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

# REDUCING HEAVY VEHICLE LANE DEPARTURE CRASHES

## Impact Assessment - Final

**October 2023**

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## Heavy vehicle road trauma

Improvements to heavy vehicle design and safety technologies have reduced the number and severity of crashes on Australian roads. However, the impact of road trauma on individuals as well as society as a whole is significant, costing the Australian economy approximately $30 billion per year (DITRDC, 2021) up from $27 billion per annum in 2014 (BITRE, 2014). This equates to around 1,200 fatalities each year on our roads, and almost 40,000 serious injuries (DITRCD, 2021) with an approximate cost of $80 million per day to the Australian economy.

Heavy vehicle crashes constitute around $1.5 billion of this, including around $63 million (Budd & Newstead, 2014) from crashes involving heavy vehicles drifting outside their lane. This is the specific road safety problem that has been considered in this Impact Assessment (IA).

Heavy vehicle drivers, other road users and the community in general will benefit from the fitment of a Lane Departure Warning System (LDWS) that warns the driver of an unintentional lane departure especially as a result of monotonous driving situations such as on national or state highways and arterial roads. The crashes prevented by LDWS include multiple vehicle crashes due to lane departures by vehicles travelling in the same and opposite direction, as well as single-vehicle crashes to lane departures.

LDWS in combination with Advanced Emergency Braking Systems (AEBS) help prevent fatigue related crashes. Research shows it can also be effective in distraction monitoring by alerting a driver at the early stages of a loss of concentration. The crash types targeted by this technology include sideswipes, opposite sideswipes, run off road, rollover and head-on crash outcomes. Australian research notes that LDWS will be most effective in higher friction situations on edge marked roads in fine conditions and at higher speeds (Budd & Newstead, 2014).

## Lane Departure Warning Systems

Heavy vehicles with advanced safety technologies are rapidly entering the marketplace and the impact of new features are transforming safety on roadways. Among the numerous safety related technologies currently available in the market, this IA examines the case for mandating LDWS in heavy vehicles.

LDWS is a passive safety system and fit under the broad definition of Advanced Driver Assistance Systems (ADAS). This means that the system alerts the driver to a potential threat but does not assume control over any aspect of the vehicle. LDWS is particularly effective in situations where the road is continuously straight and drivers have a tendency not to pay sufficient attention.

LDWS are vision-based, in-vehicle electronic systems that monitor the heavy vehicle’s position within a roadway. Based on lane markings, LDWS warns a driver if the vehicle deviates outside of its lane.

In addition to its lane departure warning function, one of the applications for LDWS is as a fatigue monitor since tired drivers often drift on the road. Another application of LDWS is as a distraction prevention device. In either case, if the driver is distracted or tired and the heavy vehicle drifts, the LDWS will give a warning in some form to the driver that the vehicle is deviating out of its lane.

This IA presents the first estimations of the number of Australian crashes that could be reduced using LDWS and therefore could improve road safety outcomes. Its intention is to inform policy making and regulatory approaches to improving motor vehicle safety in Australia and to further recommend education and outreach activities to increase awareness of the benefits of LDWS.

This Final IA considers two options to increase the fitment of LDWS in new heavy vehicles supplied to the Australian market; 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 Impact Analysis (OIA) formerly known as the Office of Best Practice Regulation (OBPR) in early 2020.

Option 1 considers the Business As Usual (BAU) case where no intervention is made. For Option 2 the benefit-cost analysis assumes a start date (new models 2024 and all vehicles 2027), followed by 15 years of regulation (after which it is assumed the Australian Design Rule (ADR) would be reviewed). The analysis includes another 20 years past the period of regulation to capture the benefits from the 20 years of the crash profile of the last lot of heavy vehicles to be fitted with LDWS when the regulation stops.

The results of the benefit-cost analysis over a 37 year period for each of these options (assuming an intervention policy period of 15 years) are summarised in Table 1 to Table 3 below. Option 2: regulation generated the highest number of lives saved (62) and serious (1,725) and minor (5,370) injuries avoided, as well as the highest likely net benefit ($4.7 million), while retaining a likely benefit-cost ratio (1.0).

**Table 1: Summary of gross and net benefits for each option**

| | Gross Benefits ($m) | Net Benefits ($m) | |
|---|---|---|---|
| | | Best case | Likely case |
| **Option 1: no intervention** | - | - | - |
| **Option 2: regulation** | 221 | 82 | 4.7 |

**Table 2: Summary of costs and benefits-cost ratios for each option**

| | Costs ($m) | Benefit-cost ratios | |
|---|---|---|---|
| | | Best case | Likely case |
| **Option 1: no intervention** | - | - | - |
| **Option 2: regulation** | 216 | 1.6 | 1.0 |

**Table 3: Summary of lives saved and serious injuries (hospital admissions) avoided**

| | Lives saved | Serious injuries avoided | Minor injuries avoided |
|---|---|---|---|
| **Option 1: no intervention** | - | - | - |
| **Option 2: regulation** | 62 | 1,725 | 5,370 |

# Public Comment

A consultation version of this IA was circulated for an eight week public comment period, which closed on 3 June 2022. A summary of the feedback and department responses is included at Appendix I.

The implementation timeframe proposed for consultative purposes was 1 November 2024 for new vehicle models and 1 November 2026 for all new vehicles (for both heavy vehicles of ADR category M and N).

During the consultation period, feedback was received from members of the public, state government agencies, industry, road user organisations and technology development companies. Eight submissions were received for the IA released for consultative purposes with seven submissions supporting Option 2 to mandate LDWS for heavy vehicles. One confidential submission preferred Option 1 however in their detailed submission requested for two years lead time if an ADR is mandated.

In their written submission, the Truck Industry Council (TIC) recommended extended implementation dates as follows:

- 1 November 2024 for new model vehicles; and
- 1 February 2027 for all vehicles.

Road user groups and state and territory government submissions supported earlier implementation dates than what was proposed during the consultation period. In a post-consultation meeting with TIC to discuss their detailed submission the Department was informed the benefits derived in the IA released for consultative purposes was marginally overstated. TIC recommended adjusting the effectiveness of LDWS due to the lack of compliant road markings in roads in regional Australia. The effect of TIC's recommendations (implementation timing and varying the effectiveness) on the benefits and costs was examined in a post consultation sensitivity analysis, which also showed substantial benefits. TIC recommended including Australian specific road markings in the Appendix to ADR 99/01 – Lane Departure Warning Systems. They stated this would facilitate local testing of heavy vehicles manufactured in Australia as well as encourage state and territory governments to adhere to uniform requirements for lane markings.

The effect of this suggested delayed timing and varied effectiveness by industry on the derived benefits, costs and lives saved was examined in a post consultation analysis, which also showed substantial positive benefits in comparison with the IA released for consultative purposes in April 2022. LDWS fitment costs, testing and development costs for LDWS systems were increased in the benefit-cost analyses to accommodate LDWS system development and testing for models destined for the Australian market. There was a reduction in the trauma savings (7 less major injuries prevented and 18 less minor injuries prevented). The new timing provides for continuity of supply to the Australian market and certainty for businesses.

# Recommended Option

In line with the *Australian Government Guide to Regulatory Impact Analysis (Second edition 2020)*, the policy option offering the greatest net benefit should always be the recommended option. Therefore, Option 2: regulation is the recommended option. Under this option, fitment of LDWS would be mandated for all new heavy goods vehicles greater than 3.5 tonnes Gross Vehicle Mass (GVM) and all omnibuses. The proposed Australian vehicle categories are those covered by UN Regulation No.130 – equivalent ADR subcategories NB1, NB2, NC, MD and ME (Goods Vehicles and Omnibuses). The final implementation dates will be determined as part of the ADR by the Government in consultation with industry.

# The IA Process

This IA has been written in accordance with Australian Government requirements, addressing the seven assessment questions set out in the *Australian Government Guide to Regulatory Impact Analysis (Second edition 2020)*:

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 will you consult about these options and how will you consult them?
6. What is the best option from those you have considered?
7. How will you implement and evaluate your chosen option?

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

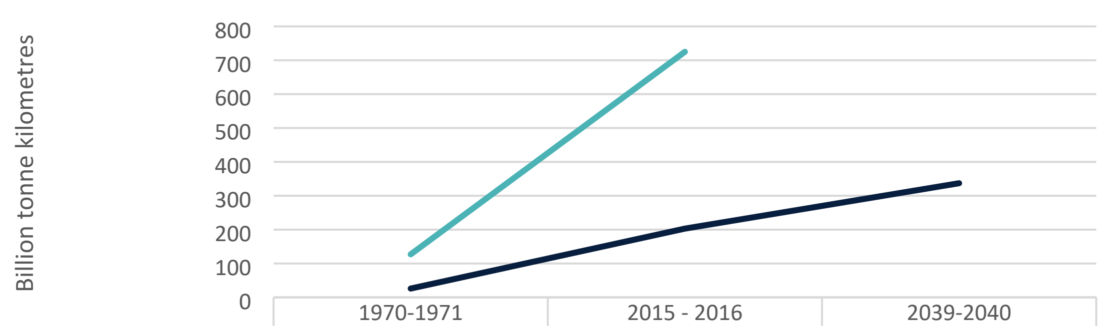
# Chapter 1: What is the problem?

## The impact of road trauma in Australia

The impact of road crashes on society is significant. Individuals injured in crashes must deal with pain and suffering, medical costs, lost income, higher insurance premium rates and vehicle repair costs. For society as a whole, road crashes result in enormous costs in terms of lost productivity and property damage. The cost to the Australian economy is approximately $30 billion per year (DITRDC, 2021). This equates to around 1,200 people fatalities each year on our roads, and almost 40,000 serious injuries (DITRDC, 2021) with an approximate cost of $80 million per day to the Australian economy. There is also a personal cost for those affected that is not possible to measure. Road trauma from heavy vehicle crashes costs Australia approximately $1.5 billion each year. This cost is broadly borne by the general public, businesses and government.

Heavy vehicles represent almost four per cent of all registered vehicles in Australia (ABS, 2020a) and account for just under nine per cent of total vehicle kilometres travelled (VKT) on public roads (ABS, 2020b). However, they are involved in almost 16 per cent of all fatal crashes (BITRE, 2021a). While heavy vehicle crashes are lower relative to other road users, these crashes are more likely to result in a death or serious injury and contribute to disproportionate harm to other road users. Over the three years ending March 2021, an average of 186 people were killed annually in 166 crashes involving heavy trucks or buses (BITRE, 2021b). The most recent available data (2018) shows that 1,877 people were hospitalised from road crashes involving heavy trucks or buses (BITRE, 2020). Approximately 500 heavy vehicle occupants are hospitalised from road crashes annually. Of these, approximately 30 per cent are categorised with high-threat-to-life injuries (DITRDC, 2021). For these reasons, heavy vehicle crashes continue to draw attention from policy makers, road safety advocates, the general public and the heavy vehicle industry itself. Alongside this, our road freight task is increasing across major cities to support the demands of continuous economic and population growth. The most recent data indicates articulated trucks and rigid trucks travelled 78,300km and 21,200km on average in the last year in comparison with 11,000km travelled on average by passenger vehicles (ABS, 2020b). This increase in economic activity however, should not result in greater trauma if the elements of our road transport system are inherently safe.

The Australian total freight task (road, rail, sea and air) has grown more than four-fold over the four-and-a-half decades to 2016, from around 127 billion tonne kilometres in 1971 to over 725 billion tonne kilometres in 2015–16—an average rate of growth of over 3.9 per cent per annum. Figure 1 shows that over that period road freight has increased eight-fold, from around 26 billion tonne kilometres in 1970–71 to around 203 billion tonne kilometres in 2015–16. Road freight volumes are projected to grow by around 56 per cent between 2018 and 2040 (central estimate) to around 337 billion tonne kilometres by 2040—average annual growth of 2 per cent per annum (BITRE, 2019a). At the same time, the higher rates of crashes involving heavy vehicles has drawn increasing attention from policy makers, road safety advocates and the general public, as well as from the heavy vehicle industry itself.




| | 1970-1971 | 2015 - 2016 | 2039-2040 |
|---|---|---|---|
| Road Freight Task | 26 | 203 | 337 |
| Total Freight Task | 127 | 725 | |

**Figure 1: Australian road freight task growth (historical and predicted)**

Road freight services, in particular, touch nearly every sector of the economy to varying degrees. Road transport is the predominant mode of transport for urban, inter-urban and regional freight, and part of the supply chain for most imports to Australia. Even the large mineral resource industries that rely on rail or coastal shipping for transport of their outputs, are dependent on road freight to transport machinery, capital equipment and other supplies to mine sites.

Heavy vehicle crashes costs the Australian economy around $1.5 billion each year, including around $63 million (Budd & Newstead, 2014) from crashes involving multiple vehicle crashes due to lane departures by vehicles travelling in the same and opposite direction, as well as single-vehicle crashes to lane departures.

Heavy vehicles drifting outside their lane is the specific road safety problem that is considered in this IA. Approximately half of all Australian road deaths result from head-on crashes or single vehicle runoff-road crashes - where a vehicle has run off the road into the path of another vehicle - or a collision with a fixed object such as a tree or pole (ANCAP, 2020). These may occur because a driver has been distracted or is inattentive, tired or fatigued, or simply stray too far beyond the marked lane, resulting in a serious crash or fatality.

Furthermore, heavy vehicles have characteristics that increase both the risk and severity of both no-fault and at-fault crashes with other road users (NTARC, 2019). These include a high gross mass, larger dimensions, reduced opportunity to manoeuvre, and longer stopping distances. A reduction in these types of crashes is particularly important in regional and remote areas of Australia, where the majority of roads are un-divided, single carriageways. 62 per cent of fatalities occur as a result of lane departure crashes (ANCAP, 2020).

# Road trauma involving heavy vehicles

## Fatalities

The Australian Road Deaths Database, maintained by the Bureau of Infrastructure, Transport and Regional Economics, provides basic details of road crash fatalities in Australia as reported by the police each month to the state and territory road authorities. This includes details on the number of fatal crashes and fatalities in crashes involving heavy articulated trucks (prime movers), rigid trucks and buses.

During the 12 months to the end of June 2021, 182 people died from 168 fatal crashes involving heavy trucks and buses. Over the period 2018-2021, an average of 170 people have died in 152 fatal crashes involving heavy trucks and buses each year (BITRE, 2021a).

Figure 2 shows the annual number of fatal crashes involving prime movers (articulated trucks), heavy rigid trucks, heavy trucks and buses in Australia for each year in the period 2012 to 2021, while Figure 3 shows the corresponding number of fatalities.

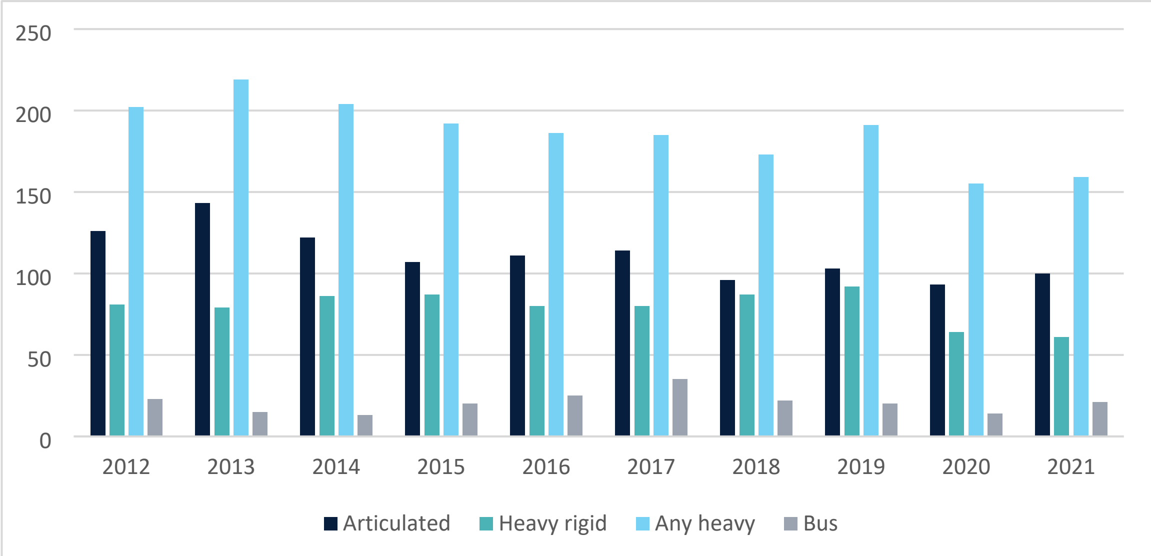



**Figure 2: Fatal crashes involving heavy trucks and buses in Australia, annual totals 2012-2021**

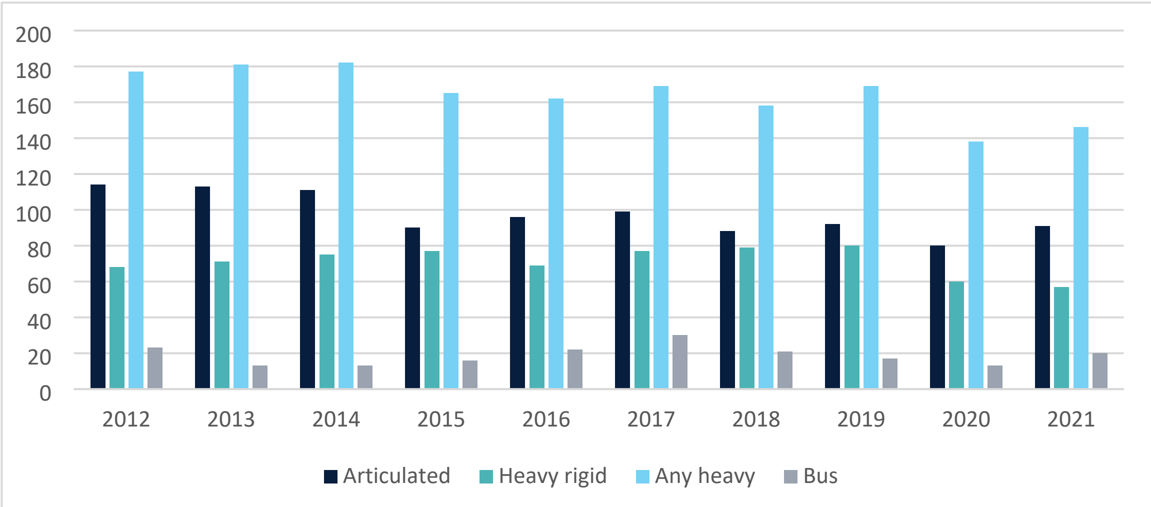



**Figure 3: Fatalities in crashes involving heavy trucks and buses in Australia, annual totals 2012-2021**

Historic data shows that fatalities in crashes involving prime movers (articulated trucks) decreased by nearly 40 per cent between 2007 and 2013 (DITCRD, 2019), and have been relatively constant since then up to the year 2020 (Figure 3). Fatalities in crashes involving rigid trucks and buses have been relatively constant over the last 10 years with a noticeable reduction in the last two years for the heavy rigid truck group.

The data supporting Figures 2 and 3 also shows that:

- Fatalities in crashes involving articulated trucks increased by 7.5 per cent by June 2021 when compared with the corresponding period one year earlier.
- Data trends reveal the fatalities in crashes involving articulated trucks increased by an average of 0.2 per cent per year over the last three years to June 2021.
- Fatalities in crashes involving heavy trucks also increased by 2.6 per cent by June 2021 when compared with the corresponding 12-month period one year earlier.

This increasing rate of trauma for the heavy vehicle sector is alarming considering the impact of the COVID pandemic on the Australian economy by reducing the road freight task and road use in general. However, it must be noted that the urban and metro road freight task increased as consumers were limited in their ability to purchase goods in a typical retail shopping environment. Instead goods were purchased online and delivered to a consumer's residence by truck or van. During the second quarter of calendar 2020, estimated vehicle kilometres travelled (VKT) declined by 22 per cent (BITRE, 2021a). In the 3rd and 4th quarters of 2020, both VKT and deaths increased to historical trend levels.

Taking into account fatality rates and crash data, fatal crashes involving heavy trucks and buses cost the economy approximately $980 million annually (MUARC, 2020).

## Serious and minor injuries

The National Injury Surveillance Unit at Flinders University, using the Australian Institute of Health and Welfare National Hospital Morbidity Database compiles data on hospitalisation due to road crashes, including those involving heavy vehicles. This shows that road injury while driving a heavy vehicle accounted for (age-standardised rates) 4 cases per 100,000 population (AIHW, 2018). 2017-2018 is the most recent data available and shows that 1,824 people were hospitalised from road crashes involving heavy vehicles (BITRE, 2019b). Prior to these two years, the previous five years of available data (2013 to 2016) in Figure 4 show that close to 1,773 people were hospitalised each year on average from road crashes involving heavy vehicles. This indicates an increasing trend in hospitalised injuries as a result of heavy vehicles on Australian roads, partly due to the growth in the road freight task over the last decade.

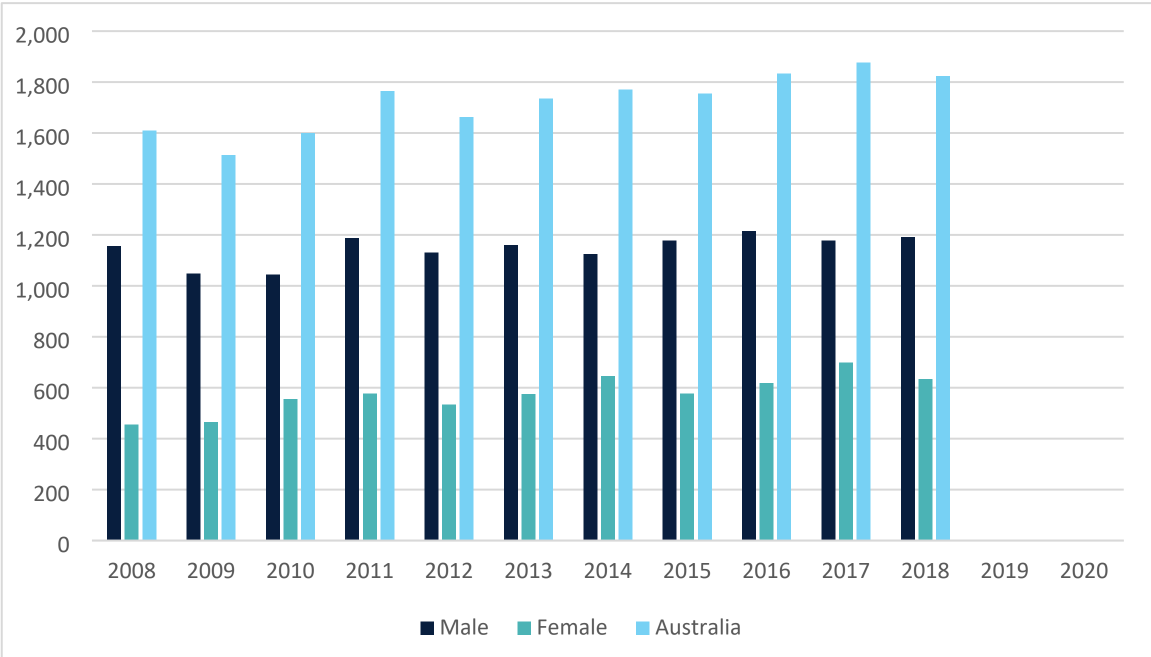



**Figure 4: Hospitalised injuries involving heavy trucks or buses by Gender**

Approximately 500 heavy truck occupants are hospitalised from road crashes each year. Of these, approximately 30 per cent are categorised with High-threat-to-life injuries (ORS, 2021).

While not a perfect measure, hospital admission provides the best available indication of serious injury crashes in Australia. With current annual serious injury rates and crash data available, serious injury crashes involving heavy trucks and buses in Australia cost approximately $520 million each year (MUARC, 2020).

# Attributes of heavy vehicle crashes

## Heavy vehicle factors

Heavy vehicles are defined as goods vehicles over 3.5 tonnes Gross Vehicle Mass (vehicle and load). Heavy vehicles are over-involved in severe road crashes, since their high mass leads to severe consequences for other road users involved in the event. In view of this and the growth in heavy goods vehicle traffic internationally and locally over the last twenty-five years, the safety performance of heavy goods vehicles continues to be strictly regulated in the best performing countries in road safety.

While busses are a sub-group of heavy vehicles, they do not figure as prominently in the road safety statistics. In fact, transport by bus and coach is considered the safest mode of road transport. Nevertheless, a total of 20 people were killed in crashes involving buses in 2019 and the trend over the last 10 years was a slight annual increase in deaths of 0.6 per cent (BITRE, 2021a).

The particular characteristics of these vehicles strongly influence – in a positive or negative way – the occurrence of road crashes and these characteristics relate to the:

- vehicle — different traction characteristics, increased dimensions and weight
- driver — professional heavy vehicle drivers spend more time driving
- vehicle use — commercial use must meet several efficiency and performance criteria

Due to the mass of heavy goods vehicles and buses/coaches, people involved in collisions with these types of vehicles suffer the most severe consequences regardless of them being occupants or outside the vehicles.

## Driver factors

Distraction, fatigue, driver inexperience and error can be causal factors in heavy vehicle crashes. Risky driving behaviours and errors include excessive speed, violations of speed limits, excessive lateral acceleration on curves, unplanned lane departures, frequent hard braking, close following distances, lateral encroachment, failure to yield at intersections, distracted driving, and general disobedience of the rules of the road. Actions to reduce the extent of these factors have generally focused on heavy vehicle drivers and fleet managers. However, in fatal multi-vehicle crashes involving a heavy vehicle, another vehicle is at fault in up to 78 per cent of incidents (NTARC, 2021). This trend has been consistent with previous years of NTARC crash data.

The work environment for the heavy vehicle driver poses many challenges - long distances, scheduling shifts, poor road and infrastructure quality, driver fatigue and inattention and vehicle or load-related issues (NHVR, 2021). In addition, personal sleep disorders for heavy vehicle drivers, such as sleep apnea, can increase the risk of a heavy vehicle crash occurring (Meuleners et al., 2015). In recent years, there has been increased research and development activity focussed on producing fatigue and/or distraction detection technologies for the transport industry. In the last five years, advances in computer technology, video software analyses and automation have resulted in wide-spread availability of low-cost detection technologies with a relatively high level of accuracy in detecting unsafe and high risk in-cab behaviours. Compared with the current prescriptive hours of work laws and regulations administered by the National Heavy Vehicle Regulator (NHVR), these technologies hold considerable promise in detecting unsafe and high-risk driving behaviours with a high degree of specificity and sensitivity.

# Government actions to address heavy vehicle trauma

A collective effort by the federal and state governments to increase the proportion of heavy vehicles on the road network with high quality primary safety technologies such as ABS, ESC, AEB and LDWS and secondary safety features, can achieve a progressive and significant reduction in Australia's road trauma levels. Early adoption of existing vehicle safety technology has provided important safety gains. Through the Office of Road Safety (ORS), the Australian

Government allocates dedicated funding for a number of road safety programs. The Australian Government also funds the Heavy Vehicle Safety Initiative (HVSI) administered by the National Heavy Vehicle Regulator (NHVR).

## Road Safety Programs

The Australian Government manages infrastructure and non-infrastructure programs that facilitate the work towards Vision Zero by federal, state, territory and local governments and the road safety sector. This includes:

- administering the Australian Government's $25 billion, four-year road safety investment
- administering grants for sector-led road safety initiatives
- developing new programs and initiatives to support the goal of Vision Zero by 2050 and interim targets set through the National Road Safety Strategy

## Heavy Vehicle Safety Initiative (HVSI)

The Heavy Vehicle Safety Initiative (HVSI) program supports implementable, value-for-money projects that deliver tangible improvements to heavy vehicle safety. The grants program has allocated over $28 million to 117 projects. Of the 6 rounds funded to date, successful projects are delivering outcomes aimed at making Australia's roads safer for all users. Some examples include:

| Organisation | Project Name | Project Description |
|---|---|---|
| Metro Tasmania | Intelligent Transport Advanced Driver Assistance Systems | Improve the safety of Tasmanian roads by reducing pedestrian fatalities, at fault collisions and enhancing driver performance through the installation of Mobileye advanced driver assistance technologies. |
| Orange City Council and Cabonne Shire Council | Power Nap - Don't Ignore the Early Warning Signs of Driver Fatigue | Intervention strategy delivering Power nap and Driver Fatigue Awareness Day, a behavioural change campaign. To improve safety and reduce stress and anxiety in Heavy Vehicle drivers. |
| South Australian Road Transport | Heavy Vehicle Simulator | Purchase an HVS to provide general heavy vehicle skills training, including driving on high risk routes in South Australia, fatigue management and research. |
| Wodonga Institute of TAFE | Multi-media Advanced Emergency Braking (AEB) Project | Educate transport operators and drivers about the benefits of voluntary early adoption and limitations of Electronic Stability Control and Advanced Emergency Braking safety technologies. |

## Driver Reviver Site Upgrades

The Australian Government is investing $8 million over two years to improve amenities at driver reviver locations nation-wide and to support the establishment of new sites.

**Round one**

Nearly $700,000 was shared by 22 organisations to purchase portable electronic variable message signs for 34 Driver Reviver sites around Australia under round one of the program.

These signs promote awareness for operational Driver Reviver sites and are available for other road safety messaging when not required at the Driver Reviver sites.

**Round two**

$7.2 million was committed under round two of the Driver Reviver program to upgrade 71 roadside rest areas across the country.

Activities to be completed under round two, announced in September 2021 will include improvements to shelters, picnic tables, power and water facilities, barbeques, parking, lighting and kitchen facilities.

The upgrades will assist volunteers to better support motorists manage their fatigue on long journeys, reducing the risk of crashes causing deaths and serious injuries.

## State and Territory Government actions

State and territory governments target identified heavy vehicle safety concerns 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
- Road safety education and
- Drivers to consider new and proven vehicle technology when purchasing a new vehicle.

Actions taken by state and territory governments to address heavy vehicle lane departure crashes include:

**Australian Capital Territory (ACT)**

The ACT is currently undertaking an assessment of ACT road infrastructure for compatibility with ADAS. By digitally mapping the ACT road network using the Mobileye system, information about the suitability of the ACT road network for ADAS technologies will be gathered. This will contribute to the effectiveness of LDWS.

**Victoria**

As there are a number of major road and rail projects underway across Victoria, there is an increasing presence of trucks on roads as they transport material, equipment and machinery. This means more potential interactions between VRUs and trucks. In partnership with state government departments, non-government organisations and industry, the Construction Truck and Community Safety Project provides new tools and ways of working to improve safety for VRUs.

The Victorian government is working to reduce the risks to vulnerable road users through a range of approaches including:

- fitting additional safety equipment to some heavy vehicles,
- raising awareness with truck drivers on sharing the road with VRUs,
- improving the design of temporary road and footpath diversions around worksites, and
- providing information to VRUs about the safest behaviours around trucks.

To improve the safety of older vehicles, the Department of Transport (DoT) is monitoring the development and effectiveness of technology which can be retro-fitted in both light and heavy vehicles.

The Victorian government is working collaboratively with contractors to progressively fit safety equipment to some of the heavy vehicles servicing the higher risk worksites to enhance safety conditions for VRUs. This equipment includes:

- side under-run protection,
- cameras, mirrors and sensors to eliminate blind spots,
- signage warning VRUs about blind spots, and
- devices to sound a warning when the vehicle is about to turn left.

The Victorian government notes that generally, ADAS such as AEB and fatigue detection can only be fitted by the vehicle manufacturer. These technologies require extensive development and complex calibration for them to operate safely and reliably with other systems in the vehicle. Accordingly, it is expensive and often not possible for these systems to be retro-fitted.

Considerations have been made to include these advanced safety systems that cannot be easily nor readily retrofitted onto in-service heavy vehicles for future contracts. On a contract-by-contract basis where new vehicles are required to be purchased, they will require safety technologies such as LDWS. After-market products which provide audible, visual and haptic warnings to drivers continue to be monitored to assess the effectiveness and feasibility for retro-fitting.

The DoT has designed and developed two e-Learning online courses to help educate fleet owners on the importance of ADAS in reducing road trauma. The courses help participants to make informed decisions and to only purchase the safest vehicle for their needs. DoT is exploring ways to roll these courses out to the wider community including heavy vehicle fleet operators.

**New South Wales**

The NSW Government fleet operational guidelines (*Motor Vehicle Operational Guidelines* (NSW Government, 2021)) requires, where practicable and available, LDWS for heavy vehicles. These guidelines inform the Motor Vehicle Scheme, which covers the supply of motor vehicles to the NSW Government fleet.

Also since 2012, Transport for NSW has been promoting safety technologies such as LDWS through the *Safety Technologies for Heavy Vehicle and Combinations* publication. The latest edition was published in 2020 (TfNSW, 2020).

**Tasmania**

'Lane departure' crashes (run-off-road and head-on crashes) account for over two thirds of serious casualties on Tasmanian roads. Strategies to reduce lane departure crashes have the greatest potential to improve road safety in Tasmania.

The most common 'lane departure' crash type resulting in serious casualties is run-off-road crashes. Runoff-road crashes occur when a vehicle veers off the roadway or across the opposing traffic lane. Run-off-road crashes account for almost one in two serious casualties. The severity of this type of crash can be reduced by protecting roadside hazards with safety barriers or removing hazards where practicable. Improved line marking (delineation), including audible edge lines and road edge widening, can help in preventing this type of crash from occurring.

The other form of 'lane departure' crash is head-on crashes, which occur when vehicles travelling in opposing directions impact one another head/front on. Head-on crashes have increased and represent around one fifth of serious casualties. Physically separating opposing traffic with median or centreline barrier is an effective method to prevent this crash type. Improved delineation can also help in reducing head-on crashes. Active vehicle technologies such as ESC, LDWS, and AEB will increasingly play an important role in preventing lane departure crashes or reducing the severity when a crash of this type occurs

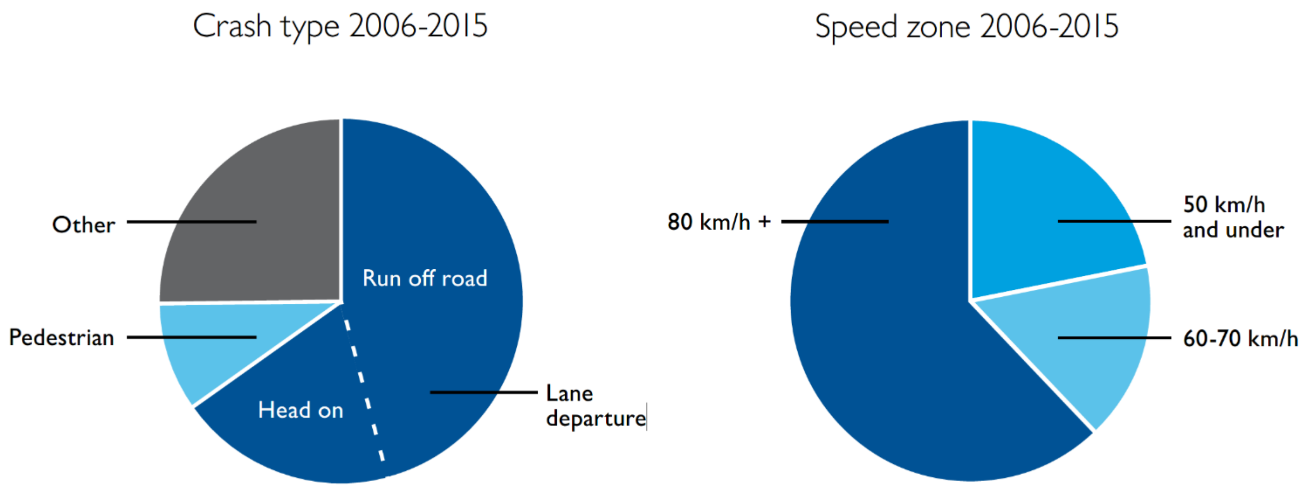



**Figure 5: Towards Zero Tasmanian Road Safety Strategy 2017-2026 (DSG, 2016)**
***Typical occurrence of lane departure crashes (left) Typical speed zones where lane departure crashes occur (right)***

The Tasmanian government's key directions for safe roads and roadsides are:

- reduce run-off-road and head-on crashes through improved infrastructure
- reduce the severity of intersection crashes through improved infrastructure treatments
- encourage the latest thinking in safe road design (the Safe System approach)
- monitor the latest innovations in Safe System infrastructure treatments and trial in Tasmania
- reduce serious casualties through improved delineation (e.g. line marking)

# Austroads - Harmonisation of Pavement Markings and National Pavement Marking Specification

Pavement markings constitute a key element of safe system infrastructure to all road users. Consistent line markings will assist the implementation of new vehicle control technologies, such as other Advanced Driver Assistance Systems (ADAS) including LDWS. These systems operate by 'reading' the road and rely on high quality line markings to function effectively and as intended by the vehicle manufacturer. Current levels of sophistication in vehicle technology require infrastructure to support their effectiveness. It is possible that future developments in these systems will be less dependent on fully harmonized and high quality line markings.

To enable ADAS, Austroads recently investigated the longitudinal and transverse line marking types and widths and other pavement markings (Austroads, 2018). The study resulted in an update to Australian Standard AS 1742.2:2009. The new version is AS 1742.2:2022 and recommends that edge lines need to be 150 mm wide with a minimum retroreflectivity of 150 millicandela (mmcd/lux/$m^2$; mcd).

However, specifications for pavement markings and materials differ between road agencies and the intervention levels for the replacement or remarking of pavement markings also differ; as a result, many do not comply with Australian Standard AS 1742.2:2009. There is a strong need for harmonised performance-based specifications and design criteria for pavement markings. The development of a harmonised performance-based specification for line markings has been on the Austroads Road Authority Pavement Markings Group (RAPMG) agenda for several years.

## 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 ADRs, before they can be offered to the market for use in transport in Australia. The ADRs set minimum national standards for vehicle safety, emission and anti-theft performance, which includes the use of technological measures to reduce crashes from heavy vehicles leaving their lane unintentionally.

Once a vehicle is supplied to the market in Australia, regulation passes to the state and territory governments, which are responsible for in-service requirements such as registration, road-worthiness and vehicle modifications. This is principally done through legislation based on the Australian Light Vehicle Standards Rules (ALVSRs), which is managed by the National Transport Commission (NTC), and the Heavy Vehicle National Law (HVNL), which is administered by the National Heavy Vehicle Regulator (NHVR). WA and NT have their own arrangements for administering heavy vehicles within their jurisdictions. Both the ALVSRs and the HVNL have as a general principle that vehicles will continue to comply with relevant ADRs even when fitted with replacement parts or modifications. The ALVSRs cover areas such as light vehicle emissions and car safety standards.

### Front Underrun Impact Protection Devices

When a heavy vehicle unintentionally deviates from its lane and enters oncoming traffic, a head-on collision can occur between the heavy vehicle and a light vehicle causing vehicle underrun, thereby increasing the severity of the outcome. This has been mitigated as much as possible by the introduction of ADR 84 - Front Underrun Impact Protection in 2009. Front underrun protection systems reduce the severity of trauma when a head-on collision occurs between a heavy and a light vehicle, but cannot reduce the frequency of those collisions. Whereas actions targeting heavy vehicle drivers and fleet managers can help reduce the frequency of heavy vehicle at-fault crashes, technology such as LDWS can also help prevent such crashes occurring.

### Construction Logistics and Community Safety-Australia (CLOCS – A)

CLOCS-A is a national approach for managing the risks and impacts associated with a construction project’s on-road transport and logistics activities to community road safety. It was developed to provide a consistent framework for industry to achieve and has been inspired by the success of the Construction Logistics and Community Safety (CLOCS) program established in the United Kingdom in reducing road trauma associated with construction logistics.

The CLOCS-A program has established a safer vehicles technical group to develop supporting standards, policies and tools required in construction and transport vehicles supporting construction projects to reduce harm (CLOCS-A, 2021). Recognising the movement of construction vehicles in populated areas can present hazards for the public, particularly vulnerable road users, CLOCS-A seeks to prioritise and promote the use of safer heavy vehicles through awarding accreditation on a 3-tiered approach – that is Bronze, Silver and Gold (CLOCS-A, 2022).

Lane Departure Warning has been identified under the Gold tier as encouraging leading safety technologies and to future proof vehicles. This forms the highest mandatory standard for heavy vehicles complying with the CLOCS-A technical requirements (CLOCS-A, 2022).

# Chapter 2: Why is government action needed?

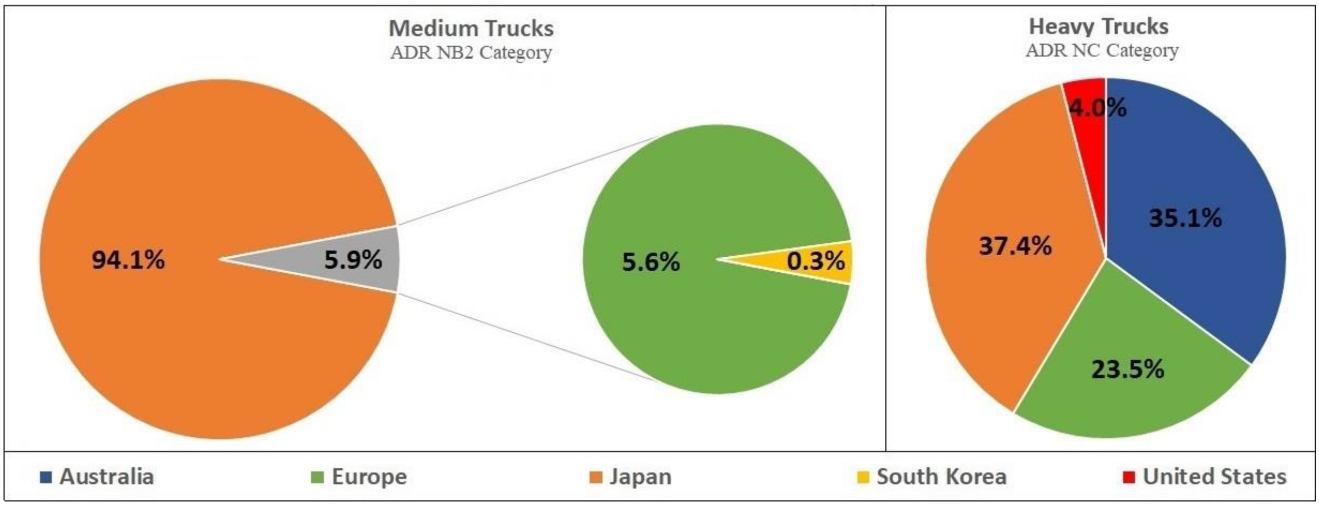
## The need for government action

Government action may be needed where the market fails to provide the most efficient and effective solution to a problem. In this case the problem is that crashes involving a heavy vehicle drifting outside its lane are estimated to cost the Australian community around $63 million every year (Budd & Newstead, 2014). These crashes are not reducing as much as they could, given the availability of effective safety technologies.

In Australia, the introduction of safety technologies through market action alone is significantly slower for heavy vehicles than it is for light vehicles. A major reason for this is the nature of construction of heavy vehicles. In comparison to light vehicles (for example cars and Sports Utility Vehicles), heavy vehicles are more likely to be built to order, with engines, drivetrains, suspensions, brakes, axles and safety systems individually specified by the purchasing business. Heavy vehicles constitute a substantial financial investment and are generally configured for business use. Purchasers may in some instances focus primarily on maximising economic productivity rather than on the safety of other road users.

A significant number of heavy vehicles are built in Australia specifically for the Australian market - more than 35 per cent of heavy duty trucks (see Figure 6 below), more than 80 per cent of the heavy haulage vehicles used in the mining industry and around 95 per cent of heavy trailers. Around two thirds of heavy trucks are imported, mostly from Japan or Europe. This means that the designs and regulations effective in other markets will have a lesser influence on the makeup of the Australian heavy duty truck fleet. Consequently, the rate of fitment of primary and secondary safety systems in the Australian heavy vehicle market is likely to remain relatively independent of fitment rates in other markets, in the absence of market intervention.

**Figure 6: Truck sales in Australia by country/region of manufacture (Truck Industry Council, 2021).**




Businesses profit from the manufacture of heavy vehicles and from their operation on Australia's public road network. However, heavy vehicle trauma and associated financial costs are borne by all road network users and the broader Australian community more generally. Though actions targeting drivers and fleet managers can reduce the frequency of heavy vehicle at-fault crashes, technology such as ABS, ESC, AEB and LDWS can also prevent crashes and/or mitigate crash severity.

Australian research (Budd & Newstead, 2014) showed that although only four per cent of Australian heavy vehicle crashed vehicles were identified as sensitive to LDWS, the protection offered was greater for higher severity crashes with 11 per cent of fatal crashes sensitive to LDWS.

# Availability and uptake of LDWS

LDWS was generally not fitted to heavy vehicles delivered to the Australian market prior to the middle of 2016, as reported by the Truck Industry Council (TIC). Since then, LDWS has typically been offered as part of a more expensive package of optional safety upgrades to purchasers of new heavy vehicles. This kind of advanced safety package also included AEB in most cases. Figure 7 shows a significant increase in the fitment rate for prime movers and NB1 category rigid vehicles with no market intervention, however the data shows a stagnation in the growth of the fitment rate in the last three years.

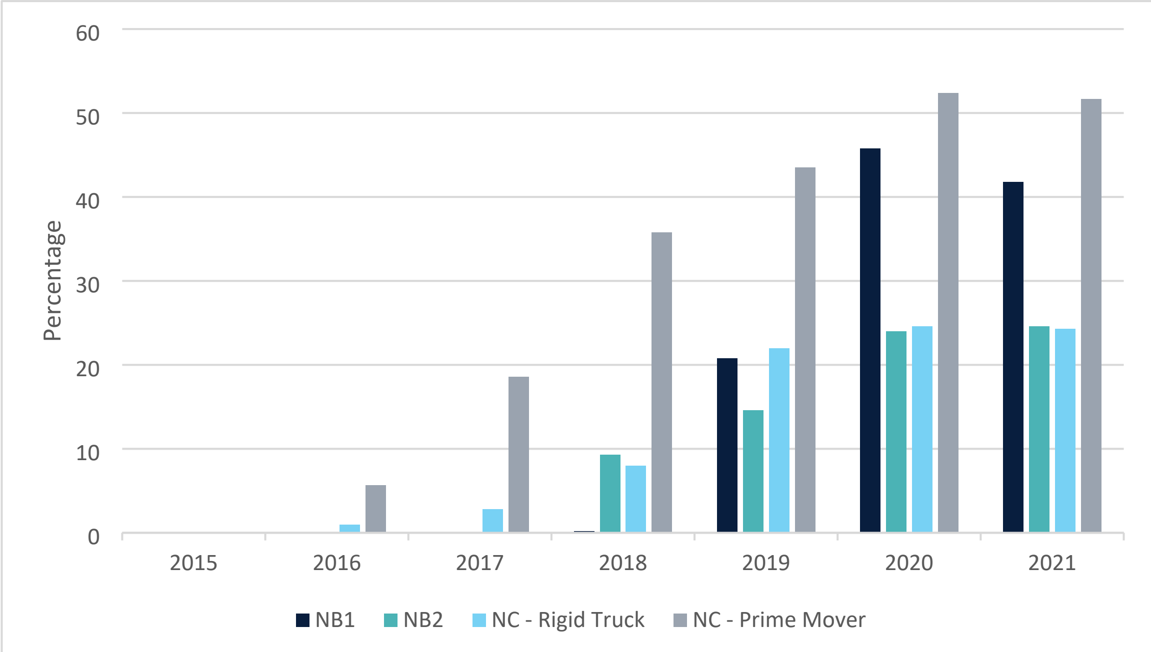



**Figure 7: Australian Truck LDWS Fitment Rates 2015 – 2021 (TIC, 2021)**

Heavy vehicle LDWS fitment rates have remained low with only around 36 per cent of all new heavy vehicles sold in 2021 being fitted with LDWS complying with internationally adopted standards. Table 4 below shows that most of these are in the heavy duty prime mover segment at 51.7 per cent (NC category prime mover). The remaining fitment of LDWS in new heavy vehicles sold in 2021 occurs in close to 41.8 per cent of NB1 category rigid vehicles, 24.6 per cent of NB2 category vehicles and 24.3 per cent in NC category rigid vehicles.

**Table 4: Industry reported LDWS fitment to heavy vehicles (TIC, 2021)**

| | Total new heavy vehicle sales (as reported) | | | | Estimated number of new vehicles fitted with LDWS (as reported) | | | | Estimated fitment of LDWS per category (%) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **ADR Category** | NB1 | NB2 | NC Prime | NC Rigid | NB1 | NB2 | NC Prime | NC Rigid | NB1 | NB2 | NC Prime | NC Rigid |
| | **16225** | **8135** | **6000** | **9000** | **6781** | **1997** | **3102** | **2188** | **41.8%** | **24.6%** | **51.7%** | **24.3%** |

In Australia, the fitment of LDWS is significantly higher for NC category heavy duty prime movers than for other heavy vehicle categories. The reason for this is not clear, but it may relate to the higher value of these prime movers and the loads that they carry. A heavy vehicle owner is more likely to order the technology if its cost is less relative to the overall cost of the heavy vehicle. Another factor may be the awareness of owners of heavy duty prime movers to a greater exposure to high loads, long distances and highway speeds. This means that there are greater consequences should a crash occur.

# Consumer knowledge

Road vehicles today are complex machines which operate in a high risk environment, leading to 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.

It is 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 that of other road users.

There is some help available for the consumer to assist with the choice of purchasing a new vehicle in the light vehicle segment. The Australian New Car Assessment Program (ANCAP) publishes safety ratings for a range of new passenger, sports utility (SUV) and light commercial vehicles (LCV) entering the Australian and New Zealand markets, using a rating system of 0 to 5 stars. ANCAP has reported that the number of top 100 selling light vehicle models offered with a LDWS as standard fitment has increased from 35 per cent of the market in June 2019, to 53 per cent of the market in June 2020 (ANCAP, 2021).

Unlike the light vehicle fleet, there are no national consumer safety ratings schemes for new heavy vehicles. Despite LDWS being a demonstrated safety technology, new heavy vehicles are generally configured with an emphasis on productivity, with a lower level of passive and active safety features than is typical of light vehicles. To provide a suitable and sufficient risk assessment of vehicles, governments around the world have over the past 20-30 years 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 other road users.

## Vehicle technology interventions

As early as 2004 (MUARC, 2004), Australian experts identified the potential of several heavy truck and bus advanced safety technologies as promising countermeasures to reduce crashes involving heavy vehicles and buses. These safety technologies are commonly referred to as Advanced Driver Assist Systems (ADAS). They may use sensors or alerts to warn a driver of a possible collision, actively assume control of a vehicle in situations where a driver does not react to the threat of an imminent crash, or improve driver and fleet management (e.g., monitoring vehicle safety systems and drivers’ hours-of-service status). Although some ADAS may be effective at preventing crashes, it is also important to know whether they are cost-effective, as this information may assist consumers in purchasing advanced safety technologies and/or government regulators in mandating their use. Research suggests that LDWS fitted to heavy vehicles may reduce up to six per cent of fatal heavy vehicle crashes (TfNSW, 2020).

On-board safety systems for heavy commercial vehicles have been developed and implemented over a considerable period of time, ranging from anti-lock braking systems (ABS) and speed control, through stability control (ESC, RSC), forward collision warning (FCW), adaptive cruise control (ACC) and driver drowsiness monitoring, to crash-imminent braking (AEB). Improvements to heavy vehicle design and safety features therefore have contributed to reducing the number and severity of heavy vehicle crashes. Some technologies have additional benefits such as improving driver and passenger comfort. Some of the more advanced technologies come at a cost but many are inexpensive over the longer term, and insignificant compared to the overall cost of the vehicle, as well as practical to integrate into the heavy vehicle architecture at the design and production phase of a new heavy vehicle.

Crash avoidance features are safety technologies that assist the driver to reduce the likelihood of a crash. Other crash avoidance features actively intervene in the driving task to prevent or mitigate a crash. Research (Budd et al., 2015) has shown these systems to be effective in reducing crashes – in some cases, highly effective – and implementation has taken place through the voluntary action of manufacturers and fleets, and in other cases through government-mandated requirements for new vehicles.

# Lane Departure Warning Systems

Lane departure warning systems (LDWS) have been in development by industry for over 20 years. LDWS are generally visual devices that look at the lane line markers to compute a predicted moment of lane departure and alert the driver when unintended lane departures are about to occur without causing undue false warnings due to subtle lateral lane position changes. Beginning with simple line scan video, LDWS have developed into sophisticated lane marker identification and lane boundary projection systems that provide the driver with a warning if the vehicle deviates out of its lane. While most LDWS apply video technology, other methods include infrared, Lidar, magnetic, and electronic mapping technologies.

Initial LDWS development was for standalone systems, but with the mandate for ESC (ADR 35/06 – Commercial Vehicle Brake Systems) systems on heavy vehicles in Australia, OEMs are looking toward future sensor fusion, or combining LDWS, Forward Collision Warning (FCW) and Blind Spot Warning (BSW) with stability controls. These integrated perimeter sensing systems would then provide the driver with warnings from 360-degrees of roadway observations, rather than just a narrow look ahead. Once integrated, the sensor array may be further infused into the stability control systems (ESC, RSC, ABS) and future vehicle-to-vehicle and vehicle-to-infrastructure intermodal communications. These combined systems would enhance crash avoidance mitigation solutions, and play important roles in setting pre-crash conditions that would reduce crash related trauma (NHTSA, 2014).

LDWS offer significant safety benefits as a large number of heavy vehicle crashes involve a single vehicle running off the road. A LDWS warns a driver when the vehicle unintentionally crosses a distinguishable lane boundary. The system uses optical signal processing techniques to determine the position of the vehicle within the lane as well as monitoring the driver’s input through their steering and indicator use. If the driver takes no action when the vehicle deviates from the lane, the system will warn the driver. This system combines very effectively with an AEB system. A LDWS cannot function on roads where lane delineation is poor or non-existent. LDWS can assist in fatigue and distraction monitoring by alerting a driver at the early stages of a loss of concentration. A LDWS can be retrofitted.

# Summary of UN Regulation No. 130

Since attaining WP.29 endorsement in 2013, the recognised international standard for LDWS for heavy vehicles is *UN Regulation No. 130 (R130) – Uniform provisions concerning the approval of motor vehicles with regard to the Lane Departure Warning System (LDWS)*. It is applicable to omnibuses (UN category $M_2$ and $M_3$ vehicles), and goods vehicles with a maximum mass over 3.5 tonnes (UN category $N_2$ and $N_3$ vehicles).

To meet UN R130, a LDWS must be active at vehicle speeds above 60 km/h (unless manually deactivated). The LDWS is required, when active, to warn the driver if the vehicle crosses over a visible lane marking, when there has been no purposeful demand to do so. If the means (e.g. a switch) is provided to manually deactivate the LDWS, the LDWS function must be automatically reactivated at the start of each new ignition on (run) cycle, and a constant optical warning must be provided to inform the driver when the LDWS is deactivated. See Appendix D for a more detailed discussion of the performance requirements of UN R130.

## Key objectives of government action

The reasons why government should intervene in the market and introduce a new regulation to mandate the fitment of LDWS for new heavy vehicles have been demonstrated in this and the previous chapter. This includes increased road safety for all vehicle occupants and road users, preventing heavy vehicle driver fatigue attributed crashes and ensuring the Australian heavy vehicle fleet is fitted with the latest safety technology by maintaining alignment with internationally agreed standards for heavy vehicles.

In the first chapter it was shown that there are still an unacceptably high rate of people getting killed and seriously injured from unintentional lane departures. Such crashes include sideswipes, opposite sideswipes, run off road, rollover and head-on collisions.

A significant reason for government action is that voluntary fitment of LDWS is still low, despite a range of information campaigns and quasi-regulation through government contracts. The availability of an international standard for LDWS and the introduction of ESC for heavy vehicles in Australia makes it viable to examine the introduction of a regulation to mitigate and prevent such crashes.

# Chapter 3: Policy options considered

Two options to increase the fitment of LDWS to new heavy vehicles supplied to the Australian market 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 in early 2020 with the Office of Impact Analysis (OIA) formerly known as the Office of Best Practice Regulation (OBPR).

Reducing road trauma is a complex problem. The National Road Safety Strategy advocates the Safe System approach which focuses on safe road use, safe people, safe speeds and safe vehicles. Implementing a new road vehicle standard through the ADRs targets the pillar of safe vehicles, whereas a range of other initiatives are taken by other actors in the road safety space. It is recognized within this framework that mandating new safety technologies to address specific road safety problem is the most effective. The low fitment rate of LDWSs in heavy vehicles supports this conclusion, despite the technology being available for well over a decade.

## Summary of options

**Non-regulatory Options**

| | |
|---|---|
| Option 1: no intervention | Allow market forces to provide a solution (Business As Usual). |

**Regulatory Options**

| | |
|---|---|
| Option 2: *Road Vehicle Standards Act 2018* (regulation) | Mandate a standard requiring the fitment of LDWS to new heavy vehicles under the RVSA based on the UN Regulation No. 130 (regulatory—mandatory). |

## Discussion of options

**Option 1: No Intervention (Business As Usual)**

The Business As Usual (BAU) case relies on the market fixing the problem, the community accepting the problem, or some combination of the two. The state of current voluntary fitment of LDWS to all new heavy vehicles is around 36 per cent with heavy duty prime movers having the highest fitment rate of around 51.7 per cent.

These fitment rates have arisen without regulation in Australia, including due to many heavy vehicle manufacturers and operators recognising the benefits of the technology to their businesses and/or the broader community. However, it is also important to note that fitment of these technologies is significantly higher in some other markets, most notably Europe were fitment has been mandatory (subject to some limited exemptions) for all new heavy vehicles since 2015.

In examining this case, European Commission requirements on the fitment of heavy vehicle LDWS in the EU and its flow on effect to the Australian market was considered. This included decreasing production costs of LDWS components as well as reduced development and testing costs over the years as the technology (as a warning system) has fully matured and best practice methods of application, development and implementation become widespread.

Actions undertaken by state and territory governments towards improving heavy vehicle safety include investment in research projects, education campaigns, and strategic partnerships. They also include increased stringency in safety requirements and access arrangements, particularly for access to government work contracts. These actions mostly address road user behaviour and infrastructure countermeasures, and only include some localised influences on the fitting of technology through contracts or by trading for road access. Thus, these measures are expected to have limited national impact on reducing heavy vehicle crashes as a result of drifting unintentionally outside their lane. Nationally, ADR 35/05 – Commercial Vehicle Brake Systems and ADR 38/05 – Trailer Brake Systems are two standards that mandate

ESC, ABS and RSC on heavy vehicles and trailers to ensure safe braking under normal and emergency conditions. These technologies help reduce the severity of heavy vehicle related trauma due to loss of control. Other proven technologies to date include AEB (ADR 97/00 – Advanced Emergency Braking (AEB) for Omnibuses, and Medium and Heavy Goods Vehicles) and LDWS. The broad introduction of technology such as LDWS is not effective through state and territory government efforts as there is no national consumer safety ratings scheme for new heavy vehicles (unlike ANCAP for light vehicles).

Under Option 1, voluntary fitment by industry of LDWS to new heavy vehicles is projected (based on recent trends and regulation in other markets) to increase year on year to some degree, with marked initial increases. The BAU option was analysed in detail in order to establish the baseline for comparison with other options.

**Option 2: Mandatory Standards under the RVSA—Regulation**

Under Option 2, the Australian Government would mandate the fitment of LDWS to new heavy vehicles supplied to the market via a new national standard (ADR) under the RVSA. This new ADR would adopt the technical requirements of UN Regulation No. 130, incorporating up to the latest series of amendments. The ADR would also include a requirement that the LDWS be fitted as prescribed. As new ADRs only apply under the RVSA to new vehicles, implementation of this option would not affect vehicles already in service.

LDWSs from various manufacturers use a variety of techniques and sub-systems to detect heavy vehicle lane departures. As such, an agreed international standard would further simplify system design and enhance quality. It is therefore important to adopt an effective standard, otherwise the benefits of LDWS will be uncertain. Research has shown UN Regulation No. 130 is effective in an Australian context (Budd & Newstead, 2014 and Budd et al., 2015). As this option is considered viable, and has been pursued internationally, the introduction of a mandatory standard was analysed further in terms of expected benefits to the community.

Chapter 2 details past, present and projected fitment rates of LDWS for HVs as supplied by TIC. Australia has a very old truck fleet: 14.0 years average age (vehicles above 3.5t GVM – ABS Motor Vehicle Census Jan 2018); 14.8 years average age (vehicles above 4.5t GVM – ABS Motor Vehicle Census Jan 2018). Trucks in Australia and New Zealand are older than in many other countries. This is due to low barriers to entry, exacerbated by having no secondary disposal market, and few restrictions on how and where they operate (Austroads, 2019). Based on these existing market characteristics and unique market supply of American, European, Japanese and locally manufactured HVs, the Department marginally over-estimated voluntary fitment rates in the BCA based on the data supplied by TIC. Chapter 4 also adjusts various parameters in the BCA to account for changes in market conditions (fitment, costs, testing, etc).

*Background*

The UN World Forum for the Harmonization of Vehicle Regulations (WP. 29) is a worldwide regulatory forum that provides the framework to establish regulatory instruments concerning motor vehicles, that 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 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* (the 1958 Agreement) and is obliged to accept vehicles that comply with the requirements of the international standard UN Regulation No. 130 (UN R130) titled '*Uniform provisions concerning the approval of motor vehicles with regard to the Lane Departure Warning System (LDWS)*'. 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 will minimise costs associated with technological development, provide manufacturers with the flexibility to incorporate or adapt systems that have already been developed and tested for markets with the same requirements. It also enables leveraging of testing and certification frameworks conducted in other markets.

Australia mandates approximately sixty active ADRs under the RVSA. Vehicles are approved on a model, or vehicle type, basis known as type approval, whereby the Australian Government approves a vehicle type based on test and other information supplied by the manufacturer. Compliance of vehicles built under that approval is ensured by the regular audit of the manufacturer's production, design and test facilities. This includes auditing the manufacturers' 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 and this has been the case since the introduction of the MVSA and is the case with the replacement of MVSA with the RVSA.

If this option were implemented, the requirements of LDWSs would adopt the requirements of UN Regulation No. 130.

Australian research has found that LDWSs could alleviate or reduce the severity of almost five per cent of all Australian heavy vehicle crashes, predominantly those involving a heavy vehicle drifting outside its lane, same direction and opposite direction lane departure multiple-vehicle crashes and single-vehicle roadway departures. The research also highlighted that the protection offered was greater for higher severity crashes with 11 per cent of fatal crashes sensitive to LDWS. Sensitivity to injury crashes were almost double that of property damage only crashes (Budd & Newstead, 2014). Furthermore, LDWS technology was found to be more sensitive to the crashes of articulated trucks and road trains than to those of rigid trucks and buses.

**Scope/Applicability**

This option was considered in relation to the scope of vehicles for which mandatory requirements for LDWS could be applied under the ADRs. This option directly aligned with the requirements of UN Regulation No. 130, which would require a new ADR to be implemented to require fitment of LDWS for new heavy vehicles of ADR categories NB1, NB2, NC, MD and ME (Goods Vehicles and Omnibuses).

**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:

- 1 November 2024 for new model vehicles; and
- 1 November 2027 for all new vehicles.

A November 2024 new model timing would mean that any new model that has not been introduced to the Australian market prior to November 2024 would have to fit a LDWS. Any existing models already being supplied to the Australian market prior to November 2024 would not have to fit a LDWS until November 2027 when all models are required to fit LDWSs.

Mandating the fitment of LDWSs to models already being supplied to the Australian market by November 2024 would impose a significant cost to vehicle manufacturers who would have to revisit the design and production stage of vehicle manufacture to safely and cost-effectively fit LDWSs to existing models. Furthermore, all vehicle models have a design and production life cycle that would not allow for introduction of new technology at short notice. Staging implementation timing in this way provides sufficient time for vehicle manufacturers to test, develop and fit LDWSs for all models by November 2027 and ensures no interruption to supply.

These lead-times are considered suitable to allow for the scope of design change and testing needed for a heavy vehicle supplier/manufacturer to incorporate a LDWS considering the technology has matured significantly with regard to lane detection.

The final implementation date will be determined by the Australian Government as part of the relevant ADR, following consultation by the department with industry.

As ADRs only apply to new vehicles the option proposed in the Final IA has 'nil' impact on the existing HV fleet.

# Chapter 4: Likely net benefit of each option

## Benefit-cost analysis

The Benefit-cost methodology used in this analysis is a 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 indicate 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 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 costs $1 million but results in benefits of $3 million, the net benefit would be 3-1 = $2 million while the BCR would be 3/1 = 3.

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

The results of Option 2 were compared with what would happen if there was no government intervention, that is, Option 1: no intervention (BAU). The period of analysis covers the expected life of the policy option (15 years of intervention) plus the time it takes for benefits to work their way through the fleet (around 30 years, the approximate maximum lifespan of a heavy vehicle).

Given that the function of UN Regulation No. 130 is to enhance heavy vehicle safety, including a focus on the safety benefit from expected reductions in trauma. It should be noted that many operators would be likely to obtain other benefits (for example, alleviation of property damage and reductions in trauma as a result of the LDWS partially acting as a fatigue monitor) that have not been included in this IA. The net benefit and the benefit-cost ratio for each option are therefore likely to be conservative estimates. Limitations exist with regard to collecting the data required to account for and tracking the VKT of heavy vehicles and road trains relevant to this Benefit Cost Analysis (BCA); this is another benefit that is unaccounted for in this analysis.

### Assumptions used in the benefit-cost analysis

**Consultation IA**

Aside from the assumed costs and system effectiveness detailed further in this chapter the following assumptions were made when developing the BCA for the consultation IA:

- The fitment rate of rigid and articulated heavy duty trucks would be identical. These types of trucks are ADR sub-category NC. This assumption was based on industry supplied data on existing and projected fitment rates.
- The majority of Australia's road freight task is carried on freeways and arterial roads with existing lane markings of good quality. This assumption is made as these roads provide the principal routes for the movement of people and goods between major regions and population centres of the jurisdictions, and between major metropolitan activity centres, together with links to major freight terminals and tourist areas in both rural and metropolitan areas. These routes provide a safe, efficient and integrated road transport system for the economic and social benefit of the community. State and Territory governments arrange for freeways (excluding privately operated freeways) and arterial roads to be upgraded and constructed as necessary with appropriate lane markings.
- The alleviation of property damage from these types of crashes and the emotional and consequential cost impacts on family and friends of those close to someone affected in a crash. The quantification of these impacts

would further increase the cost of a typical fatal crash in the BCA. The Department predicts that the effect of including these factors would further increase the benefit cost ration above 1.

**Final IA**

Information received in submissions relating to benefits, costs, assumptions and implementation timing was examined in a post-consultation analysis. The main changes in assumptions are discussed below, highlighted in Tables 6, 8, 9, 10 and 11 and summarised in the sub-section '*Summary of Benefit-Cost Analysis Post-Consultation Variations*' to this Chapter.

Some submissions mentioned that several cost variables (i.e. fitment cost, cost to test a system to regulation and governmental costs) were underestimated. To address these concerns the estimated costs for development, fitment, and testing was increased (see Table 6). The testing and fitment cost for LDWSs for HVs was obtained from TIC's submission and validated against TIC's HV AEB RIS submission and accounted for increased labour costs attributed to installation, noting that certain aspects of HV assembly do not occur on a production line. Furthermore, the estimate for the cost of testing a system to the UN regulation was increased (Table 6).

To account for the variation and quality of lane markings, the effectiveness was varied in the post-consultation benefit-cost analysis. As shown in the Table 10 below despite analysing an unrealistically low effectiveness (equivalent to the lowest rate reported by MUARC for the worst performing systems in the fleet), the BCR remained positive. It was noted that varying the effectiveness was less significant than varying the discount rate. However, as expected varying the effectiveness of the LDWS did have an impact on the projected trauma figures. This assumption anticipates that effective regulation increases the performance of LDWSs due to standardised performance requirements.

# Economic aspects - impact analysis

Impact analysis considers the magnitude and distribution of the benefits and costs among the affected parties. In the case of LDWSs for heavy vehicles, the parties affected by the options are:

## Business

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

There is an overlap between businesses and consumers when considering heavy vehicles. Unlike light vehicles, heavy vehicle owners and operators, in general, are purchasing and operating these vehicles as part of a business. This is distinct to businesses that manufacture the vehicles or supply the components. The affected businesses are represented by a number of peak bodies, including:

- Australian Livestock and Rural Transporters Association (ALRTA), that represents road transport companies based in rural and regional Australia;
- Australian Road Transport Suppliers Association (ARTSA), that represents suppliers of hardware and services to the Australian road transport industry;
- Australian Trucking Association (ATA), that represents trucking operators, including major logistics companies and transport industry associations;
- 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;
- Truck Industry Council (TIC), that represents truck manufacturers and importers, diesel engine companies and major truck component suppliers;

- Federal Chamber of Automotive Industries (FCAI) which represents the automotive sector and includes vehicle manufacturers, vehicle importers and component manufacturers/importers; and
- Federation of Automotive Products Manufacturers (FAPM) which represents the automotive component manufacturers/importers.

## Governments

Australian and state and territory governments and their represented communities.

## Impact of viable options

Two options were considered viable for further examination: Option 1: no intervention and Option 2: regulation. This section looks at the impact of these options in terms of quantifying expected benefits and costs, and identifies how these would be distributed among affected parties. These were summarised previously and are discussed in more detail below.

**Option 1 - No intervention**

Under this option, the Australian Government would not intervene, with market forces instead providing a solution to the problem. As this option is the BAU case, there are no new benefits or costs allocated. Any remaining option(s) are calculated relative to this BAU option, so that what would have happened anyway in the marketplace is not attributed to any proposed intervention.

**Option 2 - Regulation**

Option 2 involves direct intervention by the Australian Government to compel a change in the safety performance of heavy vehicles supplied to the marketplace, and the benefits and costs are those that would occur over and above those of Option 1. The fitment of LDWS would no longer be a commercial decision within this environment.

*Overall benefits*

The indirect and direct benefits are estimated at $221.2 million under Option 2 (over and above Option 1). These benefits would be shared among the community and as cost savings to governments.

The measure is estimated to save 62 lives and 1,725 serious and 5,370 minor injuries.

*Benefits - Business - Heavy vehicle owners and operators*

There would be a direct benefit through a reduction in road crashes (over and above that of Option 1) for the heavy vehicle owners/operators who purchase and/or operate new heavy vehicles equipped with LDWS due to a mandated standard. A significant proportion of the estimated 62 lives and 1,725 serious and 5,370 minor injuries under Option 2 would be occupants of heavy vehicles in highway conditions. There would also be direct benefits to business (including owners/operators and/or insurance companies) through reductions in compensation, legal costs, driver hiring and training, vehicle repair and replacement costs, loss of goods, and in some cases, fines relating to spills that lead to environmental contamination.

*Benefits - Business - Heavy vehicle manufacturers and component manufacturers/suppliers*

There may be some indirect benefits in that the heavy vehicle industry would be considered in a more positive light by the general public as a result of fitting additional safety technology.

There would be no direct benefit to heavy vehicle manufacturers (over and above that of Option 1). Component suppliers and component manufacturers benefit directly in terms of increased income/revenue from supplying additional equipment to heavy vehicle manufacturers.

*Benefits – Governments and Community*

There would be both direct and indirect benefits to governments (over and above that of Option 1) from the reduction in road crashes that would follow the increase in the number and percentage of new heavy vehicles equipped with LDWS due to a mandated standard.

*Costs - Business - Heavy vehicle owners and operators*

There would be a direct cost to heavy vehicle manufacturers (over and above that of Option 1) as a result of design/development, fitment and testing costs for the additional heavy vehicles sold fitted with LDWS due to a mandated standard.

The approximate LDWS fitment cost to business is between $1000 and $1800 per vehicle which is expected to be passed onto consumers. There may be further development costs, however, most brands have developed or are developing LDWS meeting the requirements of the UN Regulation.

This would likely cost $216 million under Option 2 (over and above Option 1). It is likely that manufacturers would pass this increase in costs on at the point of sale to heavy vehicle owners/operators who would then absorb some of it (but, as noted above, would also receive a portion of the benefits) and pass on some through increased supply chain costs.

*Costs - Governments*

There would be a cost to federal, state and territory governments for developing, implementing and administering regulations (standards) that mandate the fitment of LDWS. This is estimated to be at approximately $0.5 million.

## Benefit-Cost Analysis Detail

*System development costs*

A development cost of $50,000 to $100,000 was added for each additional vehicle model for which LDWS would be developed due to government intervention under Option 2. Preliminary industry consultation indicated that the incremental LDWS development cost is reduced substantially due to prior fitment of AEB, a system typically shared with LDWS which is required to be fitted by separate legislation (ADR 97/00 – Advanced Emergency Braking for Omnibuses, and Medium and Heavy Goods Vehicles). The estimated development cost included design, logistics, production line floor area allocation, and other overheads, for those models where LDWS is not an existing optional fitment. An additional $10,000 per model was initially examined to cover validation and testing for certification, as well as a further $10,000 per model for additional/other regulatory expenses as an extension of a manufacturer's regulatory and certification administration process. During the consultation, the TIC suggested that the LDWS validation test cost should be increased to $30,000 to $50,000 per model. The Department accepted this industry feedback, and raised the base testing and certification cost from $10,000 to $50,000 per model. Additional/other regulatory expenses of $10,000 per model were retained, as per the analysis in the Consultation IA.

*System fitment cost*

A wholesale LDWS system fitment cost range from $1,000 (low/best case) to $1,800 (high/worst case) was adopted, with $1,400 used as the likely fitment cost. This range represents the average incremental cost of fitting a LDWS relative to existing systems otherwise required to be fitted, such as AEB and ESC. Estimate includes wholesale parts + fitment. As seen by data provided by the TIC approximately half of the heavy vehicles will already be required to have AEB to comply with ADR 97/00, which reduces LDWS fitment cost to well below the "Likely" $1400. The rest will have to fit AEB and LDWS, which would bring fitment cost to around $2000. These effects are expected to cancel each other to a great extent.

The estimate for system fitment includes only the costs of a LDWS able to meet the requirements of the UN Regulation No. 130. The fitment cost adopted was a conservative average of cost estimations obtained from heavy vehicle manufacturers with regards to existing system fitment costs. The adopted fitment cost is far higher in the IA in comparison to other estimates of $300 to $400 for existing AEB systems and LDWSs (MUARC, 2014). These increased costs were accommodated in the Consultation and Final IA to reflect industry feedback. Fitment costs were allocated for each additional heavy vehicle equipped with LDWS as a consequence of government intervention.

*Government costs*

It was assumed there would be an estimated annual cost of $50,000 for the Department to create, implement and maintain a regulation under Option 6, as well as for the National Heavy Vehicle Regulator (NHVR), WA and NT 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 Department experience.

*Summary of Costs (Consultation IA April 2022 and Final IA June 2023)*

**Table 5: Summary of the various costs associated with the implementation of Option 2 in the Consultation IA published in April 2022**

| Cost description | Cost relative to BAU | | | Option | Applicability | Impact |
|---|---|---|---|---|---|---|
| | Best | Likely | Worst | | | |
| **Development of LDWS** | $50,000 | $62,500 | $75,000 | 2 | Per model | Business |
| **Fitment of LDWS** | $1,000 | $1,250 | $1,500 | 2 | Per vehicle | Business |
| **Testing of LDWS** | | $10,000 | | 2 | Per model | Business |
| **Certification of LDWS** | | $10,000 | | 2 | Per model | Business |
| **Implement and maintain ADR** | | $50,000 | | 2 | Per year | Government |

**Table 6: Summary of the various costs associated with the implementation of Option 2 in the Final IA published in 2023. Note development, fitment, testing costs increased based on feedback to Consultation IA**

| Cost description | Cost relative to BAU | | | Option | Applicability | Impact |
|---|---|---|---|---|---|---|
| | Best | Likely | Worst | | | |
| **Development of LDWS** | $50,000 | $75,000 | $100,000 | 2 | Per model | Business |
| **Fitment of LDWS** | $1,000 | $1,400 | $1,800 | 2 | Per vehicle | Business |
| **Testing of LDWS** | | $50,000 | | 2 | Per model | Business |
| **Certification of LDWS** | | $10,000 | | 2 | Per model | Business |
| **Implement and maintain ADR** | | $50,000 | | 2 | Per year | Government |

## Benefit-Cost Analysis Results

Appendix E details the calculations for the benefit-cost analysis. A summary of the results from the Consultation IA in April 2022 and the Final IA in June 2023 is provided below in the following tables. A 7 per cent discount rate was used for summarised options.

**Table 7: Summary of Consultation IA Benefit-Cost Analysis Results April 2022**

| Case | Gross Benefits ($m) | Net Benefits ($) | Cost to Business ($m) | Cost to Government ($m) | BCR | Lives Saved | Serious Injuries Avoided | Minor Injuries Avoided |
|---|---|---|---|---|---|---|---|---|
| **Best** | | 58 | $163 | $0.5 | 1.4 | | | |
| **Likely** | 221 | 17 | $204 | $0.5 | 1.1 | 63 | 1,732 | 5,389 |
| **Worst** | | -23 | $244 | $0.5 | 0.9 | | | |

**Table 8: Summary of Final IA Benefit-Cost Analysis Results June 2023**

| Case | Gross Benefits ($m) | Net Benefits ($) | Cost to Business ($m) | Cost to Government ($m) | BCR | Lives Saved | Serious Injuries Avoided | Minor Injuries Avoided |
|---|---|---|---|---|---|---|---|---|
| **Best** | | 82 | $139 | $0.5 | 1.6 | | | |
| **Likely** | 221 | 5 | $216 | $0.5 | 1.0 | 62 | 1,725 | 5,370 |
| **Worst** | | -73 | $293 | $0.5 | 0.8 | | | |

**Sensitivity Analysis**

A sensitivity analysis was carried out on the Final IA results to determine the effect of varying the critical parameters on the outcome of the benefit-cost analysis.

Firstly, while a 7 per cent (per annum) real discount rate was used for all options, the benefit-cost analysis for Option 2 was also run with a rate of 3 per cent and 10 per cent. The table below shows that the net benefits remained positive under 3 per cent discount rate and the 7 per cent discount rate. However the net benefits reduced and BCR dipped marginally below 1 (0.8) for a 10 per cent discount rate. This was to be expected in the analysis.

**Table 9: Impact on Net Benefits and BCR of changes to the real discount rate of the likely case**

| | Net Benefits ($m) | BCR |
|---|---|---|
| Low discount rate (3%) | 269 | 2.4 |
| Base case discount rate (7%) | 5 | 1.0 |
| High discount rate (10%) | -37 | 0.8 |

Next, the effectiveness of heavy vehicle LDWS was varied to establish its effect on the analysis, using both high (increment 5 per cent) and low (decrement 5 per cent) effectiveness scenario. As shown in the Table below despite analysing an unrealistically low effectiveness (equivalent to the lowest rate reported by MUARC for the worst performing systems in the fleet), the BCR remained positive. It was noted that varying the effectiveness was less significant than varying the discount rate. However, as expected varying the effectiveness of the LDWS did have an impact on the projected trauma figures.

**Table 10: Impact on the BCR due to changes to effectiveness of LDWS for heavy vehicles**

| | BCR | Lives saved |
|---|---|---|
| Low effectiveness (-5%) | 1.0 | 60 |
| Base case effectiveness | 1.0 | 62 |
| High effectiveness (+5%) | 1.0 | 66 |

Finally, the maximum value in the fitment cost range ($1,000-$1,800) was varied as follows:

- increasing the fitment cost maximum by $500 to $2,300 from $1,800
- decreasing the fitment cost maximum by $500 to $1,300 from $1,800

These fitment costs are far higher than research suggests from other international markets for an established technology, however the Department considered industry feedback on costs that may have increased due to the unique heavy vehicle sector in Australia. The net benefits and BCRs remained positive for the low cost case and base case, however the BCR dipped marginally below 1 (0.8) for the high cost case.

**Table 11: Impact on Net Benefits and BCR of changes to unit fitment cost of LDWS for heavy vehicles**

| | LDWS fitment Cost | BCR |
|---|---|---|
| Low cost (Base case -$500) | 1300 | 1.2 |
| Base case cost (likely) | 1,000 (min) – 1,800 (max) | 1.0 |
| High cost (Base case +500) | 2300 | 0.8 |

## Fitment effect of Option 2

Figure 8 shows the forecast percentage of fleet fitment under the analysed intervention Option 2 in comparison to BAU (Option 1). The BAU projected fitment rates up to early 2022 were provided by industry. For Option 2, though fitment rates are known to remain close to 100 per cent after a technology is mandated, a decay factor in fitment back to BAU rates after a 15-year policy lifespan has been incorporated (to account for example for any future policy variation and/or technology redundancy), conservatively reducing the benefits in the post-intervention run-out period of 35 years by up to 50 per cent.

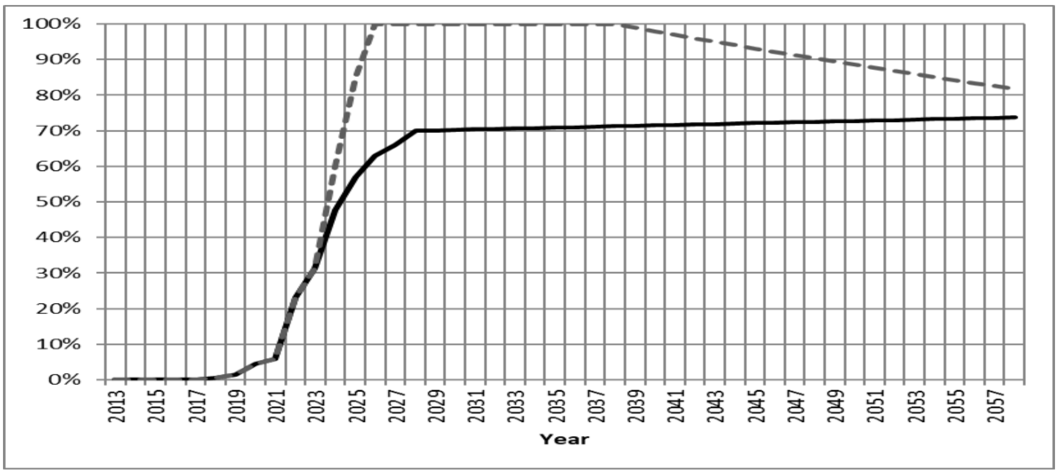



**Figure 8: Fitment via Option2 compared to BAU**

**Impact of LDWS when fitted to a heavy vehicle**

*Sensitivity*

Monash University Accident Research Centre (MUARC, 2015) reported on the impact of LDWS for heavy vehicles in Australia. Crash and crash injury benefits were modelled on police reported crash data on crashes occurring in Australia between 2013-2016 inclusive. The classification of sensitive crashes, those potentially mitigated by LDWS, was applied to crashes occurring in Australia.

Four per cent of Australian heavy vehicle crashes were identified as sensitive to LDWS, the protection offered was greater for higher severity crashes with 11 per cent of fatal crashes sensitive to LDWS. Sensitivity to injury crashes was almost double that of property damage only crashes.

*Effectiveness*

LDWS work well with Autonomous Emergency Braking Systems (AEBS) and help prevent fatigue related crashes. Lane departure crashes sensitive to LDWS include, single-vehicle roadway departure crashes and same direction and opposite direction lane departure multi-vehicle crashes. These crash types include side-swipes, rollover and head-on crashes. MUARC carried forward work done by Robinson in 2010 where a LDWS effectiveness of 20-60% reduction was assumed (MUARC, 2015). As fatigue related crashes are not accurately identifiable in Australian crash databases, MUARC used the approach developed by Anderson in 2011 to estimate fatigue warning system efficacy. In this study, MUARC assumed that efficacies in specific types of heavy vehicles may be applied to all heavy vehicle and bus (>4.5 t GVM) types in all severity injuries resulting from LDWS sensitive crashes. MUARC (MUARC, 2015) noted that Houser (2009) assessed efficacy (in large trucks) in reducing the LDWS sensitive crashes as: 23-53 per cent for single vehicle roadway departure collisions, 24-50 per cent for single vehicle roadway departure rollovers, and 23-46 per cent for same direction lane departure and other direction lane departure over-the-lane-line multi-vehicle collisions. The lower figure of the range was evaluated from a Mack field operation test studying single vehicle run-off road crashes and rollovers not caused by an impact. The upper figure resulted from motor carrier information. MUARC applied these efficacies equally across crashes of all severities. MUARC used the modest efficacy range of 23-50 per cent on all sensitive crashes equally. They made this decision based on the fact that Houser's range of values is almost the same for each crash type.

The overall effectiveness of heavy vehicle LDWS against trauma has been modelled using the lower end of this range. Like other vehicle safety technologies, LDWS effectiveness is expected to be higher for fatal and serious injuries than for minor injuries. This is due in part to the effect of downgrading of trauma severity at higher trauma levels (to serious, minor or completely mitigated from fatal) whereas for minor severity traumas, complete mitigation is the only improved outcome. This effect is modelled as an approximate 10 per cent increment in effectiveness for mitigation of fatal and serious injury crash outcomes over that of minor injury crashes, which has been observed in light vehicle crash outcomes and for which data is available.

MUARC found that LDWS technologies were more sensitive to the crashes of articulated trucks and road trains than to those of rigid trucks and buses. Though LDWS effectiveness is typically higher in high severity (for example, highway/high speed) crashes, low severity crashes occurring in lower speed areas (above 60 km/h up to 80 km/h) are higher in frequency. This biases the expected effectiveness in an arbitrary crash towards lower ranges. On the basis of the above, the adopted effectiveness values were assumed to be 30 per cent for all sensitive trauma crashes and 40 per cent for higher severity (fatal and serious injury) crashes.

## Summary of Benefit-Cost Analysis Post-Consultation Variations

During consultation, the TIC suggested the costings detailed in the Consultation IA should be reviewed and revised and the IA justification recalculated and shared with industry for review, to ensure that an accurate cost-to-benefit analysis has been performed. To account for this, costings were shared with industry outside the consultation period to validate the analysis. Figures received from industry were incorporated into the analysis which showed that even with an increase in the development and testing costs per model and an increase in the fitment cost per vehicle, the benefit-cost ratios remained relatively constant (to one decimal place) at 1.0 however these increased costs did bring down the initial BCR of 1.1 in the likely case from the Consultation IA in April 2022. Therefore, the recommended option remains the same.

**Table 12: Impact on BCR with increases in LDWS validation test/certification/system fitment/design costs**

| Cost description | Cost relative to BAU | | | Option | Applicability | Impact | BCR |
|---|---|---|---|---|---|---|---|
| | Best | Likely | Worst | | | | |
| **Development of LDWS** | $50,000 | $75,000 | $100,000 | 2 | Per model | Business | 1.0 |
| **Fitment of LDWS** | $1,000 | $1,400 | $1,800 | 2 | Per vehicle | Business | 1.0 |
| **Testing of LDWS** | | $50,000 | | 2 | Per model | Business | 1.0 |
| **Certification of LDWS** | | $10,000 | | 2 | Per model | Business | 1.0 |
| **Implement and maintain ADR** | | $50,000 | | 2 | Per year | Government | 1.0 |

In addition, the TIC and HVIA all indicated more implementation time is needed and suggested alternative dates (approximately one year delay from proposed timing in Consultation IA for all vehicles and no change in the new models date). A post-consultation sensitivity analysis was undertaken to evaluate the effects of changes in implementation timing. Whilst the benefit-cost ratio improves slightly due to a delay in the number of vehicles required to fit mandatory LDWS, the postponed timing results in almost 6 less severe injuries and approximately 18 less minor injuries with no noticeable change in fatalities.

**Table 13: Impact on BCR with delayed implementation date of November 2027 for all vehicles**

| Implementation dates | Impact | | | BCR |
|---|---|---|---|---|
| | Lives saved | Serious injuries | Minor injuries | |
| Base case implementation dates<br>(Nov 2024 new models, Nov 2026 all vehicles)<br>*Consultation IA Option 2 timing* | 63 | 1,732 | 5389 | 1.1 |
| Alternative implementation dates<br>(Nov 2024 new models, Nov 2027 all vehicles)<br>*Final IA Option 2 timing* | 62 | 1,725 | 5,370 | 1.0 |

# 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 (RBM) Framework. Under the RBM Framework, the regulatory burden is the cost of a proposal to business and the community (not including the cost to government). It is calculated in a prescribed manner that usually results in it being different to the overall costs of a proposal in the benefit-cost analysis. In line with the RBM Framework, the average annual regulatory costs were calculated for this proposal by totalling the undiscounted (nominal) cost (including development and fitment cost) for each option over the 10-year period 2026-2035 inclusive. This total was then divided by 10.

The average annual regulatory costs under the RBM of Option 2 is set out in the table below. There are no costs associated with Option 1 as it is the BAU case. The average annual regulatory cost associated with Option 2 is estimated to be $18.2 million.

**Table 14: Regulatory burden and cost offset estimates - Options 1 and 2**

| Average annual regulatory costs (relative to BAU) | | | | |
|---|---|---|---|---|
| **Change in costs ($ million)** | **Business** | **Community organisations** | **Individuals** | **Total change in costs** |
| **Total, by sector Option 1** | - | - | - | - |
| **Total, by sector Option 2** | **$18.2 m** | **-** | **-** | **$18.2 m** |

# Chapter 5: Consultation

## Consultative committees

It has been longstanding practice to consult widely on proposed new or amended vehicle standards. For many years, there has been active collaboration between the Commonwealth and the state/territory governments, as well as consultation with industry and consumer groups. Much of the consultation takes place within institutional arrangements established for this purpose. The analysis and documentation prepared in a particular case, and the bodies consulted, depend on the degree of impact the new or amended standard is expected to have on industry or road users.

The Department undertakes public consultation on significant proposals. Depending on the nature of the proposed changes, consultation may involve community and industry stakeholders as well as established government committees such as the Technical Liaison Group (TLG), Strategic Vehicle Safety and Environment Group (SVSEG), the Infrastructure and Transport Senior Officials' Committee (ITSOC) and the Infrastructure and Transport Ministers' 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 and the Australian Trucking Association) and of representative organisations of consumers and road users (particularly through the Australian Automobile Association).
- 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 state and territory transport and/or infrastructure Chief Executive Officers (CEOs) (or equivalents), the CEO of the National Transport Commission, New Zealand and the Australian Local Government Association.
- ITMM consists of the Australian, state/territory and New Zealand Ministers with responsibility for transport and infrastructure issues.

SVSEG and the TLG are the principal consultative forums for advising on ADR proposals. Membership of the SVSEG is shown at Appendix B - Strategic Vehicle Safety and Environment Group (SVSEG), and membership of the TLG is shown at Appendix C – Technical Liaison Group (TLG).

## Public comment

The Consultation IA included a draft version of the national road vehicle standard ADR 99/00 – Lane Departure Warning Systems for heavy vehicles which is based on UN R130. The ADR 99/00, Explanatory Statement and the feedback form was published on the Department's website in April 2022 for an eight week public comment period which closed on 4 June 2022. The Department also sent out an email in April 2022 to inform senior representatives of state and territory governments, key industry representatives and representative organisations of consumers and road safety experts. In addition, a notice was published in the Office of Road Safety (ORS) newsletter and the Department's social media websites (twitter, Facebook and LinkedIn) to increase public awareness and engagement.

A summary of public comment input and Departmental responses has been included in Appendix I that is used for decision making by the responsible minister. The Department sought feedback on the Consultation IA and proposed regulation including:

- Support for the recommended option
- Views on the benefit-cost analysis, including the use of crash data, research or assumptions on effectiveness of the technology, the costs or the assumed benefits.
- The suitability of UN R130 for adoption under the ADRs, including any concerns on functional and/or performance requirements, test requirements or implementation, such as the applicable vehicle categories and timing.
- Any other relevant views or information which could assist decision making

As Australia is a party to the World Trade Organisation (WTO) Agreement, and harmonisation of requirements with international regulations is a means of compliance with its obligations, a notification will be lodged with the WTO for the required period, to allow for comment by other WTO members.

The publication of an exposure draft of the proposed ADR and Consultation IA for public comment is an integral part of the consultation process. This provides an opportunity for businesses and road user groups, as well as all other interested parties, to respond to the proposal by writing or otherwise submitting their comments to the Department. Analysing proposals through the IA process assists in identifying the likely impacts of the proposals and enables informed debate on any issues. Three ways to provide input was provided:

- Completing the webform and attaching the feedback form on the Department's website or social media platforms; or
- Emailing the feedback form to Vehicle.Standards@infrastructure.gov.au, or
- Emailing comments only without a feedback form to Vehicle.Standards@infrastructure.gov.au, or
- Sending the feedback form to the Vehicle Standards Section via the post

One jurisdiction made a submission supporting the recommended Option 2 - Regulation, including maintaining the implementation timing recommended in the Consultation IA to ensure the broadest benefit of the technology. They noted in their submission that the voluntary fitment of LDWSs by manufacturers is available, however, highlighted that the feature is often not available as an option on lower cost vehicles within a model range.

The heavy vehicle industry peak body, the Truck Industry Council (TIC), Fiat Chrysler Australia and Gas Energy Australia supported Option 2 – Regulation. TIC requested costings for the IA be revisited, recommended revisions to ADR 99/00 and associated Explanatory Statement and slightly delayed implementation dates.

A submission from Australasia's leading cycling organisation (Bicycle Network) supported the recommended Option 2 - Regulation maintaining the implementation timing recommended in the Consultation IA. In their submission they also noted that one in five rider fatalities involve a heavy vehicle and highlighted that this statistic has not changed in the last two decades.

Two submissions (one confidential) from the public supported Option 2 – Regulation maintaining the timing recommended in the Consultation IA. Both submissions encouraged the Australian Government to continue to participate in UN working groups to update UN R130 to cater for Australian lane markings.

A few submissions further recognised the significant increase in safety for VRUs (cyclists) who are not participants in the consumer choice of vehicle owners but are potentially affected by the outcomes of those choices.

One anonymous submission did not support the recommended option noting that industry led fitment rates were sufficient to curb the road trauma. They did not support the analysis in the Consultation IA and associated costs however did not provide any alternative costs to consider in the Final IA.

This Final IA will be published on the Federal Register of Legislation with the new ADR for LDWS and distributed to the key consultative committees outlined before in this Final IA.

# Chapter 6: What is the best option?

The following options were identified earlier in this Final IA as being viable for analysis:

- Option 1: no intervention;
- Option 2: mandatory standards under the RVSA (regulation).

## Net benefits

Net benefit (total benefits minus total costs in present value terms) provides the best measure of the economic effectiveness of the options. Accordingly, 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.

Option 2: regulation provides the highest likely net benefit of the options examined at $5 million and a likely to best BCR range of 1.0-1.6. For Option 2 the benefit-cost analysis assumes a start date (2024 for new models and 2027 for all vehicles), followed by 15 years of regulation (after which it is assumed the ADR would be reviewed). The analysis includes another 20 years past the period of regulation to capture the benefits from the 20 years of the crash profile of the last lot of heavy vehicles to be fitted with LDWS when the regulation stops.

The benefit would be spread over a 15-year period of regulation followed by a period of around 20 years over which the overall percentage of heavy vehicles fitted with these LDWS in the fleet continues to rise as older vehicles without LDWS are deregistered at the end of their service life. The results of the benefit-cost analysis are plotted over a 37 year period.

## Casualty reductions

Of the regulatory options, Option 2 provides the greatest reduction in road crash casualties, with 62 lives saved and 1,725 serious and 5,370 minor injuries avoided.

## Recommendation

As demonstrated through this Final IA, there is a strong case for Australian Government intervention to increase the fitment of LDWS to heavy vehicles via regulation.

In addition to providing the greatest net benefit ($5 million) and a BCR of 1, Option 2 also provides the greatest reduction in road crash fatalities, serious and minor injuries. Option 2 (regulation) provides the greatest reduction in road crash casualties, with 62 lives saved and 1,725 serious and 5,370 minor injuries avoided. It would also adopt the requirements UN Regulation No. 130, harmonising Australian requirements with internationally agreed standards. Harmonisation minimises costs associated with LDWS development, and provides manufacturers with the flexibility to incorporate or adapt systems that have already been developed and tested in the markets that the vehicle was originally designed for. This should enable some leveraging of testing and certification frameworks already conducted in other markets.

This Final IA identified the road safety problem in Australia of crashes involving heavy vehicles drifting out of their lane and that the problem can be substantially alleviated via fitment of LDWS. The current overall fitment across the fleet is relatively low with around 36 per cent of all new heavy vehicles (NB1, NB2, NC prime and NC rigid) fitted with LDWS. The current low fitment rate and the number and severity of heavy vehicle lane departure related crashes indicates a need for intervention.

Manufacturers and operators are likely to be impacted via additional LDWS fitment costs for new heavy vehicles. However, such businesses also receive substantial benefits. Heavy vehicle crashes are relatively expensive on average, due to the size and mass of these vehicles. Crash alleviation will play an important role in contributing to Australia’s freight productivity and the success of the heavy vehicle industry.

Option 2 offers the important advantage of being able to guarantee 100 per cent fitment of LDWS to applicable vehicles. There would be no guarantee in the BAU case, Option 1 that the predicted take-up of LDWS would be reached and then maintained. Given there is currently a low uptake of this technology (Figure 7), there is good reason to conclude that, under BAU, sections of the market will continue to offer LDWS only as an extra - often as part of a more expensive package of optional safety upgrades.

The performance requirements in UN Regulation No. 130 or ADR 99/01 were developed in consultation with other Contracting Parties and global industry peak bodies at the World Forum for Harmonisation of Vehicle Regulations. The requirements are well established globally. The Department does not anticipate any HV manufacturers facing any difficulties being able to meet the performance requirements in the standard.

## Scope of the recommended option

It is recommended that vehicle categories applicable under UN Regulation No. 130 be adopted for heavy vehicles supplied for use in Australian road transport. UN Regulation No. 130 covers prime movers and rigid vehicles greater than 12 tonnes GVM (ADR subcategory NC), goods vehicles greater than 3.5 tonnes GVM (ADR subcategory NB) and omnibuses (ADR subcategory MD and ME).

## Timing of the recommended option

The proposed heavy vehicle LDWS implementation timeframe is

- 1 November 2024 for applicable new model vehicles
- 1 November 2027 for all applicable new vehicles.

This means that from 1 November 2024, vehicle type approval applications for models heavy vehicles that have not yet had any vehicle details added to the Register of Approved Vehicles must include information satisfying ADR 99/01 as part of their application for vehicle type approval under section 19 of the Road Vehicle Standards Rules 2019 and from 1 November 2027, models of heavy vehicles covered by type approvals under section 19 of the Rules will have their approvals automatically suspended unless they have been updated to include information satisfy ADR 99/01.

The implementation lead-time for an ADR change that results in an increase in stringency is generally no less than 18 months for new models and 24 months for all other models. The proposed timetable would not meet these typical minimum lead-times (with regard to the new model date) however this new model date has been agreed with the heavy vehicle industry.

# Chapter 7: Implementation and Evaluation

If Option 2 is chosen, a new national road vehicle standard, also known as an ADR will be made under section 12 of the RVSA. The RVSA allows the Minister to determine national road vehicle standards.

Under the RVSA, the ADRs are national road vehicle standards intended to make vehicles safe to use, control the emission of gas, particles or noise, secure vehicles against theft, provide for the security marking of vehicles and promote the saving of energy. The ADRs are applied to vehicles as criteria for approval under various regulatory pathways set out in the Road Vehicle Standards legislation. Vehicles approved under these regulatory pathways can be provided to the market in Australia for use in transport.

## Overview of the Regulatory Framework

The RVSA establishes a regulatory framework to regulate the importation and first supply of road vehicles to the market in Australia. The core principle of this framework is that vehicles which comply with appropriate standards are suitable for provision to the market in Australia. The ADRs have set out those standards since the early 1970s. At that time, they were applied cooperatively by the Australian Motor Vehicle Certification Board representing the Commonwealth and state and territory governments. In 1989, this arrangement was replaced by the *Motor Vehicle Standards Act 1989* (MVSA) and the ADRs were determined as national standards.

## Exemption from Sunsetting

**Source of the Exemption**

A standard (ADR) made under section 12 of the RVSA is not subject to the sunsetting provisions of section 50 of the *Legislation (Exemptions and Other Matters) Act 2003* through section 12 of the *Legislation (Exemptions and Other Matters) Regulation 2015 (table item 56C)*. A similar exemption was previously granted in respect of national road vehicle standards made under section 7 of the *Motor Vehicle Standards Act 1989* (MVSA) (item 40, section 12 of the *Legislation (Exemptions and Other Matters) Regulation 2015*). This exemption is important to ensure that ADRs continue to remain in force, and available to regulators and industry.

It is appropriate that standards made under section 12 of the RVSA remain enduring and effective to regulate ongoing road worthiness of vehicles throughout their useful life and reduce regulatory burden on vehicle manufacturers.

**Intergovernmental Dependencies**

The exemption concerns ADRs which facilitate the establishment and operation of the intergovernmental vehicle standard regime that Commonwealth, State and Territory governments rely on to regulate the safety of vehicles on public roads.

The Commonwealth uses the ADRs as the basis on which approvals to supply types of road vehicles to the market are granted under the *Road Vehicle Standards Rules 2019*. States and territories use the ADRs as the primary criteria on which vehicles are assessed for road worthiness. This 'in-service' aspect is dependent on the date of manufacture, which determines the applicable version of the ADRs against which the vehicle can be assessed. The ability to rely on national standards is particularly relevant given the long service life of vehicles – the average age of vehicles in Australia is over 10 years.

While the ADRs are regularly updated to reflect changes in technology, it is not possible to apply these new standards retrospectively to vehicles that are already in use. With former ADRs kept on the Federal Register of Legislation, State and Territory governments can use them to ensure vehicles continue to comply with the ADRs that were in force when they were first supplied to the market.

In the event that the Commonwealth could not justify the maintenance of the ADRs, State and Territory governments would be compelled to create their own vehicle standards. Whilst this could mean adopting the substance of the lapsed ADRs as an interim measure, the differing needs and agendas of each State and Territory government may result in variations to in-service regulations.  Having different vehicle standards across the states and territories would make the scheme operate contrary to the underlying policy intent of the Act which is to set nationally consistent performance-based standards.

**Commercial Dependencies**

The effect on vehicle manufacturers to redesign existing models to comply with new ADRs would present a burden and be a costly and onerous exercise. Manufacturers should not be expected to continually go back to redesign existing vehicles. Furthermore, ongoing product recalls to comply with new ADRs would undermine consumer confidence with significant financial impact to manufacturers. This exemption allows vehicle manufacturers to focus their efforts to ensure new models supplied to the market continue to comply.

# Review of the National Road Vehicle Standards

While ADRs are exempt from sunsetting, they are subject to review every ten years, as resources permit, and when developments in vehicle technology necessitates updates to requirements. Comprehensive parliamentary scrutiny is available through these reviews.

Reviews of the ADRs ensure the ongoing effectiveness of a nationally consistent system of technical regulations for vehicle design, which are closely aligned, wherever appropriate with leading international standards such as UN Regulations. Aligning with such standards facilitates the rapid introduction of the latest safety devices and technological advances into the Australian market, while also contributing to the industry’s cost competitiveness in the domestic market. This new ADR would be scheduled for a full review on an ongoing basis and in line with this practice, including an evaluation of whether the ADR will still be required in the future.

In reviewing an existing ADR, the department relies on data and input from industry, jurisdictions and research organisations to demonstrate the continued effectiveness of the measure. The Australian Government will work with state and territory government agencies to provide reversing collision data within the official road injury record system. This allows for ongoing monitoring of road trauma attributed to reversing collisions as well as the fitment of reversing aids over time.

# Chapter 8: Conclusion and recommended option

## Conclusion

Research indicates that crashes caused by heavy vehicles leaving the lane and resulting in crashes costs the Australian community approximately $63 million annually, in addition to the associated emotional trauma inflicted on family and friends of those involved in these crashes. The economic impacts of emotional trauma on family and friends of those involved (and its consequential impacts on the economy) due to these crashes have not been quantified in this IA, however it can be reasonably assumed that the BCR would only increase if it was quantified and included in the analysis.

These impacts can be mitigated through the mandatory fitment of LDWS to all heavy vehicles. This Final IA showed that regulation (Option 2) will provide the highest net benefit to the Australian economy and the highest reduction in trauma savings. With a national road freight task projected to grow steadily into the future, effort to reduce Australia's road trauma requires consideration of every aspect of heavy vehicle safety.

Reducing the occurrence of crashes due to heavy vehicles unintentionally departing their lane is the specific road safety problem that has been considered in this IA. Heavy vehicle LDWSs capable of warning the driver of an unintentional lane departure especially in the field of monotonous driving situations, such as on national or state highways and arterial roads, are a mature technology for which international standards exist (UN Regulation No. 130). Around 36 per cent of all new heavy vehicles are fitted with LDWS. Though fitment has been mandatory in other major markets such as Europe since November 2015, this has not strongly influenced the fitment rate in the Australian heavy vehicle fleet. Furthermore, the rate at which the technology is being fitted has begun to reduce.

This Final IA considered two intervention options, Option 1 being the BAU case to increase fitment of LDWS to the heavy vehicle fleet. It was found that the most significant (and only positive) net benefits are to be gained by mandating LDWS fitment for new heavy vehicles.

Option 2, mandatory regulation adopting the internationally-agreed requirements of UN Regulation No.130, is expected to yield benefits of $221.2 million over the BAU case, with a likely case benefit-cost ratio of 1.0 (best case up to 1.6) and $5 million in net benefits. Option 2 would save 62 lives and mitigate 1,725 serious and 5,370 minor injuries.

In line with the *Australian Government Guide to Regulatory Impact Analysis (second edition 2020)* (2020) and the *Regulatory Impact Analysis Guide for Ministers' Meetings and National Standard Setting Bodies* (2021), the policy option offering the greatest net benefit should always be the recommended option. Therefore, Option 2: regulation is the recommended option. Under this option, fitment of LDWS would be mandated for all new heavy goods vehicles greater than 3.5 tonnes Gross Vehicle Mass (GVM) and all omnibuses. The proposed Australian vehicle categories are those covered by UN Regulation No.130 – equivalent ADR subcategories NB1, NB2, NC, MD and ME (Goods Vehicles and Omnibuses). The proposed implementation timing is:

- 1 November 2024 for new model vehicles; and
- 1 November 2027 for all new vehicles.

In terms of the impact of the recommended option, the costs to business for the necessary changes to vehicles would normally be passed on to consumers, while the benefits would flow to the community and the consumers or their families that are directly involved in crashes.

# Appendix A – References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# Appendix B – Strategic Vehicle Safety and Environment Group

The prime purpose of the Strategic Vehicle Safety and Environment Group (SVSEG) is to consider how governments, industry and road user organisations will ensure that vehicles sold in Australia are both safe and environmentally friendly. SVSEG is an advisory body of ITSOC, which is primarily responsible for advising the Council on road safety matters of national concern. SVSEG will coordinate work on national vehicle issues on behalf of ITSOC and government representatives of SVSEG will serve as the Austroads Safety Task Force (ASTF) Safe Vehicles Theme Group (SVTG).

*Manufacturer Representatives*

Australian Road Transport Suppliers Association (ARTSA)

Bus Industry Confederation (BIC)

Commercial Vehicle Industry Association of Australia (CVIAA)

Caravan Industry Association of Australia Ltd (CIAA)

Federal Chamber of Automotive Industries (FCAI)

Heavy Vehicle Industry Australia (HVIA)

Truck Industry Council (TIC)

Victorian Automobile Chamber of Commerce (VACC)

*Consumer Representatives*

Australasian New Car Assessment Program (ANCAP)

Australian Automobile Association (AAA)

Australian Trucking Association (ATA)

*Government Representatives*

Department of Infrastructure, Transport, Regional Development and Communications

Department of Transport and Main Roads, QLD

Road Safety Commission, WA

Department of Transport, WA

Department of Transport, VIC

Transport for NSW, NSW

Department for Infrastructure and Transport, SA

Department of Infrastructure, Planning and Logistics, NT

Department of State Growth, TAS

Justice and Community Safety, ACT

New Zealand Transport Agency

*Intergovernmental Representatives*

National Transport Commission (NTC)

National Heavy Vehicle Regulator (NHVR)

# Appendix C – Technical Liaison Group

The Technical Liaison Group (TLG) has two principal roles: to advise the Strategic Vehicle Safety and Environment Group (SVSEG) on detailed technical issues relating to the implementation and development of the ADRs for vehicles, and to advise SVSEG on detailed technical issues relating to regulatory and non-regulatory approaches to improving vehicle safety and environmental performance.

*Manufacturer Representatives*

Australian Road Transport Suppliers Association (ARTSA)

Bus Industry Confederation (BIC)

Commercial Vehicle Industry Association of Australia (CVIAA)

Caravan Industry Association of Australia Ltd

Federal Chamber of Automotive Industries (FCAI)

Heavy Vehicle Industry Australia (HVIA)

Truck Industry Council (TIC)

Victorian Automobile Chamber of Commerce (VACC)

*Consumer Representatives*

Australasian New Car Assessment Program (ANCAP)

Australian Automobile Association (AAA)

Australian Trucking Association (ATA)

Registered Automotive Workshop Scheme Association

Australian Imported Motor Vehicle Industry Association (AIMVIA)

*Government Representatives*

Department of Infrastructure, Transport, Regional Development and Communications

Department of Transport and Main Roads, QLD

Department of Transport, VIC

Transport for NSW, NSW

Department for Infrastructure and Transport, SA

Department of Infrastructure, Planning and Logistics, NT

Department of State Growth, TAS

Justice and Community Safety, ACT

New Zealand Transport Agency

*Intergovernmental Representatives*

National Transport Commission (NTC)

National Heavy Vehicle Regulator (NHVR)

# Appendix D – ADR 99/01 – Lane Departure Warning Systems

The performance of the LDWS is assessed in a series of four tests conducted at a speed of 65 ± 3 km/h. Two of these tests are performed by gently drifting the vehicle to the left, so that the vehicle crosses the lane markings at two different rates of departure within the range 0.1 to 0.8 m/s. The other two tests are performed by gently drifting the vehicle to the right, so that the vehicle crosses the lane markings at two different rates of departure within the range 0.1 to 0.8 m/s. In all tests, the required warnings must be provided before the outside of the tyre on the front wheel closest to the lane markings passes more than 0.3 m beyond the outside edge of the lane markings. UN R130 also includes failure warning signal and deactivation warning signal tests for the LDWS.

**Warning and activation**

Summary of the requirements for the test vehicles and conditions. LDWS is required (when active) to warn the driver if the vehicle crosses over a visible lane marking, when there has been no purposeful demand to do so (including for both straight sections, and curved sections having an inner lane marking with a radius ≥250 m. The LDWS is active above road speeds of 60 km/h providing it has not been manually deactivated by a switch within the cabin.

Test conditions: -

- On a flat dry asphalt or concrete surface.
- Ambient temperature shall be between 0° and 45°.
- Visible lane markings.
- The vehicle tested with recommended vehicle manufacture tyre pressures.

The vehicle test weight: -

- The vehicle maybe tested at any condition of load.
- The distribution of the mass among the axles being that stated by the vehicle manufacturer.
- This must not exceed any of the maximum permissible mass for each axle.
- No alteration shall be made once the test procedure has begun.
- The vehicle manufacture shall demonstrate through the use of documentation that the system works at all conditions of load.

Warning signals: -

- At least two warning means out of optical, acoustic and haptic, or
- One warning means out of haptic and acoustic, with spatial indication about the direction of unintended drift of the vehicle.
- Where an optical signal is used for the LDWS, it uses the failure warning signal in a flashing mode.
- The optical warning signal shall be yellow. The optical warning signals shall be visible even by daylight; the signal must be easily verifiable by the driver from the driver's seat.

In the case where the LDWS is equipped with a user-adjustable warning threshold, the LDWS shall be performed with the warning threshold set at its maximum lane departure setting. No alteration shall be made once the test procedure has begun.

The performance of the LDWS is assessed in a series of four tests.

Drive the vehicle at a speed of 65 km/h +/- 3 km/h into the center of the test lane in a smooth manner so that the attitude of the vehicle is stable.

| **Vehicle speed 65 + 3 km/h**<br>**The vehicle crosses the lane markings at two different rates of departure within the range 0.1 to 0.8 m/s** | | |
|---|---|---|
| Range one drifting to the left<br>0.1 – 0.8 m/s (first rate) | Passing lane marking >0.3m | Driver warning occurs |
| Range two drifting to the left<br>0.1 – 0.8 m/s (second rate, different to the first rate) | Passing lane marking >0.3m | Driver warning occurs |
| Range one drifting to the right<br>0.1 – 0.8 m/s (first rate) | Passing lane marking >0.3m | Driver warning occurs |
| Range two drifting to the right<br>0.1 – 0.8 m/s (second rate, different to the first rate) | Passing lane marking >0.3m | Driver warning occurs |

In all tests, the required warnings must (when active) warn the driver before the outside of the tyre on the front wheel closest to the lane markings passes more than 0.3 m beyond the outside edge of the lane markings.

The LDWS optical warning signals shall be activated either when the ignition (start) switch is turned to the “on” (run) position or when the ignition (start) switch is in a position between the “on” (run) and “start” that is designated by the manufacturer as a check position (initial system (power-on)). This requirement does not apply to warning signal shown in a common space.

A constant optical warning signal shall inform the driver that the LDWS function has been deactivated. This shall be a yellow warning signal.

**Failure Warning**

When the driver is provided with an optical warning signal to indicate that the LDWS is temporarily not available, for example due to inclement weather conditions, the signal shall be constant.

**Failure Detection**

This requires disconnecting the power source to any LDWS component or disconnecting any electrical connection between LDWS components. The optical warning signal shall be constant. The LDWS disable control (manually deactivated) shall not be disconnected when simulating a LDWS failure.

The failure optical warning signal shall be constant and remain constant while the vehicle is being driven. It is to be reactivated after a subsequent ignition “off” ignition “on” cycle as long as the simulated failure exists.

**Deactivation test**

If the vehicle is equipped with means to deactivate the LDWS, turn the ignition (start) switch to the “on” (run) position and deactivate the LDWS. The optical warning signal shall be constant. Turn the ignition (start) switch to the “off” position. Again, turn the ignition (start) switch to the “on” (run) position and verify that the previously activated warning signal is not reactivated, thereby indicating that the LDWS has been reinstated and the optical warning signal is extinguished. If the ignition system is activated by means of a “key”, the above requirement shall be fulfilled without removing the key.

# European mandate of UN Regulation No. 130

Mandatory fitment of LDWS to new heavy vehicles and buses complying with UN Regulation No. 130 has been implemented across the European market since 1 November 2015, followed by mandates in Japan and Korea. Today, the European mandate had taken full effect for all new heavy vehicles covered by UN Regulation No. 130 (with exemptions including urban buses and off-road or agricultural vehicles). Though now well established, the European mandate has not strongly influenced Australian market fitment rates, in part due to the bespoke sale configurations selected by Australian operators. However, the mandate has reduced and mitigated heavy vehicle head-on and single vehicle runoff-road crashes in Europe, providing useful European data on the effectiveness of the technology that has been used to support Australian research.

# Appendix E – Benefit-cost analysis

The model used in this analysis was the Net Present Value (NPV) model. The costs and expected benefits associated with government intervention (Option2) were summed over time. The further the cost or benefit occurred from the nominal starting date, the more they were discounted. This allowed all costs and benefits to be compared equally among the options, no matter when they occurred. Tables 1, 2 and 3 summarises the outcomes from this analysis.

1. The number of new registered vehicles in ADR categories covered by UN Regulation No. 130 were established for each year between 1968 and 2021 inclusive, utilising available Australian Bureau of Statistics Motor Vehicle Census (report series 9309.0) data (Australian Bureau of Statistics, 2017a), and registrations per capita for years prior to availability of census data:

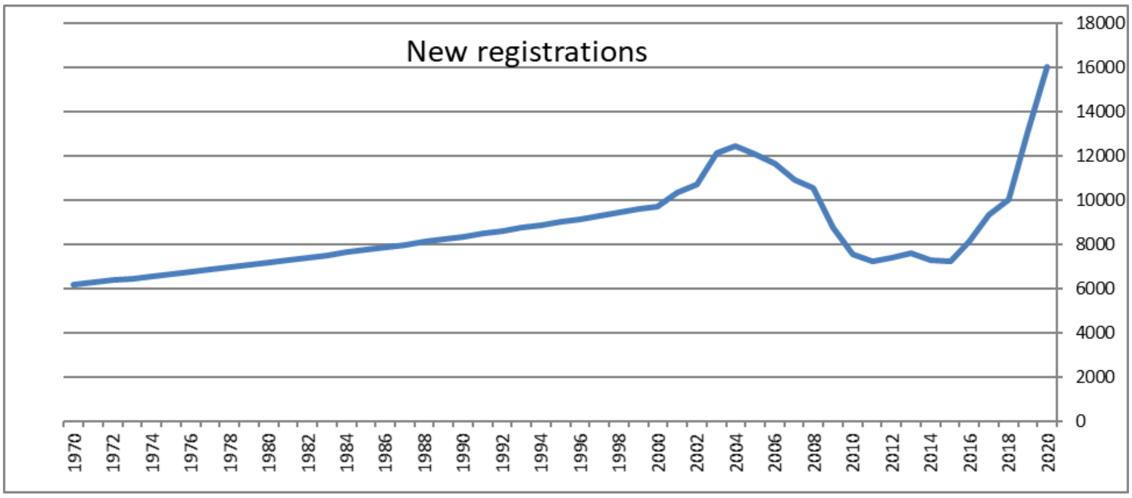



**Figure 9: New Australian heavy vehicle registrations, categories covered by UN Regulation No. 131 to 2021.**

2. Data from MUARC was used to determine the typical crash frequency by age for vehicle categories covered by UN Regulation No. 130:

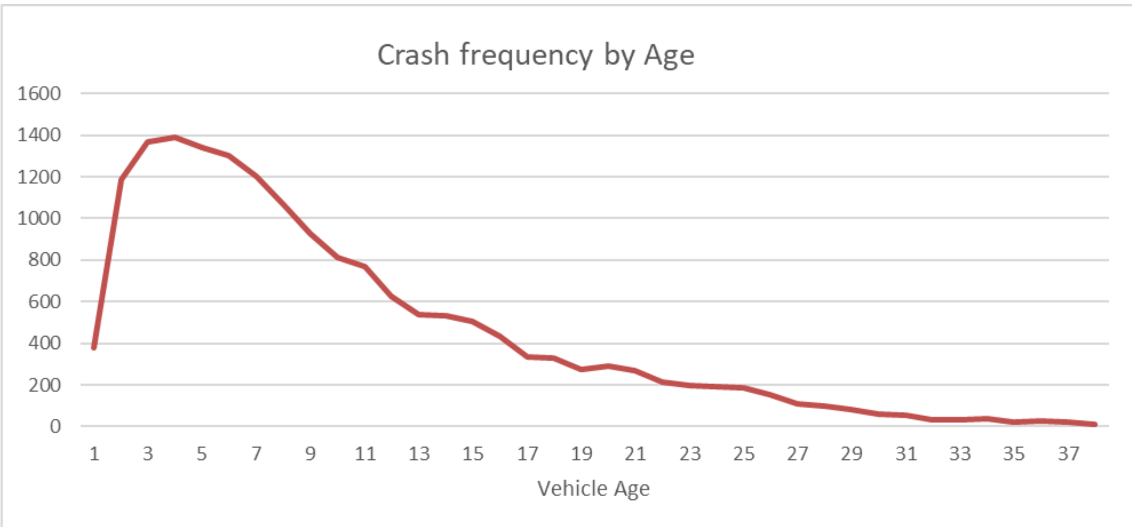



**Figure 10: Crash frequency by vehicle age**

3. Data from steps 1 and 2 were used to determine the likelihood of a vehicle of a given age being involved in a casualty crash over the course of 1 year as a function of the registered vehicles of a given age:

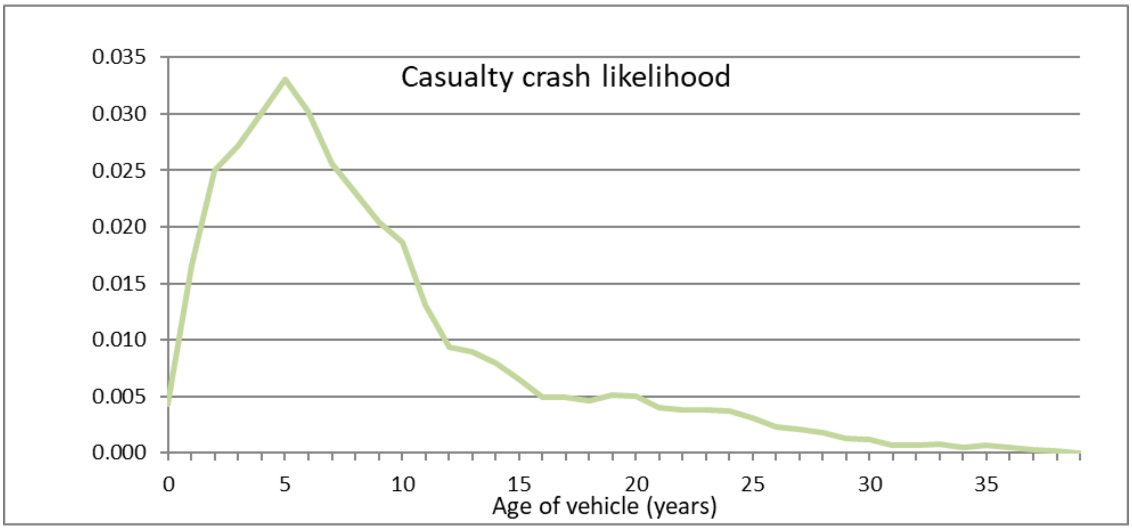



**Figure 11: Crash likelihood by age**

4. New combined vehicle sales data for applicable vehicle categories was established:

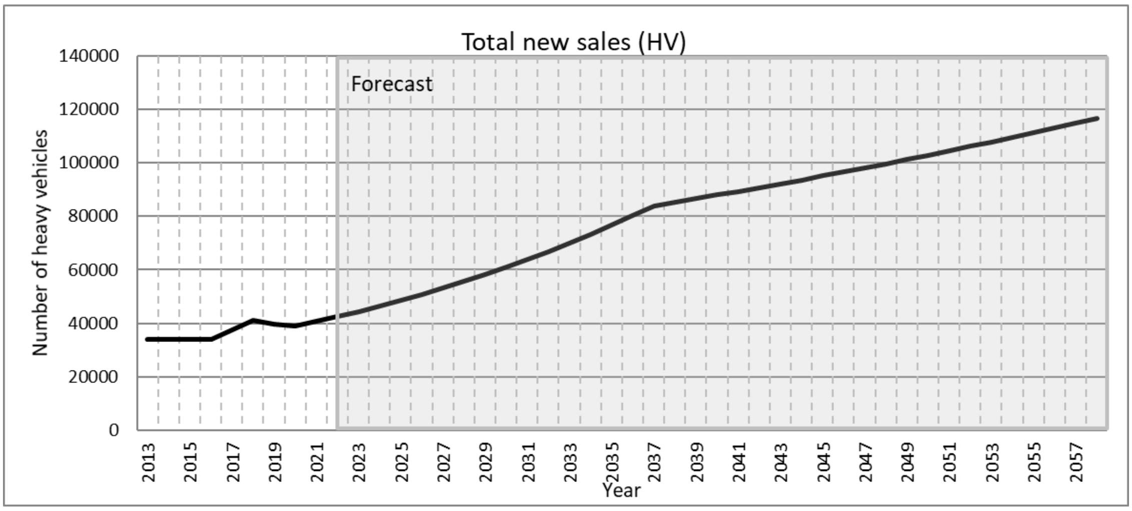



**Figure 12: Past and projected heavy vehicle sales**

Short to medium forecast sales were obtained from industry bodies, beyond which growth rates were projected from NTC statistics (NTC, 2016), heavy duty vehicle industry (Heavy Duty Sales, 2018), Bus Industry Council's National Technical Suppliers Summit 2017 and VFACTs.

5. The projected increased fitment rate at sale was established for Option 2 (solid line – BAU):

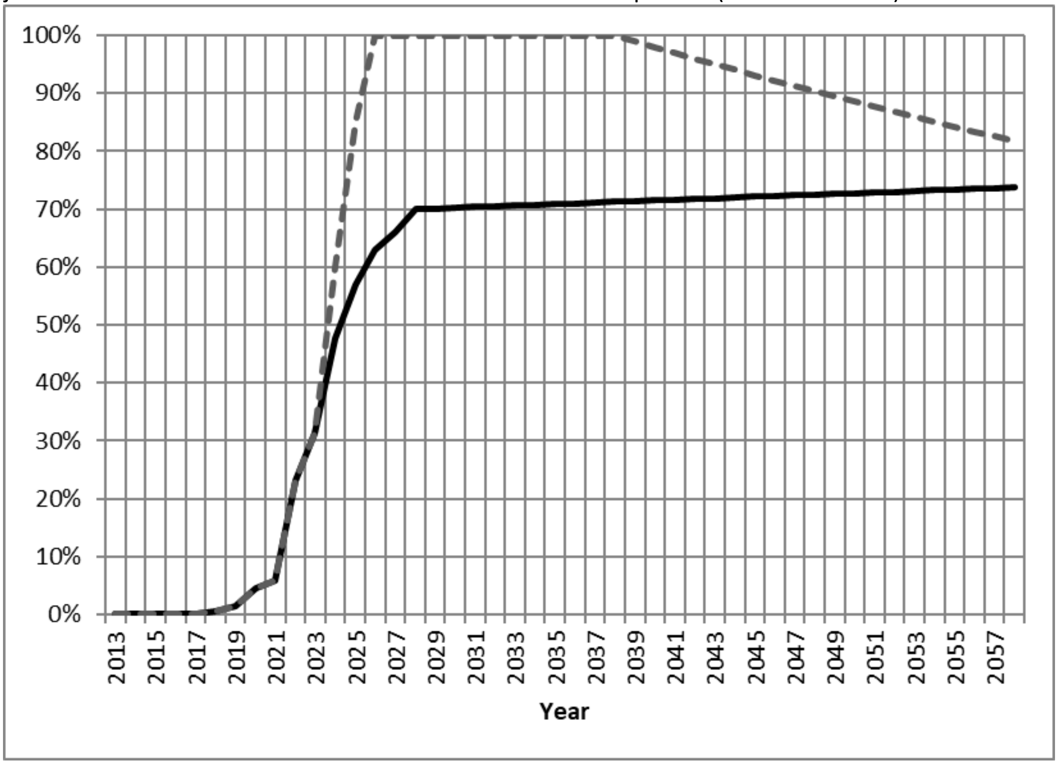



**Figure 13: Projected fitment effect**

6. Fitment increase by year is determined from available sales data (step 4) and fitment data (step 5):

| Fitment increase over BAU at sale | |
|---|---|
| Year | Option 2 |
| 2024 | 5,772 |
| 2025 | 13,600 |
| 2026 | 18,750 |
| 2027 | 18,022 |
| 2028 | 16,633 |
| 2029 | 17,332 |
| 2030 | 18,062 |
| 2031 | 18,824 |
| 2032 | 19,619 |
| 2033 | 20,449 |
| 2034 | 21,315 |
| 2035 | 22,219 |
| 2036 | 23,163 |
| 2037 | 24,148 |
| 2038 | 24,421 |
| 2039 | 23,832 |
| 2040 | 23,227 |
| 2041 | 22,606 |
| 2042 | 21,969 |
| 2043 | 21,315 |
| 2044 | 20,645 |
| 2045 | 19,957 |
| 2046 | 19,251 |
| 2047 | 18,527 |
| 2048 | 17,786 |
| 2049 | 17,025 |
| 2050 | 16,245 |
| 2051 | 15,446 |
| 2052 | 14,627 |
| 2053 | 13,788 |
| 2054 | 12,929 |
| 2055 | 12,048 |
| 2056 | 11,146 |
| 2057 | 10,222 |

7. The table below shows for each year of fitment increase at sale due to intervention, the additional fitment costs calculated over the intervention period (15 years):

| Additional fitment costs ($) | |
|---|---|
| Year | Option 2 |
| 2024 | 7,214,507 |
| 2025 | 16,999,733 |
| 2026 | 23,437,537 |
| 2027 | 22,528,049 |
| 2028 | 20,790,712 |
| 2029 | 21,665,043 |
| 2030 | 22,577,544 |
| 2031 | 23,529,896 |
| 2032 | 24,523,856 |
| 2033 | 25,561,257 |
| 2034 | 26,644,009 |
| 2035 | 27,774,111 |
| 2036 | 28,953,646 |
| 2037 | 30,184,788 |
| 2038 | 30,526,104 |

8. From the first year of intervention (November 2024), the number of crashes affected by the increased fitment was determined for each year over a 37 year period (2 year implementation and 35 years of analysis), for the viable intervention option as shown in the tables below. The crashes affected each year are the product of the likelihood of a crash at the vehicle's age (from step 3) with the increased fitment at sale (step 5), summed as they infiltrate the fleet over time.

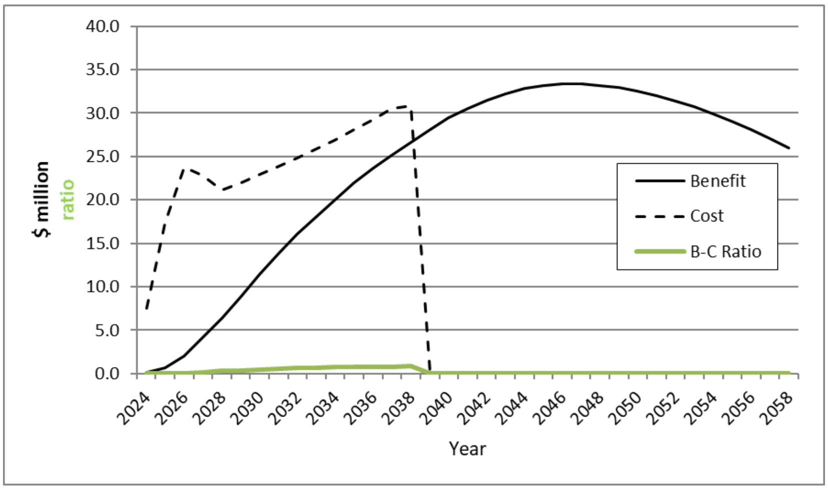
| Year | Vehicle Age | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Total vehicles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | .. | .. | 36 | 37 | |
| 1 | 25 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 25 |
| 2 | 96 | 59 | | | | | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 154 |
| 3 | 144 | 226 | 81 | | | | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 451 |
| 4 | 157 | 340 | 312 | 78 | | | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 886 |
| 5 | 174 | 370 | 468 | 300 | 72 | | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 1383 |
| 6 | 191 | 409 | 510 | 450 | 277 | 75 | | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 1911 |
| 7 | 174 | 450 | 564 | 490 | 415 | 288 | 78 | | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 2459 |
| 8 | 148 | 411 | 620 | 542 | 452 | 433 | 300 | 81 | | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 2987 |
| 9 | 133 | 348 | 567 | 596 | 500 | 471 | 451 | 313 | 84 | | | | | | | | | | | | | | | | | | | | | .. | .. | | | 3463 |
| 10 | 118 | 312 | 480 | 545 | 550 | 521 | 491 | 470 | 326 | 88 | | | | | | | | | | | | | | | | | | | | .. | .. | | | 3902 |
| 11 | 108 | 278 | 431 | 461 | 503 | 573 | 543 | 512 | 490 | 340 | 92 | | | | | | | | | | | | | | | | | | | .. | .. | | | 4331 |
| 12 | 75 | 254 | 384 | 414 | 425 | 524 | 598 | 566 | 534 | 511 | 354 | 96 | | | | | | | | | | | | | | | | | | .. | .. | | | 4734 |
| 13 | 54 | 178 | 350 | 369 | 382 | 443 | 546 | 623 | 590 | 556 | 532 | 369 | 100 | | | | | | | | | | | | | | | | | .. | .. | | | 5092 |
| 14 | 52 | 128 | 245 | 336 | 340 | 398 | 462 | 569 | 649 | 615 | 580 | 555 | 385 | 104 | | | | | | | | | | | | | | | | .. | .. | | | 5417 |
| 15 | 46 | 122 | 176 | 236 | 310 | 355 | 415 | 481 | 593 | 677 | 641 | 604 | 578 | 401 | 105 | | | | | | | | | | | | | | | .. | .. | | | 5740 |
| 16 | 38 | 107 | 168 | 169 | 217 | 323 | 370 | 432 | 502 | 618 | 705 | 668 | 630 | 603 | 406 | 103 | | | | | | | | | | | | | | .. | .. | | | 6059 |
| 17 | 28 | 89 | 148 | 161 | 156 | 226 | 337 | 385 | 451 | 523 | 644 | 735 | 697 | 657 | 610 | 396 | 100 | | | | | | | | | | | | | .. | .. | | | 6343 |
| 18 | 28 | 67 | 123 | 142 | 149 | 163 | 236 | 351 | 402 | 470 | 545 | 672 | 766 | 726 | 664 | 595 | 386 | 97 | | | | | | | | | | | | .. | .. | | | 6582 |
| 19 | 27 | 67 | 92 | 118 | 131 | 155 | 169 | 246 | 366 | 419 | 490 | 568 | 700 | 799 | 734 | 648 | 580 | 376 | 95 | | | | | | | | | | | .. | .. | | | 6780 |
| 20 | 30 | 63 | 93 | 88 | 109 | 137 | 161 | 177 | 256 | 382 | 436 | 510 | 592 | 730 | 808 | 717 | 632 | 564 | 365 | 92 | | | | | | | | | | .. | .. | | | 6942 |
| 21 | 29 | 70 | 87 | 89 | 81 | 113 | 143 | 168 | 184 | 267 | 398 | 455 | 532 | 618 | 738 | 788 | 698 | 615 | 548 | 354 | 89 | | | | | | | | | .. | .. | | | 7066 |
| 22 | 23 | 69 | 97 | 84 | 82 | 85 | 118 | 149 | 175 | 192 | 279 | 415 | 474 | 555 | 625 | 720 | 768 | 680 | 597 | 532 | 343 | 86 | | | | | | | | .. | .. | | | 7148 |
| 23 | 22 | 55 | 95 | 93 | 77 | 86 | 88 | 123 | 155 | 183 | 200 | 290 | 432 | 494 | 561 | 610 | 702 | 748 | 661 | 580 | 515 | 332 | 83 | | | | | | | .. | .. | | | 7185 |
| 24 | 22 | 52 | 76 | 91 | 86 | 81 | 89 | 92 | 128 | 162 | 191 | 208 | 303 | 451 | 500 | 547 | 594 | 683 | 727 | 641 | 561 | 498 | 320 | 80 | | | | | | .. | .. | | | 7183 |
| 25 | 21 | 52 | 72 | 73 | 84 | 89 | 84 | 93 | 96 | 134 | 168 | 199 | 217 | 316 | 456 | 488 | 534 | 578 | 664 | 705 | 621 | 543 | 481 | 308 | 77 | | | | | .. | .. | | | 7151 |
| 26 | 18 | 50 | 72 | 69 | 67 | 88 | 93 | 88 | 97 | 100 | 139 | 176 | 207 | 226 | 319 | 445 | 475 | 519 | 562 | 644 | 683 | 600 | 524 | 463 | 296 | 73 | | | | .. | .. | | | 7092 |
| 27 | 13 | 42 | 69 | 69 | 64 | 70 | 91 | 97 | 91 | 101 | 104 | 145 | 183 | 216 | 229 | 311 | 433 | 463 | 505 | 545 | 624 | 660 | 579 | 504 | 444 | 283 | 70 | | | .. | .. | | | 7006 |
| 28 | 12 | 31 | 58 | 66 | 63 | 66 | 73 | 95 | 101 | 95 | 105 | 109 | 151 | 191 | 218 | 224 | 304 | 422 | 450 | 490 | 528 | 603 | 637 | 557 | 484 | 425 | 270 | 66 | | .. | .. | | | 6895 |
| 28 | 10 | 28 | 42 | 56 | 61 | 66 | 69 | 76 | 99 | 106 | 99 | 110 | 113 | 158 | 193 | 213 | 218 | 295 | 410 | 436 | 474 | 510 | 582 | 613 | 535 | 463 | 406 | 257 | 63 | .. | .. | | | 6762 |
| 30 | 8 | 24 | 38 | 41 | 52 | 64 | 69 | 72 | 79 | 103 | 110 | 103 | 114 | 118 | 160 | 188 | 208 | 212 | 287 | 398 | 423 | 458 | 492 | 560 | 588 | 512 | 442 | 386 | 243 | .. | .. | | | 6612 |
| 31 | 7 | 18 | 33 | 37 | 38 | 54 | 66 | 72 | 75 | 82 | 108 | 115 | 108 | 119 | 120 | 156 | 184 | 202 | 206 | 279 | 385 | 408 | 442 | 474 | 538 | 563 | 489 | 420 | 365 | .. | .. | | | 6446 |
| 32 | 0 | 16 | 25 | 32 | 34 | 39 | 56 | 69 | 75 | 78 | 86 | 112 | 120 | 112 | 121 | 117 | 152 | 179 | 196 | 200 | 270 | 372 | 394 | 426 | 455 | 515 | 537 | 464 | 398 | .. | .. | | | 6261 |
| 33 | 0 | 0 | 23 | 24 | 29 | 36 | 41 | 58 | 72 | 78 | 81 | 90 | 117 | 125 | 114 | 118 | 114 | 148 | 174 | 191 | 194 | 261 | 359 | 379 | 409 | 435 | 491 | 511 | 440 | .. | .. | | | 6055 |
| 34 | 0 | 0 | 0 | 22 | 22 | 31 | 37 | 43 | 61 | 75 | 81 | 85 | 93 | 122 | 126 | 111 | 115 | 111 | 144 | 168 | 185 | 187 | 252 | 346 | 364 | 391 | 416 | 467 | 484 | .. | .. | | | 5833 |
| 35 | 0 | 0 | 0 | 0 | 20 | 23 | 32 | 39 | 44 | 63 | 78 | 85 | 88 | 97 | 124 | 123 | 108 | 112 | 108 | 139 | 163 | 178 | 181 | 242 | 332 | 348 | 373 | 395 | 442 | .. | .. | | | 5599 |
| 36 | 0 | 0 | 0 | 0 | 0 | 21 | 24 | 33 | 40 | 46 | 66 | 82 | 88 | 92 | 98 | 121 | 120 | 105 | 108 | 104 | 135 | 158 | 172 | 174 | 232 | 318 | 332 | 355 | 374 | .. | .. | 36 | | 5355 |
| 37 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 25 | 35 | 42 | 48 | 69 | 85 | 92 | 93 | 96 | 118 | 117 | 102 | 105 | 101 | 130 | 152 | 166 | 167 | 222 | 303 | 316 | 336 | .. | .. | 138 | 31 | 5099 |

9. From the number of crashed affected determined in the previous step, the trauma alleviated by Option 2 by year as the product of effectiveness for each trauma type and the impact of the technology is determined:

| Year | Option 2 | | |
|---|---|---|---|
| | Fatal | Major | Minor |
| 2024 | 0.40 | 11.08 | 34.48 |
| 2025 | 0.61 | 16.76 | 52.16 |
| 2026 | 0.81 | 22.23 | 69.16 |
| 2027 | 1.00 | 27.41 | 85.28 |
| 2028 | 1.18 | 32.38 | 100.76 |
| 2029 | 1.35 | 37.13 | 115.53 |
| 2030 | 1.51 | 41.42 | 128.89 |
| 2031 | 1.64 | 45.21 | 140.67 |
| 2032 | 1.77 | 48.64 | 151.37 |
| 2033 | 1.89 | 51.94 | 161.64 |
| 2034 | 2.01 | 55.26 | 171.97 |
| 2035 | 2.13 | 58.64 | 182.49 |
| 2036 | 2.25 | 61.90 | 192.63 |
| 2037 | 2.36 | 64.77 | 201.55 |
| 2038 | 2.44 | 67.14 | 208.93 |
| 2039 | 2.51 | 69.01 | 214.76 |
| 2040 | 2.56 | 70.45 | 219.24 |
| 2041 | 2.60 | 71.46 | 222.38 |
| 2042 | 2.62 | 72.01 | 224.07 |
| 2043 | 2.62 | 72.09 | 224.34 |
| 2044 | 2.61 | 71.82 | 223.49 |
| 2045 | 2.59 | 71.32 | 221.92 |
| 2046 | 2.57 | 70.61 | 219.73 |
| 2047 | 2.53 | 69.66 | 216.78 |
| 2048 | 2.49 | 68.48 | 213.09 |
| 2049 | 2.44 | 67.10 | 208.79 |
| 2050 | 2.38 | 65.55 | 203.98 |
| 2051 | 2.32 | 63.85 | 198.68 |
| 2052 | 2.25 | 61.94 | 192.74 |
| 2053 | 2.18 | 59.82 | 186.15 |
| 2054 | 2.09 | 57.53 | 179.03 |
| 2055 | 2.01 | 55.13 | 171.54 |
| 2056 | 1.91 | 52.62 | 163.73 |
| 2057 | 1.82 | 49.99 | 155.55 |
| 2058 | 1.72 | 47.24 | 146.99 |

10. From demographic information provided by MUARC (MUARC, 2019) and the totals established in step 9, the typical age of a sensitive fatality was used to determine the cost to society due to loss of life according to the Willingness to Pay (WTP) method. The typical cost of a serious and minor injury was established using methods outlined in BITRE Report 102.

11. Summary plot for Option 2 by year:



# Appendix F – Acronyms and abbreviations

| | |
|---|---|
| ABS | Antilock Brake System |
| AEB/AEBS | Autonomous (Advanced) Emergency Braking (System) |
| ADAS | Advanced Driver Assistance Systems |
| ADR | Australian Design Rule |
| ALRTA | Australian Livestock and Rural Transporters Association |
| ARTSA | Australian Road Transport Suppliers Association |
| BAU | Business as Usual |
| BCR | Benefit-Cost Ratio |
| BIC | Bus Industry Confederation |
| BITRE | Bureau of Infrastructure, Transport and Regional Economics |
| BSW | Blind Spot Warning |
| BTE | Bureau of Transport Economics (now BITRE) |
| CCA | Competition and Consumer Act 2010 |
| CEO | Chief Executive Officer |
| C'th | Commonwealth |
| CVIAA | Commercial Vehicle Industry Association Australia |
| EPA | Environment Protection Authority |
| ESC | Electronic Stability Control |
| EU GSR | European Union General Safety Regulation |
| FCW | Forward Collision Warning |
| FMVSS | Federal Motor Vehicle Safety Standard |
| GVM | Gross Vehicle Mass |
| ISA | Intelligent Speed Assist |
| ITMM | Infrastructure and Transport Ministers Meeting |
| ITSOC | Infrastructure and Transport Senior Officials' Committee |
| LDWS | Lane Departure Warning System |
| LKA | Lane Keep Assist |
| MUARC | Monash University Accident Research Centre |
| MVSA | Motor Vehicle Standards Act 1989 |
| NHTSA | National Highway Traffic Safety Administration |
| NPV | Net Present Value |
| NRSS | National Road Safety Strategy 2021-2030 |
| NTARC | National Truck Accident Research Centre |
| NTC | National Transport Commission |
| OEM | Original Equipment Manufacturer |
| OBPR | Office of Best Practice Regulation |
| ORS | Office of Road Safety |
| PBS | Performance Based Standards |
| RBM | Regulatory Burden Measurement |
| RIS | Regulation Impact Statement |

| | |
|---|---|
| RSC | Roll Stability Control |
| RVSA | Road Vehicles Standards Act 2018 |
| SCA | Side Curtain Airbag |
| SPECTS | Safety, Productivity & Environment Construction Transport Scheme |
| SVSEG | Strategic Vehicle Safety and Environment Group |
| TfNSW | Transport for New South Wales |
| TIC | Truck Industry Council |
| TISOC | Transport and Infrastructure Senior Officials’ Committee |
| TLG | Technical Liaison Group |
| UN | United Nations |
| US | United States |
| WP.29 | UN World Forum for the Harmonization of Vehicle Regulations |

# Appendix G – 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. |
| 1998 Agreement | UN Agreement Concerning the Establishing of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles, of June 1998. |
| Advanced Driver Assistance Systems (ADAS) | Safety systems that work automatically to assist a driver in avoiding or mitigating the effects of a crash. |
| Autonomous (Automatic) Emergency Braking (AEB) | A combination of a vision-sensing control system and actuators that forms a safety system which is designed in specific conditions to reduce the severity of an accident or avoid a collision altogether by taking control of the vehicle braking from the driver. |
| Antilock Brake System (ABS) | A portion of a service brake system that automatically controls the degree of rotational wheel slip relative to the road at one or more road wheels of the vehicle during braking. |
| Benefit-Cost Ratio (BCR) | The ratio of expected total (gross) benefits to expected total costs (in terms of their present monetary value) for a change of policy relative to business as usual. |
| Bus (or Omnibus) | A passenger vehicle having more than 9 seating positions, including that of the driver. |
| Certification | Assessment of compliance to the requirements of a regulation/standard. Can relate to parts, sub-assemblies, or a whole vehicle. |
| Crash | Any apparently unpremeditated event reported to police, or other relevant authority, and resulting in death, injury or property damage attributable to the movement of a road vehicle on a public road. |
| Discount Rate | A rate of interest used to translate costs which will be incurred and benefits which will be received across future years into present day values. |
| Fatal Crash | A crash for which there is at least one death. |
| Gross Vehicle Mass (GVM) | The maximum laden mass of a motor vehicle as specified by the manufacturer. |
| Light Vehicle | For the purposes of this RIS, any vehicle in a category (or equivalent ADR category) covered by UN Regulation No. 152. |
| Hospitalised Injury | A person admitted to hospital from a crash occurring in traffic. Traffic excludes off-road and unknown location. |
| Lane Departure Warning System (LDWS) | Provide a warning to the driver when the vehicle unintentionally drifts outside of the lane. |
| Lane Keep Assist (LKA) | Provides steering input to help keep the vehicle in the middle of a detected lane and provides visual and tactile alerts if the vehicle is detected drifting out of the lane. |
| Net Benefit | The sum of expected benefits (in monetary terms), less expected costs associated with a change of policy relative to business as usual. |

| | |
|---|---|
| Net Present Value (NPV) | The difference between the present economic value (determined using an appropriate discount rate) of all expected benefits and costs over time due to a change of policy relative to business as usual. |
| Road Crash Fatality | A person who dies within 30 days of a crash as a result of injuries received in that crash. |
| Rear-end Crash | Denotes a scenario involving two vehicles, where the second vehicle strikes the rear of the first vehicle. |
| Type Approval | Written approval of an authority/body that a vehicle type (i.e., model design) satisfies specific technical requirements. |

# Appendix H – Heavy 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.

The categories listed below are those relevant to vehicles greater than 4.5 tonnes '*Gross Vehicle Mass*' and trailers greater than 4.5 tonnes Gross Trailer Mass (Heavy Vehicles).

**OMNIBUSES (M)**

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.

Sub-category MD1 – up to 3.5 tonnes '*Gross Vehicle Mass*'

MD2 – up to 3.5 tonnes 'Gross Vehicle Mass'

MD3 – over 3.5 tonnes, up to 4.5 tonnes '*Gross Vehicle Mass*'

MD4 – over 4.5 tonnes, up to 5 tonnes '*Gross Vehicle Mass*'

MD5 – up to 2.7 tonnes '*Gross Vehicle Mass*'

MD6 – over 2.7 tonnes, up to 5 tonnes '*Gross Vehicle Mass*'

**HEAVY OMNIBUS (ME)**

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

**GOODS VEHICLES (N)**

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 good 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 two or more non-separable but articulated units shall be considered as a single vehicle.

**MEDIUM GOODS VEHICLE (NB)**

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

Sub-category NB1 – over 3.5 tonnes, up to 4.5 tonnes '*Gross Vehicle Mass*'

NB2 – over 4.5 tonnes, up to 12 tonnes '*Gross Vehicle Mass*'

**HEAVY GOODS VEHICLE (NC)**

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

# Appendix I – Public Comment Summary

| Correspondent | Supported Option | Comments | Departmental Response |
|---|---|---|---|
| Adam Brighouse | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2) | 1. Agreed |
| Bicycle Network | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2)<br>2. Highlights that 1 in 5 rider fatalities involve a heavy vehicle and notes that this statistic has not changed in over 20 years.<br>3. Bicycle network proposes the Department examine the case for Blind Spot Information Systems (BSIS) and exit warning technologies to be fitted as mandatory for all vehicles. | 1. Agreed<br>2. Noted<br>3. Noted, the Department values the input of its stakeholders and will consider the case to introduce these safety technologies in line with the ADR work program, National Road Safety Strategy and National Road Safety Action Plans. BSIS is part of the Safer Freight Vehicles package. |
| Anonymous | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2)<br>2. Recommended the Department consider avenues to retrofit heavy vehicles with forward collision warning and LDWS to reduce fatalities and injuries further.<br>3. Suggested increasing the speed of uptake of new safety technologies into ADRs for pedestrian and cyclist warning.<br>4. Supported ADRs for more advanced technologies along with having them as default 'on'.<br>5. Recommended more consumer awareness surrounding these technologies. | 1. Agreed<br>2. Noted. The ADRs apply to vehicles when first supplied to the Australian market. In-service modification and their safety is the responsibility of the state and territory road authorities.<br>3. Noted. A new ADR for Reversing Aids to ensure the safety of pedestrians in reversing incidents was implemented in June 2023. BSIS is part of the Safer Freight Vehicles package.<br>4. Noted.<br>5. The Department will work with state and territory governments, road safety advocates and organisations, such as ANCAP to expand its advocacy and community education activities on LDWS. As part of its community education and advocacy role, ANCAP has conducted a number of community engagement activities to promote and explain the availability, function, benefits and limitations of ADAS |

| | | | |
|---|---|---|---|
| | | | currently available on new vehicles. |
| Anonymous | Option 1 | 1. Does not support mandating LDWS for all heavy vehicles. (Option 1)<br>2. Not supported by the evidence presented in the Consultation IA.<br>3. Believes an exemption for NB category vehicles designed for off-road use should apply.<br>4. Expressed concerns that cost estimates in the BCA seem low. (*No alternative costs were provided by submitter.)*<br>5. Believes the default 'on' setting should be reconsidered due to potential driver annoyance resulting in adverse effects on safety.<br>6. Recommends 2 years lead time on implementation once the ADR is signed if the preferred option is to mandate an ADR. | 1. Noted<br>2. It was noted in this IA that fitment of LDWS has been increasing steadily in recent years. However, currently LDWS perform differently depending on the manufacturer and not all vehicles fitted with LDWS will meet all the injury risk derived performance requirements of UN R130. It is these performance based limits that will deliver the large majority of benefits outlined in this IA.<br>3. Noted. Exemptions are clearly set out in the ADR, as consulted on separately with stakeholders to implement the recommended option.<br>4. Noted. While new safety technologies can be expensive, progressive fitment and increased production lowers the price of the technology over time. Therefore, while there may be some initial increases in pricing on specific models, this will usually be absorbed into the price of the vehicle during its production life. The Department consulted with industry on costs, existing and projected fitment rates prior to developing the consultation IA. Post-consultation dialogue with the heavy vehicle industry have resolved these matters further and the final IA BCA outcomes have been adjusted to reflect this.<br>5. Noted. The Department engages at the UN working groups to influence UN regulations through future amendments.<br>6. Noted. Final implementation dates will be determined as part of |

| | | | |
|---|---|---|---|
| | | | the ADR, following further consultation by the Department with industry and decision by the Minister. |
| Truck Industry Council (TIC) | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2)<br>2. TIC suggests that the IA for the ADR 99/00 be amended to acknowledge that not all heavy vehicles are driven by professionals.<br>3. TIC noted that on Page 6 of the ES, there is an incorrect reference to “reversing technologies” that should be changed to “lane departure warning systems”.<br>4. TIC recommended delineating the different forms of freight task and avoid the generalization used at the bottom of page 10 of the Consultation IA, to better characterise freight volumes in their respective freight task types.<br>5. TIC suggested rewriting the statement regarding ”steering shudder” on Page 20 of the Consultation IA to better clarify and reflect the need for LDWS to have two forms of driver warnings. They suggest removing any implication that certain techniques of warning are preferred or necessary.<br>6. TIC suggested revising the BAU to show that LDWS are sub-systems of a majority of AEB systems. They noted that the mandating of ADR 97/00 will drive automatic adoption of LDWS, which will result in higher fitment rates that would mean mandating ADR 99/00 would be of little value.<br>7. TIC suggested that the ADR 99/00 Consultation IA must | 1. Agreed.<br>2. Noted. The IA has been revised to reflect this.<br>3. Noted. See above.<br>4. Noted. The Final IA has been updated to state that while the overall road freight task may have been reduced during the COVID pandemic, the urban/metro road freight task increased.<br>5. Noted.<br>6. Noted. The Department consulted with industry on costs, existing and projected fitment rates prior to developing the Consultation IA. The analysis in the Consultation IA identified and accounted for heavy vehicles fitted with AEBS and LDWS. Post-consultation dialogue with the heavy vehicle industry have resolved these matters with regard to the BCA and the final IA BCA outcomes have been adjusted to reflect this.<br>7. Noted. Appendix D in the Final IA details the specific performance requirements of ADR 99/00.<br>8. The Austroads report (AP-R578-18) documents a project undertaken to achieve national harmonisation through the development of national performance specification/criteria for pavement markings.<br>9. Post-consultation dialogue with TIC have informed the original BCA conducted in the Consultation IA with regard to effectiveness of the LDWS and |

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|---|---|---|---|
| | | clearly state actual performance requirements of ADR 99/00.<br>8. TIC stated that the Consultation IA must clearly detail federal, State, Territory and Local governments need to develop line markings and surrounding regulations that align with European standards so that European vehicles can provide a maximum safety benefit on Australian roads.<br>9. TIC thought the BCR assumptions should be clarified, in particular what percentage of roads LDWS is believed to be effective on.<br>10. TIC thought that LDWS on light vehicles, is of higher importance and time sensitivity than LDWS on heavy vehicles.<br>11. TIC requested the costings for LDWS for heavy vehicles should be revised, justified and reshared for review.<br>12. TIC suggested greater clarity surrounding applicability requirements in ADR 99/00. For vehicles over 2.5m wide and up to and including 2.5m wide, they believe clarity is needed for applicability dates and vehicle exemptions.<br>13. TIC suggested re-naming the standard to; Vehicle Standard (Lane Departure Warning Systems) 2022, to more appropriately reflect the correct year.<br>14. Recommended ADR99/00 implementation timings be amended as follows:<br>a. Clause 3.3.1 - 1 November 2024 for NEW model vehicles (no change to the | Australian roads. TIC agreed the BCA conducted was approximately in the right direction however requested a revision to consider lane marking effectiveness and their impact on benefits derived.<br>10. Noted. The Department is examining the case to introduce Emergency Lane Keep Systems (ELKS) in Australia for light vehicles.<br>11. See 9 above.<br>12. Noted. Post-consultation dialogue with TIC revealed their preference for a delayed implementation date for ADR 99/00. Final implementation dates will be determined as part of the ADR, following further consultation by the Department with industry and decision by the Minister.<br>13. Agreed. The revised ES and ADR 99/00 both have been updated to 2023.<br>14. Noted. See 12.<br>15. Noted. See 12.<br>16. In 2022, the Department consulted with local government councils building and designing roads and the heavy and light vehicle peak bodies to develop a proposal for the UN expert working group to include Australian highway lane markings in the Annex to UN R130 (GRVA-16-10). In addition, the Department has amended ADR 99/00 to include Australian lane markings in Appendix C. |

| | | | |
|---|---|---|---|
| | | Consultation IA recommendation)<br>b. Clause 3.3.2 - 1 February 2027 for ALL vehicles<br>15. Recommended the introduction dates would need to ensure that a minimum of two (2) years from the ADR gazettal date for the introduction on NEW model trucks and a minimum of three (3) years from the ADR gazettal date for the introduction on ALL model trucks.<br>16. TIC recommend that ADR 99/00 must specifically detail the line marking test specifications that the LDWS system must meet. They also suggest removing all line markings from Annex 3 of UN R 130 that are not applicable to Australia. | |
| Anonymous | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2) | 1. Agreed |
| Gas Energy Australia | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2)<br>2. GEA notes that mandatory adoption of trusted safety technology is important not only for the heavy vehicle industry but all road users.<br>3. GEA supports the proposed implementation timing. | 1. Agreed<br>2. Agreed<br>3. Noted. Final implementation dates will be determined as part of the ADR, following further consultation by the Department with industry and decision by the Minister. |
| Fiat Chrysler Automobiles (FCA) | Option 2 | 1. Supports mandating LDWS for all heavy vehicles. (Option 2)<br>2. FCA recommends removing references to AS 1746.2:2009, and instead include applicable Australian line markings in an appendix to ADR 99/00.<br>3. FCA suggests revising ADR 99/00 to allow for UN R130 approvals, and that UN R130 test results can be supplemented with simulations showing compliance with Australian lane markings. | 1. Agreed.<br>2. Noted. In 2022, the Department consulted with local government councils building and designing roads and the heavy and light vehicle peak bodies to develop a proposal for the UN expert working group to include Australian highway lane markings in the Annex to UN R130 (GRVA-16-10). In addition, the Department has amended ADR 99/00 to include only Australian lane markings in Appendix C |

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| | | | 3. Noted. See above. |