehicle constructed primarily for the carriage of goods and having at least 4 wheels; or 3 wheels and a *'Gross Vehicle Mass'* exceeding 1.0 tonne.

A vehicle constructed for both the carriage of persons and the carriage of goods shall be considered to be primarily for the carriage of goods if the number of seating positions times 68 kg is less than 50 per cent of the difference between the *'Gross Vehicle Mass'* and the *'Unladen Mass'.*

The equipment and installations carried on certain special-purpose vehicles not designed for the carriage of passengers (crane vehicles, workshop vehicles, publicity vehicles, etc.) are regarded as being equivalent to goods for the purposes of this definition.

A goods vehicle comprising 2 or more non-separable but articulated units shall be considered as a single vehicle.

LIGHT GOODS VEHICLE (NA)

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

MEDIUM GOODS VEHICLE (NB)

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

HEAVY GOODS VEHICLE (NC)

A goods vehicle with a *'Gross Vehicle Mass'* exceeding 12.0 tonnes.

Sub-categories of Vehicle Categories

FORWARD-CONTROL PASSENGER VEHICLE (MB)

MB1 up to 2.7 tonnes *'GVM'*

MB2 over 2.7 tonnes *'GVM'*

OFF-ROAD PASSENGER VEHICLE (MC)

MC1 up to 2.7 tonnes *'GVM'*

MC2 over 2.7 tonnes *'GVM'*

LIGHT OMNIBUS (MD)

MD1 up to 3.5 tonnes *'GVM',* up to 12 *'Seats'*

MD2 up to 3.5 tonnes *'GVM',* over 12 *'Seats'*

MD3 over 3.5 tonnes *'GVM',* up to 4.5 tonnes *'GVM'*

MD4 over 4.5 tonnes *'GVM',* up to 5 tonnes *'GVM'*

MD5 up to 2.7 tonnes *'GVM'*

MD6 over 2.7 tonnes *'GVM'*

LIGHT GOODS VEHICLE (NA)

NA1 up to 2.7 tonnes *'GVM'*

NA2 over 2.7 tonnes *'GVM'*

MEDIUM GOODS VEHICLE (NB)

NB1 over 3.5 tonnes, up to 4.5 tonnes *'GVM'*

NB2 over 4.5 tonnes, up to 12 tonnes *'GVM'*

Appendix 2 – Benefit-Cost Analysis Methodology

The model used in this analysis was the Net Present Value (NPV) model. The costs and expected benefits associated with government intervention (Option 2) were summed over time relative to the BAU case (Option 1). The further the cost or benefit occurred from the nominal starting date, the more they were discounted. The analysis was broken up into the following steps.

1. National Passenger Vehicles (PV), SUV, LCV and heavy vehicles (HV) sales were established using the Federal Chamber of Automotive Industries (FCAI) Vendor Field Analytical and Characterisation Technologies System (VFACTS) data for each year between 2009 and 2020. Extrapolated numbers to 2067 assuming average growth/decline per-annum of new vehicle sales over this period were then used to estimate future LPV, LCV and HVs sales for each year of intervention.

2. The number of registered LPVs, LCVs and HVs nationally were established using the ABS motor vehicle census data for each calendar year between 2009 and 2020. Average per-annum increases in the number of registered vehicles over this period were then used to estimate future numbers of registered LPVs, LCVs and HVs for the period from 2023 to 2067 for each year of intervention.

3. The mandatory fitment increase of reversing aids at sale under government intervention (Option 2) in comparison to BAU (Option 1) in new LPVs, LCVs and HVs were determined for each year from 2024 to 2067 (15-year policy period and 30-year life of vehicle). The difference in fitment is calculated to determine the fitment increase from government intervention at point of sale.

4. Taking the mandatory fitment increase of reversing aids at sale from government intervention from 2024 to 2067 multiplied by the likelihood of a vehicle of a given age being involved in a reversing collision, the total number of vehicles fitted with reversing aids can be determined (relative to vehicle age and year from first fitment at 2024). The total number of vehicles fitted with reversing aids is also used as the number of trauma crashes affected assuming a single vehicle is involved in a single crash.

5. The annual number of occupant fatalities and serious injuries in reversing collisions by vehicle age for the new registered LPV, LCV and HVs fleet were determined using the crash frequency by age data reported in Fitzharris and Stephan (2013). The total deaths and hospitalisation from the 12-month period ending March 2021 reported from BITRE (2021) was used assuming one crash per vehicle to be conservative.

6. The casualty crash rate was calculated using the rate of occupant fatalities and serious injuries in reversing collisions by vehicle age per annum divided by the total number of vehicles registered (ABS, 2020).

7. The likelihood of a vehicle of a given age being involved in a reversing collision was estimated as a function of the total number of LPVs, LCVs and HVs registered. This was calculated by multiplying the total number of LPVs, LCVs and HVs registered from 2024 to 2067 (prediction) with the casualty crash rate by vehicle age divided by the annual LPV registration rate from 2024 to 2067 by vehicle age.

8. The fitment rate of reversing aids (camera-monitor devices for indirect vision and / or the electromagnetic parking sensors) on new passenger vehicles in Australia from Fildes et al. (2017) were used to establish the effectiveness of the system (in reducing fatalities and serious injuries in reversing collisions) for vehicles sales on a BAU case (Option 1) and government intervention (Option 2).

9. The fitment cost of $40 for sensors only refers to the wholesale cost of sensor fitment. The fitment cost for ultrasonic backup sensors are the minimum for manufacturers to ensure compliance with the legislation.

10. The number of reversing collisions from LPV, LCV and HV trauma crashes that can be prevented for each year between 2024 and 2067 due to new LPVs and LCVs entering the fleet with reversing aids was estimated.

11. The total savings from government intervention (Option 2) over BAU (Option 1) was determined using the total cost per trauma multiplied by the effectiveness of reversing aids on all trauma and the proportion of fatalities that occur from reversing collisions from 2024 to 2067 (15-years policy period and 30-years life of vehicle).

12. The effect of reversing aids on road trauma is 0.003933 and is obtained by multiplying the effectiveness of the technology in reducing all sensitive trauma and the sensitivity of the crash. The sensitivity calculated is 0.0057 using the rate of killed and serious injuries (KSI) from research conducted by MUARC (Fildes et al., 2014) divided by the total number of deaths and hospitalisations per year from BITRE (2021). The effectiveness of the technology in reducing all sensitive trauma obtained from Keall et al. (2018) is 0.69 assuming at a minimum that manufacturers will only install reversing sensors on their vehicles to comply with the government's proposed reversing aids legislation.

13. The total cost of trauma is the sum of the cost of fatalities, serious injuries and minor injuries. The cost of fatalities, serious injuries and minor injuries is obtained by respectively multiplying the unit cost of fatalities, serious injuries and minor injuries under NPV by the proportion of fatalities, serious injuries and minor injuries from reversing collisions per year relative to the total population of Australia. NPV costs can be determined from the 2020 inflation rate provided by the Reserve Bank of Australia (RBA).

14. The proportion of fatalities, serious injuries and minor injuries from reversing collisions per year relative to the total population of Australia was calculated using crash data showing deaths and serious injuries per state from research undertaken by MUARC (Fildes et al., 2014) over a 10-year period from 2000 – 2010. The number of fatalities and serious injuries in all states were summed up and the results from the sample population were scaled up to the total population size in Australia.

15. The unit cost of serious injuries and minor injuries was obtained from BITRE (2009) as of 2006. The unit cost of a fatality was calculated based on the typical fatality age and the average life years lost as of 2007.

16. The typical fatality age of 4 years is used since for reversing accidents children under 5 years old are at the greatest risk – accounting for 90 per cent of children killed and 70 per cent of those seriously injured, where many children who survive these incidents sustain severe and permanent injuries (BITRE, 2012).

17. Total annual costs associated with the implementation of government intervention (Option 2) for business and government were determined using the system development costs (per vehicle mode), fitment of system (per vehicle supplied), regulatory compliance costs (per vehicle model) and government and regulation costs (per year of regulatory intervention) outlined in Section 4 over the 15-year policy period. It was also assumed that the 10 major brands for passenger cars produce an average of 1 new model every 3 years – hence 0.33 of a new model per year.

18. The total annual financial benefits associated with implementation of government intervention (Option 2) were determined by subtracting the costs incurred by businesses and governments from the net savings from government intervention over the BAU case.

19. For government intervention (Option 2) all calculated annual benefit and cost values were discounted and summarised, to determine the net present value of the total costs to business and government, and the net benefit to society. A real discount rate of 7% was assumed, this being in line with OBPR recommendations. A discount rate of 3% and 10% were used for sensitivity analysis for the recommended option.

20. The BCR was calculated for the discount rates above by determining the ratio of the NPV saved over the NPV costs incurred from government intervention.

Appendix 3 – Benefit-Cost Analysis – Details of Results

1. The trend in new passenger vehicles (PV), sports utility vehicles (SUV), LCV and HV sales for the years 2009 to 2020 was established using data from FCAI VFACTS. Note: SUV is considered as a LPV but it is classified separately in VFACTS data.

2. The data to 2067 was extrapolated by period assuming an average of 7.19% decline for PVs, 8.76% growth for SUVs, 1.33% growth for LCVs and 2.33% growth for HVs ongoing per-annum to determine the forecasted total number of sales for LPVs, LCVS and HVs. This average of percentage growth / decline was determined from the yearly percentage growth / decline from years 2009 – 2020 using the FCAI VFACTS data. Note that an end limit of 2038 is used for graphical representation of vehicle sales as shown in Figure 1 assuming that the actual and forecasted trend for vehicle sales is ongoing until 2067.

Table 1: Actual and predicted new vehicle sales from 2009 to 2067 (source: FCAI VFACTS New Vehicle Sales 2009-2020)

Year	Total PVs	Total SUVs	Total LCVs	Total LPVs = (Total PVs + Total SUVs)	Total HVs	Sum of LPVs, LCVs and HVs
2009	540562	188153	181058	728715	27555	937328
2010	592122	235285	179553	827407	28614	1035574
2011	559314	244136	176940	803450	28261	1008651
2012	576855	307253	197331	884108	31648	1113087
2013	566454	333511	203838	899965	31696	1135499
2014	531596	352347	197372	883943	31325	1112640
2015	515683	408471	198464	924154	32184	1154802
2016	486257	441017	217168	927274	32968	1177410
2017	450012	465646	236127	915658	36849	1188634
2018	378413	495300	238590	873713	41426	1153729
2019	315875	483338	225353	799213	37969	1062535
2020	222103	454701	205271	676804	34567	916642
2021	206132	494536	208006	700668	35373	944046
2022	191309	537861	210777	729170	36197	976144
2023	177552	584982	213585	762534	37041	1013160
2024	164785	636230	216430	801015	37905	1055350
2025	152935	691969	219314	844904	38788	1103006
2026	141938	752590	222235	894528	39692	1156456
2027	131731	818523	225196	950254	40618	1216068
2028	122258	890232	228196	1012490	41564	1282251

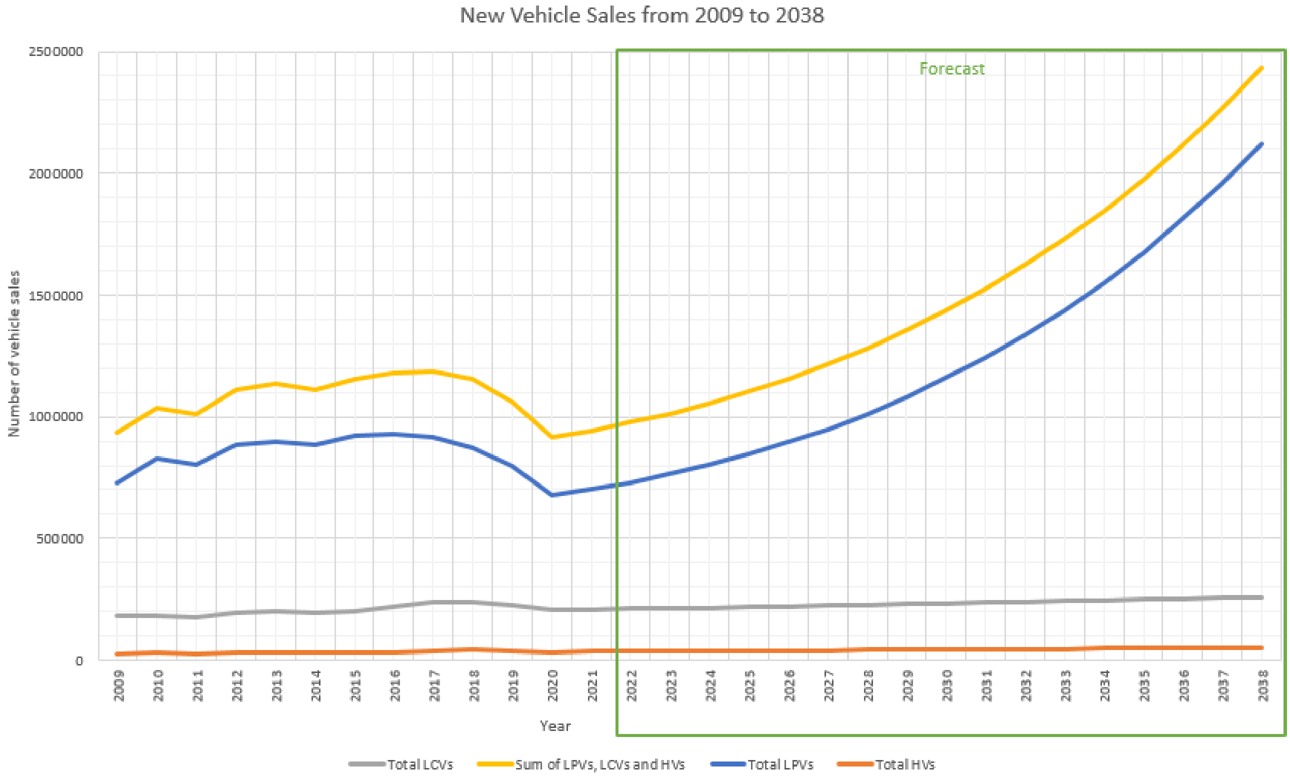
Year	Total PVs	Total SUVs	Total LCVs	Total LPVs = (Total PVs + Total SUVs)	Total HVs	Sum of LPVs, LCVs and HVs
2029	113467	968222	231236	1081689	42533	1355459
2030	105308	1053046	234317	1158353	43525	1436195
2031	97735	1145300	237439	1243035	44539	1525013
2032	90707	1245637	240602	1336344	45578	1622524
2033	84184	1354764	243807	1438948	46640	1729396
2034	78131	1473451	247055	1551582	47727	1846365
2035	72512	1602537	250347	1675049	48840	1974236
2036	67298	1742930	253682	1810229	49978	2113889
2037	62459	1895624	257062	1958083	51143	2266288
2038	57967	2061695	260486	2119662	52336	2432484
2039	53799	2242314	263957	2296113	53555	2613625
2040	49930	2438757	267473	2488688	54804	2810965
2041	46340	2652411	271036	2698750	56081	3025868
2042	43008	2884781	274647	2927789	57389	3259825
2043	39915	3137509	278306	3177424	58726	3514457
2044	37045	3412378	282014	3449423	60095	3791532
2045	34381	3711328	285771	3745708	61496	4092976
2046	31909	4036467	289578	4068376	62930	4420884
2047	29614	4390091	293436	4419705	64397	4777538
2048	27485	4774696	297345	4802180	65898	5165423
2049	25508	5192994	301307	5218502	67434	5587243
2050	23674	5647938	305321	5671612	69006	6045939
2051	21972	6142739	309388	6164711	70614	6544714
2052	20392	6680889	313510	6701280	72261	7087051
2053	18925	7266183	317687	7285109	73945	7676741
2054	17564	7902755	321919	7920319	75669	8317907
2055	16301	8595094	326208	8611395	77433	9015036
2056	15129	9348087	330554	9363217	79238	9773008
2057	14041	10167049	334958	10181090	81085	10597132
2058	13032	11057757	339420	11070788	82975	11493183

Year	Total PVs	Total SUVs	Total LCVs	Total LPVs = (Total PVs + Total SUVs)	Total HVs	Sum of LPVs, LCVs and HVs
2059	12094	12026498	343942	12038592	84909	12467443
2060	11225	13080107	348524	13091332	86888	13526744
2061	10418	14226021	353167	14236438	88914	14678519
2062	9668	15472325	357872	15481993	90986	15930852
2063	8973	16827814	362640	16836787	93107	17292535
2064	8328	18302055	367471	18310382	95278	18773131
2065	7729	19905449	372367	19913178	97499	20383043
2066	7173	21649313	377327	21656486	99771	22133585
2067	**6657**	**23545952**	**382354**	**23552609**	**102097**	**24037061**

Table 2: Percentage growth / decline of new vehicles sales from 2009 to 2020 (source: FCAI VFACTS New Vehicle Sales 2009-2020)

Year	PV	SUV	LCV	HV
2009	-	-	-	-
2010	9.54%	25.05%	-0.83%	3.84%
2011	-5.54%	3.76%	-1.46%	-1.23%
2012	3.14%	25.85%	11.52%	11.98%
2013	-1.80%	8.55%	3.30%	0.15%
2014	-6.15%	5.65%	-3.17%	-1.17%
2015	-2.99%	15.93%	0.55%	2.74%
2016	-5.71%	7.97%	9.42%	2.44%
2017	-7.45%	5.58%	8.73%	11.77%
2018	-15.91%	6.37%	1.04%	12.42%
2019	-16.53%	-2.42%	-5.55%	-8.35%
2020	-29.69%	-5.92%	-8.91%	-8.96%
Average	**-7.19%**	**8.76%**	**1.33%**	**2.33%**

Figure 1: Actual and forecasted total sales of LPVs, LCVs and HVs from 2009 to 2038



3. The trend in the total number of LPVs, LCVs and HVs registered for the years 2009 – 2020 was established from ABS Motor Vehicle Census data. Extrapolate data to 2067 by period assuming 1.85% growth for LPVs, 3.39% growth LCVs and 1.40% growth for HVs ongoing per-annum. Note that an end limit of 2038 is used for graphical representation of vehicle registration as shown in Figure 2 assuming that the actual and forecasted trend for vehicle registration is ongoing until 2067.

Table 3: Actual and predicted new vehicle registered from 2009 to 2067 (source: ABS Motor Vehicle Census 2009 – 2020)

Year	Total LPVs	Total LCVs	Total HVs
2009	12023098	2371082	421702
2010	12269305	2460568	431278
2011	12474044	2530630	318223
2012	12714235	2617799	322115
2013	13000021	2717673	325998
2014	13297260	2824053	329464
2015	13549449	2907006	331699
2016	13820437.98	2985495.162	334684.291

Year	Total LPVs	Total LCVs	Total HVs
2017	14083026.3	3078045.512	341043.293
2018	14336520.78	3185777.105	346499.985
2019	14508559.02	3313208.189	353429.985
2020	14682661.73	3405978.018	358378.005
2021	14954958.37	3521471.637	363395.297
2022	15232304.87	3640881.539	368482.831
2023	15514794.89	3764340.522	373641.591
2024	15802523.81	3891985.887	378872.573
2025	16095588.8	4023959.59	384176.789
2026	16394088.81	4160408.401	389555.264
2027	16698124.64	4301484.068	395009.038
2028	17007798.95	4447343.482	400539.164
2029	17323216.31	4598148.857	406146.712
2030	17644483.23	4754067.904	411832.766
2031	17971708.19	4915274.025	417598.425
2032	18305001.69	5081946.499	423444.803
2033	18644476.27	5254270.685	429373.03
2034	18990246.55	5432438.227	435384.253
2035	19342429.31	5616647.269	441479.632
2036	19701143.45	5807102.672	447660.347
2037	20066510.11	6004016.244	453927.592
2038	20438652.66	6207606.977	460282.578
2039	20817696.77	6418101.286	466726.534
2040	21203770.42	6635733.266	473260.706
2041	21597003.98	6860744.949	479886.356
2042	21997530.23	7093386.573	486604.765
2043	22405484.43	7333916.863	493417.231
2044	22821004.32	7582603.316	500325.073
2045	23244230.22	7839722.502	507329.624
2046	23675305.04	8105560.365	514432.238
2047	24114374.33	8380412.548	521634.29

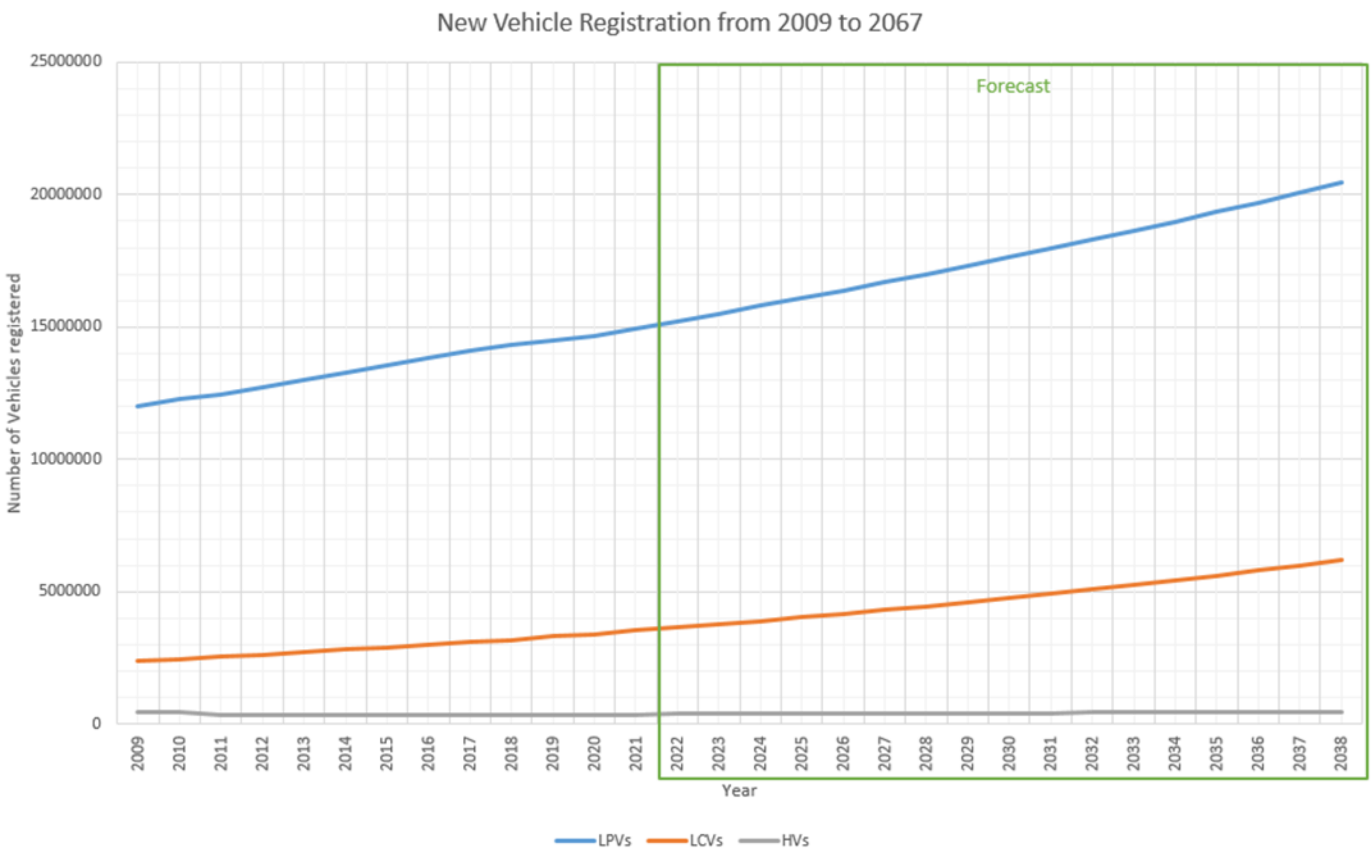
Year	Total LPVs	Total LCVs	Total HVs
2048	24561586.36	8664584.719	528937.17
2049	25017092.15	8958392.91	536342.29
2050	25481045.49	9262163.869	543851.082
2051	25953603.06	9576235.426	551464.997
2052	26434924.43	9900956.864	559185.507
2053	26925172.12	10236689.31	567014.104
2054	27424511.67	10583806.14	574952.302
2055	27933111.71	10942693.38	583001.634
2056	28451143.96	11313750.17	591163.657
2057	28978783.36	11697389.15	599439.948
2058	29516208.07	12094036.98	607832.107
2059	30063599.56	12504134.78	616341.757
2060	30621142.68	12928138.63	624970.542
2061	31189025.69	13366520.05	633720.129
2062	31767440.35	13819766.6	642592.211
2063	32356581.97	14288382.32	651588.502
2064	32956649.49	14772888.37	660710.741
2065	33567845.54	15273823.59	669960.691
2066	34190376.49	15791745.06	679340.141
2067	**34824452.56**	**16327228.78**	**688850.903**

Table 4: Percentage growth of vehicles registered from 2009 to 2020 (source: ABS Motor Vehicle Census 2009 – 2020)

Year	LPV	LCV	HV
2009	-	-	-
2010	2.00%	3.80%	2.30%
2011	2.00%	3.40%	1.10%
2012	1.90%	3.40%	1.20%
2013	2.20%	3.80%	1.20%
2014	2.30%	3.90%	1.10%
2015	1.90%	2.90%	0.70%

Year	LPV	LCV	HV
2016	2.00%	2.70%	0.90%
2017	1.90%	3.10%	1.90%
2018	1.80%	3.50%	1.60%
2019	1.20%	4.00%	2.00%
2020	1.20%	2.80%	1.40%
Average	**1.85%**	**3.39%**	**1.40%**

Figure 2: Actual and forecasted total registration of LPVs, LCVs and HVs from 2009 to 2038



4. The crash frequency by vehicle age for LPVs, LCVs and HVs was established.

Table 5: Crash frequency by vehicle age for LPVs, LCVs and HVs (source: Fitzharris and Stephan (2013) Appendix 8a and 8c for LPVs and LCVs, and MUARC for HVs)

Vehicle Age (years)	LPV			LCV			HV		
	Frequency	% of total	Cumulative %	Frequency	% of total	Cumulative %	Frequency	% of total	Cumulative %
0	3908	2.10%	2.10%	4827	3.80%	3.80%	377	1.91%	1.91%
1	9153	4.93%	7.03%	12860	10.12%	13.92%	1184	6.00%	7.92%
2	9008	4.85%	11.89%	12301	9.68%	23.60%	1369	6.94%	14.86%
3	9078	4.89%	16.77%	11375	8.95%	32.56%	1389	7.04%	21.90%
4	9270	4.99%	21.77%	10457	8.23%	40.79%	1340	6.80%	28.70%
5	9482	5.11%	26.87%	9159	7.21%	48.00%	1304	6.61%	35.31%
6	9401	5.06%	31.94%	8150	6.41%	54.41%	1202	6.10%	41.41%
7	9335	5.03%	36.96%	7523	5.92%	60.33%	1063	5.39%	46.80%
8	9326	5.02%	41.99%	6827	5.37%	65.70%	926	4.70%	51.50%
9	9279	5.00%	46.98%	6054	4.76%	70.47%	810	4.11%	55.61%
10	9402	5.06%	52.05%	5449	4.29%	74.76%	771	3.91%	59.52%
11	9410	5.07%	57.12%	4954	3.90%	78.66%	627	3.18%	62.70%
12	9095	4.90%	62.01%	4609	3.63%	82.29%	540	2.74%	65.44%
13	9209	4.96%	66.97%	4063	3.20%	85.48%	535	2.71%	68.15%
14	8845	4.76%	71.74%	3489	2.75%	88.23%	505	2.56%	70.71%
15	8596	4.63%	76.37%	3001	2.36%	90.59%	431	2.19%	72.90%
16	7610	4.10%	80.47%	2776	2.18%	92.78%	333	1.69%	74.59%
17	7043	3.79%	84.26%	2489	1.96%	94.74%	327	1.66%	76.24%
18	6106	3.29%	87.55%	1994	1.57%	96.30%	273	1.38%	77.63%
19	5173	2.79%	90.33%	1496	1.18%	97.48%	292	1.48%	79.11%
20	4092	2.20%	92.54%	1070	0.84%	98.32%	269	1.36%	80.47%
21	3261	1.76%	94.29%	755	0.59%	98.92%	211	1.07%	81.54%
22	2575	1.39%	95.68%	645	0.51%	99.43%	197	1.00%	82.54%
23	1957	1.05%	96.73%	381	0.30%	99.73%	194	0.98%	83.53%
24	1466	0.79%	97.52%	216	0.17%	99.90%	184	0.93%	84.46%
25	1106	0.60%	98.12%	90	0.07%	99.97%	153	0.78%	85.24%
26	792	0.43%	98.55%	42	0.03%	100.00%	110	0.56%	85.79%
27	600	0.32%	98.87%				98	0.50%	86.29%

Vehicle	LPV			LCV			HV		
28	477	0.26%	99.13%				83	0.42%	86.71%
29	409	0.22%	99.35%				61	0.31%	87.02%
30	287	0.15%	99.50%				55	0.28%	87.30%
31	237	0.13%	99.63%				31	0.16%	87.46%
32	190	0.10%	99.73%				32	0.16%	87.62%
33	154	0.08%	99.81%				36	0.18%	87.80%
34	101	0.05%	99.87%				22	0.11%	87.91%
35	73	0.04%	99.91%				27	0.14%	88.05%
36	55	0.03%	99.94%				21	0.11%	88.16%
37	37	0.02%	99.96%				11	0.06%	88.21%
38	30	0.02%	99.97%				6	0.03%	88.24%
39	20	0.01%	99.98%				5	0.03%	88.27%
40	9	0.00%	99.99%				4	0.02%	88.29%
41	11	0.01%	99.99%				0	0.00%	88.29%
42	4	0.00%	100.00%				4	0.02%	88.31%
43	6	0.00%	100.00%				1	0.01%	88.31%
Total	**185678**			**127052**			**17413**		

5. The fitment rate of reversing aid technologies (camera-monitor devices for indirect vision and / or the electromagnetic parking sensors) on new LPVs, LCVs and HVs sold between 2012 and 2037 was established.

   For LPVs existing fitment rate from years 2012 – 2015 was obtained from Keall et al. (2018) and used in the trend for the no intervention / BAU case (Option 1) and the case for government intervention (Option 2).

   For HVs it was assumed that the fitment rate at 2012 was almost non-existent, the maximum fitment rate for the year 2020 was 20% across the heavy vehicle fleet, with an expected fitment rate of 50% by 2037 due to the importation of Japanese heavy models fitted with these technologies.

   For LCVs, it was assumed that the fitment rate is halfway between the fitment rate of passenger vehicles and heavy vehicles, where the fitment rate at 2012 was assumed to be 30% and the maximum fitment rate for 2020 was assumed to be 70% across the light commercial vehicle fleet. Note that fitment rate reaches 100% with government intervention and reaches a maximum of 95% without a mandate for government intervention.

Figure 3: Forecasted fitment rate of reversing aid technologies in LPVs under no intervention / BAU (Option 1) and Government Intervention (Option 2)

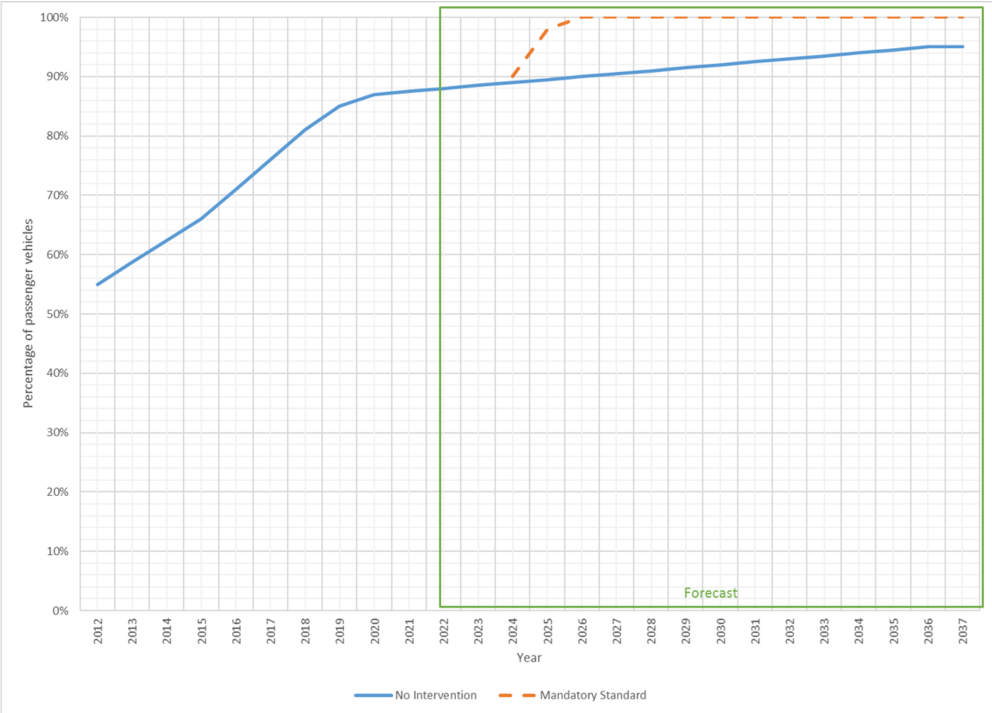


Figure 4: Forecasted fitment rate of reversing aid technologies in LCVs under no intervention / BAU (Option 1) and Government Intervention (Option 2)

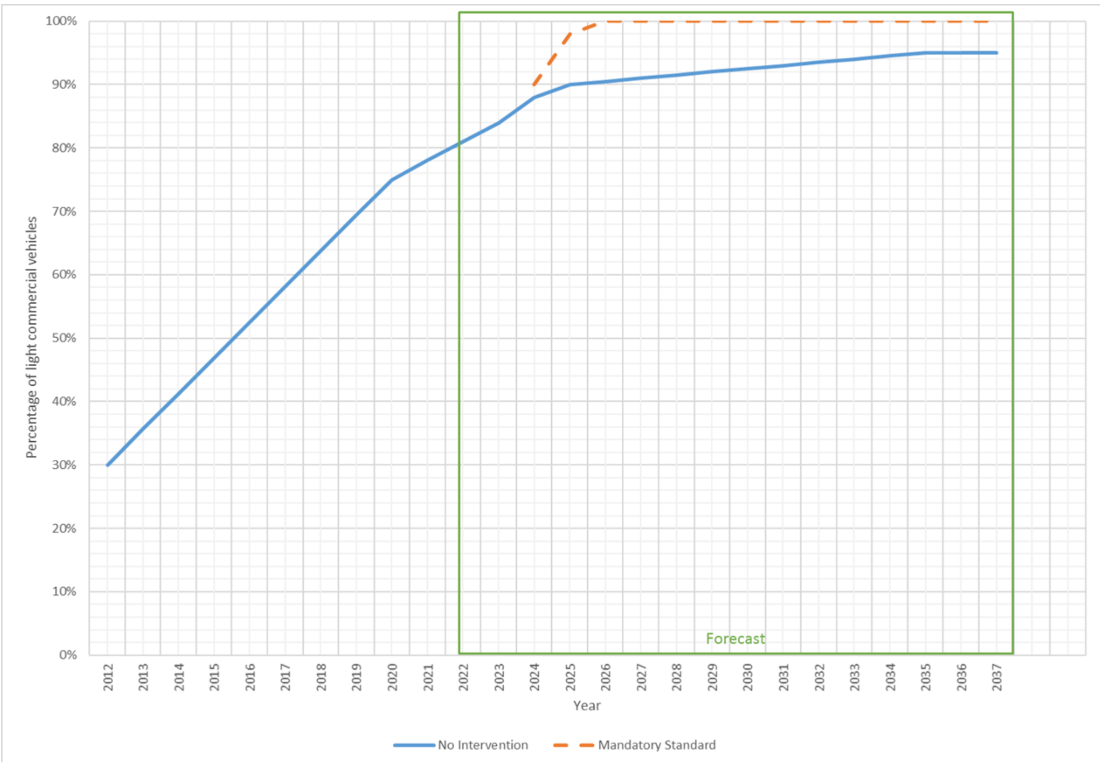
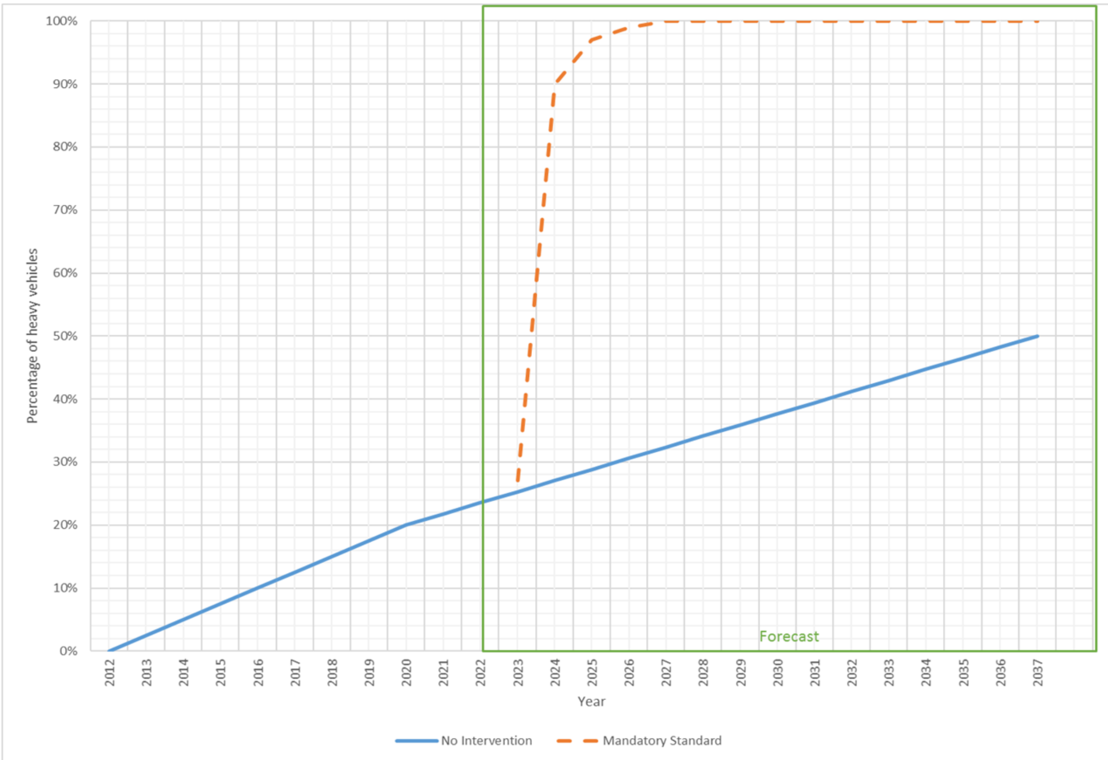


Figure 5: Forecasted fitment rate of reversing aid technologies in HVs under no intervention / BAU (Option 1) and Government Intervention (Option 2)



6. The number of LPVs, LCVs and HVs fitted at sale with reversing aid technologies under government intervention (Option 2) and under the BAU case (Option 1) was calculated using the fitment rate multiplied by the vehicle sales from 2024 to 2067.

7. The fitment increase at sale under government intervention was calculated by taking the difference between the two Options.

8. The annual rate of occupant fatalities and serious injuries in reversing collisions by vehicle age for the new registered LPV, LCV and HV fleet was established using the crash frequency by vehicle age data multiplied by the total hospitalisation and fatalities reported from BITRE (2021).

9. The casual crash rate over the total number of registered vehicles was calculated by dividing the annual rate of occupant fatalities and serious injuries in reversing collisions by vehicle age by the total number of all vehicles registered per annum (ABS, 2020).

10. The likelihood of a vehicle of given age being involved in a reversing collision over the course of one year was assumed as a function of the total number of LPVs, LCVs and HVs registered. This was calculated by multiplying the total number of LPVs, LCVs and HVs registered with the casual crash rate over the total number of registered vehicles by vehicle age divided by the annual LPV, LCVs and HVs registered by vehicle age.

11. The number of reversing collisions trauma crashes that can be prevented for each year between 2024 and 2067 due to new LPVs, LCVs and HVs entering the fleet with reversing aids was calculated by multiplying the likelihood of a vehicle of given age being involved in a reversing collision over the course of one year as a function of the total number of LPVs, LCVs and HVs registered, with the increased fitment of reversing aids at point of sale under government intervention relative to BAU. It was assumed that one vehicle fitted with the technology can prevent a single crash hence the total number of vehicles fitted represents the number of crashes that can be prevented.

Table 11: Estimated number of LPVs reversing collisions prevented for each year between 2024 and 2067 from introduction of government intervention in 2024.

Year from first fitment (2024)	Vehicle Age																																													Total number of LPVs fitted
	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	36	37	38	39	40	41	42	43	44	45	
1	55																																													55
2	126	199																																												325
3	121	191	335																																											647
4	119	187	329	348																																										983
5	118	186	327	347	368																																									1347
6	118	186	326	346	367	391																																								1733
7	114	179	315	334	355	378	404																																							2078
8	110	174	305	323	343	366	391	418																																						2429
9	107	169	297	314	334	356	380	407	437																																					2802
10	104	164	288	305	324	345	369	395	424	455																																				3172
11	103	162	284	301	320	341	364	390	418	450	484																																			3616
12	100	158	277	294	312	332	355	380	408	439	472	509																																		4036
13	94	149	261	276	294	313	334	358	384	413	445	480	518																																	4319
14	93	147	258	273	290	309	330	353	379	408	439	473	511	552																																4813
15	87	137	241	255	271	289	309	331	355	381	411	443	478	517	559																															5063
16	82	130	228	242	257	274	292	313	336	361	389	419	453	489	529	573																														5368
17	71	112	197	209	222	236	252	270	290	312	336	362	391	422	457	494	483																													5114
18	64	101	178	188	200	213	227	244	261	281	303	326	352	381	412	446	408	442																												5026
19	54	85	150	159	169	180	192	206	221	237	256	276	298	322	348	377	337	365	396																											4626
20	45	70	124	131	139	148	159	170	182	196	211	228	246	265	287	311	260	281	305	331																										4090
21	34	54	96	101	107	114	122	131	141	151	163	175	189	205	221	240	202	218	237	257	359																									3518
22	27	42	74	79	83	89	95	102	109	117	126	136	147	159	172	186	155	168	182	198	279	303																								3028
23	21	32	57	60	64	68	73	78	84	90	97	105	113	122	132	143	115	124	135	146	215	233	253																							2563
24	15	24	42	45	48	51	54	58	62	67	72	78	84	91	98	106	84	91	99	107	159	173	187	204																						2096
25	11	18	31	33	35	37	39	42	45	49	53	57	61	66	71	77	62	67	72	79	116	126	137	149	161																					1693
26	8	13	23	24	26	27	29	31	33	36	39	42	45	49	53	57	43	47	51	55	85	93	101	109	119	129																				1363
27	6	9	16	17	18	19	20	22	23	25	27	29	31	34	37	40	32	34	37	40	60	65	70	76	83	90	98																			1057
28	4	7	12	12	13	14	15	16	17	18	20	21	23	25	27	29	25	27	29	31	44	48	52	56	61	66	72	78																		864
29	3	5	9	10	10	11	12	12	13	14	15	17	18	19	21	23	21	22	24	26	34	37	40	44	47	51	56	61	66																	742
30	3	4	8	8	9	9	10	10	11	12	13	14	15	16	18	19	14	15	17	18	28	31	34	36	40	43	47	51	55	60																666
31	2	3	5	5	6	6	7	7	8	8	9	9	10	11	12	13	11	12	13	14	19	21	23	25	27	29	32	35	38	41	45															508
32	2	2	4	4	5	5	5	6	6	7	7	8	8	9	10	10	9	10	10	11	16	17	18	20	22	24	26	28	30	33	36	39														446
33	1	2	3	3	4	4	4	4	5	5	6	6	6	7	8	8	7	8	8	9	12	13	14	16	17	18	20	22	24	26	28	30	33													382
34	1	1	3	3	3	3	3	4	4	4	4	5	5	6	6	6	4	5	5	6	10	10	11	12	13	15	16	17	19	20	22	24	26	28												325
35	1	1	2	2	2	2	2	2	2	3	3	3	3	4	4	4	3	3	4	4	6	7	7	8	9	9	10	11	12	13	14	15	17	18	20											229
36	0	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	2	2	3	3	4	5	5	6	6	7	7	8	8	9	10	11	12	13	14	15										177
37	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	4	4	4	5	5	6	6	7	7	8	9	9	10	11	12									141
38	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	5	5	6	6	7	7	8	9								102
39	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	4	4	4	5	5	6	6	7	7							87
40	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	4	4	4	5	5						61
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2					30
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3				38
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1			15
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2		24
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	33

Table 12: Estimated number of LCVs reversing collisions prevented for each year between 2024 and 2067 from introduction of government intervention in 2024.

Year from first fitment (2024)	Vehicle Age																																													Total number of LCVs fitted
	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	36	37	38	39	40	41	42	43	44	45	
1	205																																													205
2	528	490																																												1018
3	488	454	418																																											1360
4	437	406	374	341																																										1557
5	388	361	332	303	273																																									1657
6	329	306	281	257	231	205																																								1609
7	283	263	242	221	199	176	153																																							1538
8	253	235	216	197	178	158	137	116																																						1489
9	222	206	190	173	156	138	120	101	103																																					1409
10	190	177	163	148	134	119	103	87	88	89																																				1298
11	166	154	142	129	116	103	90	76	77	78	79																																			1209
12	146	135	125	114	102	91	79	67	67	68	69	70																																		1133
13	131	122	112	102	92	82	71	60	61	62	62	63	64																																	1084
14	112	104	96	87	79	70	60	51	52	52	53	54	55	55																																979
15	93	86	79	72	65	58	50	42	43	44	44	45	45	46	47																															860
16	77	72	66	60	54	48	42	35	36	36	37	37	38	38	39	39																														755
17	69	64	59	54	49	43	37	32	32	32	33	33	34	34	35	35	31																													706
18	60	56	51	47	42	37	32	27	28	28	28	29	29	30	30	30	24	24																												634
19	46	43	40	36	33	29	25	21	22	22	22	22	23	23	23	24	17	18	18																											506
20	34	31	29	26	24	21	18	15	16	16	16	16	16	17	17	17	12	12	12	12																										378
21	23	22	20	18	16	15	13	11	11	11	11	11	11	12	12	12	8	8	8	9	13																									274
22	16	15	14	12	11	10	9	7	7	7	8	8	8	8	8	8	7	7	7	7	9	9																								200
23	13	12	11	10	9	8	7	6	6	6	6	6	6	7	7	7	4	4	4	4	7	7	7																							166
24	8	7	6	6	5	5	4	3	3	4	4	4	4	4	4	4	2	2	2	2	4	4	4	4																						99
25	4	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1	1	2	2	2	2	2																					55
26	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	1																				23
27	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																			10
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																		0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0															0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0														0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0													0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0												0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 13: Estimated number of HVs reversing collisions prevented for each year between 2024 and 2067 from introduction of government intervention in 2024.

Year from first fitment (2024)	Vehicle Age																																													Total number of HVs fitted
	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	36	37	38	39	40	41	42	43	44	45	
1	64																																													64
2	197	202																																												400
3	225	231	237																																											693
4	225	231	237	237																																										930
5	214	220	226	225	225																																									1109
6	205	211	217	216	215	215																																								1279
7	187	192	197	196	196	195	194																																							1357
8	163	167	172	171	171	170	170	169																																						1352
9	140	144	147	147	147	146	146	145	144																																					1306
10	121	124	127	127	127	126	126	125	124	124																																				1250
11	113	116	119	119	119	118	118	117	117	116	115																																			1289
12	91	93	96	96	95	95	95	94	94	93	92	92																																		1125
13	77	79	81	81	81	81	80	80	80	79	78	78	77																																	1033
14	75	77	79	79	79	79	79	78	78	77	77	76	75	74																																1083
15	70	72	74	74	74	73	73	73	72	72	71	71	70	69	69																															1077
16	59	61	62	62	62	62	62	61	61	60	60	60	59	58	58	6																														912
17	45	46	47	47	47	47	47	47	46	46	46	45	45	44	44	4	4																													700
18	44	45	46	46	46	46	45	45	45	45	44	44	44	43	43	4	4	4																												681
19	36	37	38	38	38	38	37	37	37	37	36	36	36	35	35	4	4	4	4																											566
20	38	39	40	40	40	40	39	39	39	39	38	38	38	37	37	4	4	4	4	4																										599
21	34	35	36	36	36	36	36	36	35	35	35	35	34	34	34	3	3	3	3	3	4																									546
22	27	27	28	28	28	28	28	28	27	27	27	27	27	26	26	3	3	3	3	3	3	3																								427
23	24	25	26	26	26	26	26	25	25	25	25	25	24	24	24	2	2	2	3	3	3	3	3																							397
24	24	24	25	25	25	25	25	25	25	24	24	24	24	24	23	2	2	2	2	2	3	3	3	3																						388
25	22	23	23	23	23	23	23	23	23	23	23	22	22	22	22	2	2	2	2	2	2	3	3	3	3																					365
26	18	19	19	19	19	19	19	19	19	19	19	18	18	18	18	2	1	1	1	1	2	2	2	2	2	2																				300
27	13	13	14	14	14	14	13	13	13	13	13	13	13	13	13	1	1	1	1	1	1	1	2	2	2	2	2																			216
28	11	12	12	12	12	12	12	12	12	12	12	11	11	11	11	1	1	1	1	1	1	1	1	1	1	1	1	1																		191
29	9	10	10	10	10	10	10	10	10	10	10	10	9	9	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	160
30	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																117
31	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1															104
32	3	3	4	4	4	4	4	4	4	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0														59
33	3	4	4	4	4	4	4	4	4	4	4	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1													61
34	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1												67
35	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0											42
36	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										50
37	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0									39
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								20
39	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							11
40	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						9
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					7
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			7
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		2
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

12. The unit cost of a fatality was calculated (2007 dollars) based on the typical fatality age and the average life years lost. As fatalities from reversing collisions tend to occur in vulnerable population groups (the elderly and children under 5 years old), we used a typical fatality age of 4 years old hence we can assume an average of 78 life years lost. Additional costs incurred in a fatality (i.e. medical costs, coronial costs etc.) was obtained from BITRE (2009).

Table 14: Unit Cost of a Fatality

Average Life Expectancy for Males	80 years
Average Life Expectancy for Females	84 years
Typical fatality age*	4 years
Average Life Years Lost	**78 years**

Value of a statistical life year (VLY) – 2007 dollars	$151,000
Value of a Statistical Life - VSL Willingness to Pay method (WTP) – 2007 dollars	**$4,667,454**

Additional Cost Variables in Fatalities	Cost
Medical costs (hospital and ambulance) (BITRE, 2009) – 2007 dollars	$4,341
Coronial costs (BITRE, 2009) – 2007 dollars	$2,004
Premature funeral costs (BITRE, 2009) – 2007 dollars	$4,457
Legal costs (BITRE, 2009) – 2007 dollars	$23,256
Correctional services costs (BITRE, 2009) – 2007 dollars	$9,570
Recruitment and retraining (BITRE, 2009) – 2007 dollars	$10,824
Travel delay and additional air pollution and operating costs (BITRE, 2009) – 2007 dollars	$20,992
Police costs (BITRE, 2009) – 2007 dollars	$1,917
Costs of fire and rescue services (BITRE, 2009) – 2007 dollars	$2,930
Total Cost of a Fatality – 2007 dollars WTP + Additional Costs Incurred Above	**$4,747,745**

13. The unit cost of fatalities calculated above was based on 2007-dollar value. The unit cost of serious injuries and minor injuries was obtained from BITRE (2009) based on 2006-dollar value. To determine the current dollar value of unit cost per trauma for fatalities, serious injuries and minor injuries, we used the NPV formula and applied an inflation rate of 0.022 for the 2020 financial year as determined from the inflation rate calculator published by the Reserve Bank of Australia. Note data is unavailable for the 2021 financial year.

Table 15: Current dollar value for the unit cost of trauma

Current year	2020
Inflation rate	0.022

Type of trauma	Unit cost	Year	Current $
Fatal	$4,747,745	2007	$6,300,123
Serious	$266,000	2006	$360,740
Minor	$14,700	2006	$19,936

14. The proportion of fatalities, serious injuries and minor injuries in pedestrians from reversing collisions in Australia was calculated using research undertaken by MUARC (Fildes et al., 2014) showing deaths, serious injuries and minor injuries per state (NSW, SA, WA, QLD, VIC) over a 10-year period from 2000 – 2010. The sum of the number of fatalities, serious injuries and minor injuries in all states over the 10-year period was based on Fildes et al. (2014) and divided by 10 to determine the number of fatalities, serious injuries and minor injuries per annum. The results were scaled up based on the sample population size shown in Fildes et al. (2014) by 1.04 to determine the number of trauma types relative to the population in Australia.

Table 16: Average annual number of pedestrians per trauma type involved in reversing collisions

	Total Population Size
Population Sample Size in Fildes et al. (2014)	24,390,000
Population of Australia	25,360,000
Scale Factor	**1.04**

Trauma Type	Average Annual Number of Pedestrians in Fildes et al. (2014)	Average Annual Number of Pedestrians scaled up to Australian population size (1.04 scale factor)
Fatality	7.60	7.90
Serious	214.58	223.11
Minor	**95.24**	**99.03**

15. The effect of reversing aid technologies on road trauma was obtained by multiplying the effectiveness of the technology in reducing all sensitive trauma and the sensitivity of the crash. The sensitivity was calculated using the number of pedestrians killed or seriously injured (KSI) from research conducted by MUARC (Fildes et al., 2014) and divided by the total number of deaths and hospitalisations per year from BITRE (2021). The effectiveness of the technology in reducing all sensitive trauma was obtained from Keall et al. (2018) at 0.69 assuming at minimum that manufacturers will only install reversing sensors on their vehicles to comply with the proposed reversing aids legislation.

Table 17: Effect of reversing aid technologies on all trauma relative to sensitivity of the technology

Total number of fatalities and hospitalisations (BITRE, 2021) 1127 road deaths + 39404 hospitalisations	40531
KSI (Fildes et al., 2014) **7.90 total fatalities per year scaled to AUS population size + 223.11 total serious injuries per year (scaled to AUS population size)**	**231.02**

Effectiveness of technology in reducing all sensitive trauma (Keall et al., 2018)	0.69
Sensitivity = KSI / Total number of fatalities and hospitalisations	0.0057
Effect on all trauma = Effectiveness of technology X Sensitivity	**0.003933**

16. The total cost of trauma is the sum of the cost per trauma for fatalities, serious injuries and minor injuries. The cost per trauma of fatalities, serious injuries and minor injuries was obtained by respectively multiplying the unit cost of fatalities, serious injuries and minor injuries under NPV by the proportion of fatalities, serious injuries and minor injuries from reversing collisions per year relative to the total population of Australia. NPV costs can be determined from the 2020 inflation rate provided by the Reserve Bank of Australia (RBA).

Table 18: NPV Unit Cost per Trauma

Trauma Type	Average Annual Number of Pedestrians	Ratio of Pedestrians = Average annual number of pedestrians per trauma type / 7.90	Proportion = Ratio / Total Ratio	Cost per trauma = Unit Cost in NPV X Proportion
Fatality	7.90	1	0.024	$150,844
Serious	223.11	28.23	0.676	$243,865
Minor	99.03	12.53	0.300	$5,982
Total		**41.77**	**1.0**	**$400.690**

17. To determine the number of lives saved, severe injuries avoided and minor injuries avoided over 37 years from government intervention after 2024 under the 7% discount rate, the total number of LPVs, LCVs and HVs fitted with the technology was multiplied by the effect on all trauma and the proportion of fatality, serious injuries and minor injuries.

Table 19: Lives saved, severe injuries and minor injuries avoided under government intervention for LPVs, LCVs and HVs

Vehicle type	Total number of vehicles fitted	Number of Lives Saved = Total number of vehicles fitted X Effect on all trauma X Proportion of fatalities	Severe Injuries Avoided = Total number of vehicles fitted X Effect on all trauma X Proportion of serious injuries	Minor Injuries Avoided = Total number of vehicles fitted X Effect on all trauma X Proportion of minor injuries
LPVs	81386	8	216	96
LCVs	22007	2	66	30
HVs	22272	2	58	26

18. The total annual costs associated with the implementation of government intervention (Option 2) for business and government were determined over the 15-year policy period (2024 to 2037) using the following costs incurred. It was assumed that the 10 major brands for LPVs, LCVs and HVs would produce an average of 1 new model every 3 years – hence 0.33 of a new model per year.

19. The total savings from government intervention (Option 2) over the BAU case (Option 1) was calculated by multiplying the total cost per trauma, the effectiveness of reversing aid technologies on all trauma and the number of reversing collisions that can be prevented for each year between 2024 and 2067 due to new LPVs, LCVs and HVs entering the fleet with reversing aids. This was assessed over a 15-year policy period and 30-year life of vehicle.

20. The total annual financial benefits associated with implementation of government intervention (Option 2) were determined by subtracting the net costs incurred by businesses and governments from the net savings from government intervention over the BAU case.

Table 20: Cost incurred by government and businesses from implementing reversing aids

Cost item incurred by business	Estimated Cost
Fitment of system per vehicle that would otherwise not have the technology (wholesale cost)	$40
Testing of system to a regulation per model	$10,000
Regulation Compliance per model	$1,500

Cost item incurred by government	Estimated Cost
Implement and maintain regulation per year	$50,000

21. A real discount rate of 7% in line with OBPR recommendations was applied to the net savings, net costs and net benefits to determine the NPV of the total costs to businesses and government and the net benefit to society. A discount rate of 3% and 10% was used for sensitivity checks.

22. The NPV saved over the NPV costs was calculated to determine the BCR from government intervention over the discount rates above for the LPVs, LCVs and HVs fleet.

Table 24: NPV savings, costs and benefits incurred by businesses and government and the benefit cost ratio from government intervention (Option 1) assessed with 3%, 7% and 10% discount rate over a 15-year policy period for LPVs

Discount Rate	NPV Saving	Fitment Cost	Testing and Regulation compliance cost	Government cost	NPV Benefits	BCR
7% discount rate	$46,683,002	$26,662,125	$345,645	$455,395	$19,219,836	1.7
3% discount rate	$80,835,267	$36,715,412	$453,044	$596,896	$43,069,913	2.14
10% discount rate	$32,430,324	$21,401,962	$288,650	$380,303	$10,359,406	1.47

Table 25: NPV savings, costs and benefits incurred by businesses and government and the benefit cost ratio from government intervention (Option 1) assessed with 3%, 7% and 10% discount rate over a 15-year policy period for LCVs

Discount Rate	NPV Saving	Fitment Cost	Testing and Regulation compliance cost	Government cost	NPV Benefits	BCR
7% discount rate	$21,727,072	$7,140,351	$345,645	$455,395	$13,785,679	2.74
3% discount rate	$30,097,495	$8,984,588	$453,044	$596,896	$20,062,966	3.00
10% discount rate	$17,520,215	**$6,133,910**	$288,650	$380,303	$10,717,349	2.58

Table 26: NPV savings, costs and benefits incurred by businesses and government and the benefit cost ratio from government intervention (Option 1) assessed with 3%, 7% and 10% discount rate over a 15-year policy period for HVs

Discount Rate	NPV Saving	Fitment Cost	Testing and Regulation compliance cost	Government cost	NPV Benefits	BCR
7% discount rate	$16,054,318	$9,689,126	$345,645	$455,395	$5,564,150	1.53
3% discount rate	$24,228,306	$12,702,686	$453,044	$596,896	$10,475,678	1.76
10% discount rate	$12,301,069	$8,086,606	$288,650	$380,303	$3,545,508	1.40

Appendix 4 – Consultation Groups

Strategic Vehicle Safety and Environment Group (SVSEG)

Manufacturer Representatives

- Australian Automobile Association (AAA)
- Australasian New Car Assessment Program (ANCAP)
- Australian Road Transport Suppliers Association (ARTSA)
- Australian Trucking Association (ATA)
- Bus Industry Confederation (BIC)
- Caravan Industry Association of Australia (CIAA)
- Commercial Vehicle Industry Association of Australia (CVIAA)
- Federal Chamber of Automotive Industries (FCAI)
- Heavy Vehicle Industry Australia (HVIA)
- Truck Industry Council (TIC)
- Victorian Automobile Chamber of Commerce (VACC)

Government Representatives

- Department of Infrastructure, Transport, Regional Development and Communications, Australian Government (Chair)
- National Heavy Vehicle Regulator
- Department of Planning, Transport and Infrastructure, SA
- Department of Infrastructure, Planning and Logistics, NT
- Department of State Growth, TAS
- Department of Transport and Main Roads, QLD
- Department of Transport, VIC
- Department of Transport, WA
- Road Safety Commission, WA
- Justice and Community Safety, ACT
- Transport for NSW, NSW
- New Zealand Transport Agency

Inter-Governmental Agency

- National Transport Commission (NTC)

Technical Liaison Group (TLG)

Manufacturer Representatives

Australian Road Transport Suppliers Association

Bus Industry Confederation

Caravan Industry Association of Australia

Commercial Vehicle Industry Association of Australia

Federal Chamber of Automotive Industries

Federation of Automotive Product Manufacturers

Truck Industry Council

Consumer Representatives

Australian Automobile Association

Australian Automotive Aftermarket Association

Australian Motorcycle Council

Australian Trucking Association

Government Representatives

Department of Infrastructure and Transport, SA

Department of Infrastructure, Planning and Logistics, NT

Department of Infrastructure, Transport, Regional Development and Communications, Australian Government

Department of State Growth, TAS

Department of Transport and Main Roads, QLD

Department of Transport, VIC

Department of Transport, WA

Justice and Community Safety, ACT

New Zealand Transport Agency

Road Safety Commission, WA

Transport for NSW, NSW

Inter-Governmental Agency

National Transport Commission

National Heavy Vehicle Regulator

Appendix 5 – Acronyms and Abbreviations

AAA	Australian Automotive Association
ABS	Australian Bureau of Statistics
ABS-DURF	Australian Bureau of Statistics Death Unit Record File
ADR	Australian Design Rule for Motor Vehicles
AEB	Autonomous Emergency Braking
AIS	Abbreviated Injury Scale
ALRTA	Australian Livestock and Rural Transporters Association
ANCAP	Australian New Car Assessment Program
ARTSA	Australian Road Transport Suppliers Association
ATA	Australian Trucking Association
BAU	Business as Usual
BCR	Benefit-Cost Ratio
BIC	Bus Industry Confederation
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BSM	Blind Spot Monitoring
CVIAA	Commercial Vehicle Industry Association Australia
DITRDC	Australian Government Department of Infrastructure, Transport, Regional Development and Communications
ECIS	Monash University Enhanced Crash Investigation Study
EU	European Union
Euro NCAP	European New Car Assessment Program
FAPM	Federation of Automotive Products Manufacturers
FCAI	Federal Chamber of Automotive Industries
FRCD	Australian Fatal Road Crash Database
Global NCAP	The Global New Car Assessment Programme
GTR	Global Technical Regulations
HV	Heavy Vehicle
HVIA	Heavy Vehicle Industry Australia
ITMM	Infrastructure and Transport Minister's Meeting
ITSOC	Infrastructure and Transport Senior Official's Committee
JNCAP	Japan New Car Assessment Program

KSI	Killed or Seriously Injuries
Latin NCAP	New Car Assessment Programme for Latin America and the Caribbean
LCV	Light Commercial Vehicle
LPV	Light Passenger Vehicle
MUARC	Monash University Accident Research Centre
MVSA	Motor Vehicle Standards Act 1989
NCAP	New Car Assessment Programs
NCIS	National Coroners Information System
NHTSA	United States National Highway Traffic Safety Administration
NRMA	National Roads and Motorists' Association
NRSAP	National Road Safety Action Plan 2021-2025
NRSS	National Road Safety Strategy 2021-2030
NPV	Net Present Value
NTC	National Transport Commission
OBPR	Office of Best Practice Regulation
OEM	Original Equipment Manufacturer
ORS	Office of Road Safety
PV	Passenger Vehicles
RAA	Royal Automobile Association of South Australia
RACQ	Royal Automotive Club of Queensland
RACV	Royal Automotive Club of Victoria
RBA	Reserve Bank of Australia
RBM	Regulatory Burden Measurement
RCIS	VicRoads Road Crash Information System
RIS	Regulation Impact Statement
RVSA	Road Vehicle Standards Act 2018
SUV	Sports Utility Vehicle
SVSEG	Strategic Vehicle Safety and Environment Group
TAC	Transport Accident Commission
TIC	Truck Industry Council
TLG	Technical Liaison Group
UN	United Nations
VFACTS	Vendor Field Analytical and Characterisation Technologies System

VIFM	Victorian Institute of Forensic Medicine
WP.29	World Forum for the Harmonisation of Vehicle Regulations

Appendix 6 – Glossary of Terms

1958 Agreement	UN Agreement Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations of March 1958.
Abbreviated Injury Scale (AIS)	An anatomically-based injury severity scoring system that classifies each injury by body region on a 6 point scale. AIS 1 – Minor; AIS 2 – Moderate; AIS 3 – Serious; AIS 4 – Severe; AIS 5 – Critical; and AIS 6 – Maximal (currently untreatable).
Audible Warning Device	A device consisting of one or several sound emission outlets that are excited simultaneously, emitting an acoustic signal which is intended to give audible warning of the presence of a vehicle in a dangerous road traffic situation and which is intentionally operated by a driver.
Autonomous Emergency Braking (AEB)	A form of an automatic braking system that stops the vehicle if it senses that the vehicle is about to collide with an object (vehicle and / or pedestrian etc.)
Reversing Collision	Collision that occurs when the driver reverses the car into an object, person, or other car.
Benefit-Cost Analysis	A process by which organisations can analyse decisions, systems or projects, or determine a value for intangibles. The analysis identifies the benefits of an action as well as the associated costs, and subtracting the costs from benefits. When completed, a cost benefit analysis will yield results that can be used to develop reasonable conclusion around the feasibility and / or advisability of a decision or situation.
Benefit-Cost Ratio (BCR)	The ratio of expected total (gross) benefits to expected total costs (in terms of present monetary value) for a change of policy relative to business as usual.
Blind Spot	A blind spot in a vehicle is an area around the vehicle that cannot be directly observed by the driver while at the controls, under existing circumstances.
Blind Spot Monitoring (BSM)	A system using a set of sensors mounted on the side mirrors or rear bumper to detect vehicles in adjacent lanes. If the sensors detect something, the will alert the driver via an audible and / or visual warning. Some vehicles will include a camera as the main part of the system or to complement the sensors.
Business As Usual (BAU)	The normal execution of standard functional operations within an organization.
Casualty	A person who is injured or killed in an accident.
Casualty Department	The department of a hospital providing immediate treatment for emergency cases

Category L_1 Vehicle	A two-wheeled vehicle with an engine cylinder capacity in the case of a thermic engine not exceeding 50 cm^3 and whatever the means of propulsion a maximum design speed not exceeding 50 km/h.
Category LA Vehicle	See Appendix 1 – Vehicle Categories
Category M Vehicle	Power-driven vehicles having at least four wheels and used for the carriage of passengers.
Category MA Vehicle	See Appendix 1 – Vehicle Categories
Category MB Vehicle	See Appendix 1 – Vehicle Categories
Category MC Vehicle	See Appendix 1 – Vehicle Categories
Category MD Vehicle	See Appendix 1 – Vehicle Categories
Category ME Vehicle	See Appendix 1 – Vehicle Categories
Category N Vehicle	Power-driven vehicles having at least four wheels and used for the carriage of goods.
Category NA Vehicle	See Appendix 1 – Vehicle Categories
Category NB Vehicle	See Appendix 1 – Vehicle Categories
Category NC Vehicle	See Appendix 1 – Vehicle Categories
Certification	Assessment of compliance to the requirements of a regulation / standard. Can relate to parts, sub-assemblies, or a whole vehicle.
Contracting Party	A country which is a signatory to an international agreement (e.g. the 1958 Agreement).
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.
Devices for Indirect Vision	Devices that can be used to observe the traffic area adjacent to the vehicle which cannot be observed by direct vision. These can be conventional mirrors, camera-monitors or other devices able to present information about the indirect field of vision to a driver.
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.
Emergency Brake Assist	Automobile braking technology that increases braking pressure in an emergency, when the driver pushes the brakes to execute an emergency stop.
Fatal Crash	A crash for which there is at least one death.
Gross Cost	The entire acquisition cost of an object

Hospitalised Injury	A person admitted to hospital from a crash occurring in traffic. Traffic excludes off-road and unknown location.
Lane Support Systems	A broad term for a group of active safety technologies that aim to keep your car within its lane. These systems detect lane markings of the road ahead and either alert the driver or apply some form of corrective action to prevent the vehicle from moving out of the lane.
Killed / Road Fatalities	A human casualty who dies immediately or within 30 days after the collision due to injuries received in the crash (International Definition adopted by the Vienna Convention 1968).
Killed or Seriously Injured (KSI)	A standard metric for safety policy, particularly in transportation and road safety.
Minor Injury	Defined as a soft-tissue injuries and / or minor psychological or psychiatric injuries. Classified as an AIS 1 on the injury severity scale.
Net Benefit	The sum of expected benefits (in monetary terms), less expected costs associated with a change in policy relative to business as usual.
Net Cost	The gross cost of an object, reduced by any financial benefits gained from owning the object.
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.
Net Savings	Savings attributable to a program's intervention in the market, exclusive of other reasons for changes
Original Equipment Manufacturer (OEM)	OEMs purchase parts from other manufacturers or suppliers and use them to assemble their finished products. OEMs also make parts and sub-assemblies that are resold to other companies who assemble them into their own finished products.
Pedestrian	Person travelling on foot.
Private Property	Land or belongings owned by a person or group and kept for their exclusive use.
Public Road	Road or street which is commonly used by the public or any section to which the public has a right of access
Reversing Collision Avoidance	A type of collision avoidance driver-assisted system designed to prevent or reduce the severity of a rear-end collision by autonomous braking.

Serious Injury	Defined as a serious long-term impairment or loss of a body function; or permanent serious disfigurement; or severe long-term mental or severe long-term behavioural disturbance or disorder; or loss of a foetus. A serious injury may also be a permanent impairment of 30% or more and may be a single significant injury, or a combination of injuries as a result of a transport accident. Serious injuries takes into account both the injuries sustained by the vehicle occupant and the long-term impact of the transport accident on the lives of the occupant. Classified as an AIS 3+ on the injury severity scale.
Type Approval	Written approval of an authority/body that a vehicle type (i.e. model design) satisfies specific technical requirements.
World Trade Organization Agreement on Technical Barriers to Trade	World Trade Organization agreement that aims to ensure technical regulations, standards and conformity assessment procedures are non-discriminatory and do not create unnecessary obstacles to trade. Whilst recognising member countries right to implement measures to achieve legitimate policy objectives, the Agreement strongly encourages members to base their measures on international standards as a means to facilitate trade.

Appendix 7 – United Nations Regulation No. 158 Performance Requirements

UN R158 sets performance requirements for reversing aids fitted to vehicles to enhance the driver's vision or awareness when reversing. It was endorsed as a UN Regulation by WP.29 in June 2021. The Regulation introduces requirements for light passenger vehicles, light commercial vehicles, busses and heavy vehicles, covering vehicle categories M and N, corresponding to ADR subcategories MA, MB, MC, MD, ME, NA, NB and NC. The objective is to give a clear view of the rear of the vehicle within specified fields of vision or to detect objects in the field of detection.

The specific requirements are to detect objects behind the vehicle that are at least 80 cm tall and 30 cm wide in an area ranging from 20 centimetres to 1 meter behind the vehicle. The field of vision is defined as between 30 cm to 3.5 meter behind the vehicle. The Regulation set performance criteria for two main technologies: ultra-sonic sensors and rear-view cameras.

It requires that at least one means of vision or detection shall be provided to the driver during a backing event. Devices for means of vision includes direct vision, close-proximity rear-view mirrors, rear-view camera systems or devices for indirect vision as defined in UN R46 (ADR 14/02). Means of detection other than vision may be a sensor system. Devices for means of awareness involve at least two kinds of information signals selected from audible, optical or haptic.

A reversing event starts when the vehicle transmission or drive mode is engaged in reverse and ends when one of the following forward motion conditions is met: the vehicle speed is less than 16km/h, distance travelled is less than 10 meters, continuous duration is less than 10 seconds or the vehicle's direction selector is not placed in reverse.

EXEMPTIONS

Vehicles where installation of means of rear visibility or detection is incompatible with their on-road use may be partly or fully exempt from the Regulation.

DEACTIVATION

The rear-view image shall remain visible during the backing event until either, the driver modifies the view, or the vehicle direction selector is no longer in the reverse position or the backing event is finished. Modifying the view means to switch to any other camera views.

The view can be manually switched off when the vehicle is not moving rearward. But it must default to on whenever a reversing event starts.

The system may be switched off when the vehicle detects a coupling by means of a coupling device.