



# The Development of the “Vision Zero” Approach in Victoria, Australia

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## Contents

Introduction .....	477
The Years Before Vision Zero .....	477
Early Years .....	477
Safety in the 1970s and the Haddon Matrix .....	478
Behavioral Approaches Predominate Throughout the 1970s, 1980s, and 1990s .....	479
Establishment of MUARC .....	482
The Beginning of Towards Zero .....	482
Moving Beyond Behavioral Approaches .....	482
Introducing Vision Zero and Safe System to Victorian Decision-Makers .....	483
Use of Safe System Across Australia .....	484
Implementing a Safe System in the 2000s .....	484
Early Implementation of Safe System .....	484
Advancing Vehicle Safety .....	486
Investing in Safe Infrastructure .....	487

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Towards Zero .....	489
Adopting the Vision Zero Principles .....	489
Adopting Towards Zero .....	489
Public Education and Towards Zero .....	492
Community Support for Towards Zero .....	494
Adoption of Towards Zero Approach Across Australia .....	495
Implications for the Future .....	496
Challenges Remain .....	496
Road Safety Management .....	497
Reporting and Accountability .....	498
Future Challenges and Opportunities .....	499
How to Improve Speed Management and Road Infrastructure? .....	499
Realizing the Benefits of Safer and Autonomous Vehicles .....	500
Improved Data and Research .....	501
Conclusion .....	502
References .....	503

## Abstract

For many decades, road safety measures in Australia focused almost exclusively on behavioral approaches. When Claes Tingvall was appointed Director of MUARC, he introduced the concept of “Vision Zero” to Australia and, with it, the “Safe System” approach. While political leaders initially regarded a vision for zero deaths as unachievable, they supported the inherent logic of the Safe System.

Initially the Safe System was applied as four independent pillars. While this lack of integration had limitations, it did enable road safety measures to move beyond road user behavior to focus more on safer road infrastructure and vehicle safety.

The initial Safe System approach became “Towards Zero” an approach that accepts humans are fragile, and the road system designed to protect from death or serious injury was adopted across all Australia jurisdictions between 2004 and 2018.

Public education has been used to introduce and explain Towards Zero and bring greater attention to the importance of purchasing a safe vehicle. Infrastructure investment has moved from a “blackspot” approach to the Safe System approach. However, shifting community and decision-makers’ understanding of the importance of speed limits being set to match the safety standard and design of a road remains a challenge. Future opportunities involve better integration of the components of the Safe System, focusing on serious injuries and improving strategy delivery, performance reporting, management, and accountability.

## Keywords

Towards Zero · Safe System · Road Safety Strategy · Road Infrastructure Investment · Drink Driving Case Study · Vehicle Safety · Speed Management

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## Introduction

The aim of this chapter is to chart the progress of the Vision Zero approach across Australia. To do this, it is important by way of background to understand a little of the country's governance structure.

In January 1901, the Australian colonies united to become a nation, with the colonies becoming Australia's six states. Through this process of federation, the British Parliament passed legislation allowing the six Australian states to govern in their own right as part of the Commonwealth of Australia. While regulatory powers with regard to road-based vehicles rested with the Commonwealth, powers with regard to traffic law and penalties, driver licensing, vehicle registration, road infrastructure, traffic management, and planning (with the exception of large, joint projects) sat with each state. This has meant developments that influence road safety outcomes have to some degree evolved differently across state boundaries. The collaborative process across states has also meant that there are significant areas of commonality.

The approach to this chapter, then, is to focus on development of the Vision Zero approach within the State of Victoria (the home state of the chapter's authors) while drawing attention to the main areas of commonality and departure across jurisdictions.

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## The Years Before Vision Zero

### Early Years

Road transport across Australia evolved in a relatively haphazard way. With the introduction of motorized transport, emphasis was placed on providing roads and streets in areas of high population concentration and arteries to connect the major towns. The demand for roads far outstripped the system thinking needed to ensure that the network was efficient and safe for all road users. Professor Ian Johnston reinforced this view by stating, "We evolved inappropriate policies, practices and designs from an unmotorised era of personal transport because we had nothing else to go on and struggled to react to the rate of growth" (Johnson 2015).

In the 1940s and 1950s, the appetite for owning personal transport was fueled by population growth, as well as the novelty, convenience, and efficiency offered by the private motor car. The relatively slow development of public transport and the long distances that separated major population centers also added to the appeal.



Bourke Street, Melbourne CBD, 1950

Scientific knowledge to guide safe development of the road traffic system grew slowly until the late 1960s. According to Johnson, the next decade saw “the discipline of ‘traffic safety science’ [emerge] – not a science in its own right but a confluence of the disciplines of epidemiology, public health, engineering, psychology, mathematics and statistics, and trauma medicine” (Johnson 2005). Trauma medicine provided an important impetus for introducing key safety policies by identifying severe injury types associated with unrestrained vehicle occupants and alcohol-related crashes. These findings, together with a rising road toll, galvanized bipartisan support for an agenda for change (Johnson 2015).

### **Safety in the 1970s and the Haddon Matrix**

The 1970s heralded a move to develop the scientific evidence to support well-founded, effective safety policy. The Haddon Matrix (Haddon 1968; Haddon 1972) provided one of the earliest systematic frameworks through which to assess the safety contributions of key elements of the traffic system along a crash timeline (refer below). Under this epidemiological approach to road safety, discrete injury factors were systematically examined in order to identify which countermeasures could be implemented, often guided by benefit-cost analysis. At the same time, the first major in-depth accident study in Australia was conducted by the Road Accident

Research Unit at the University of Adelaide (Roberston et al. 1966). Increasingly, the disparate but related elements that give rise to crashes and subsequent injury outcomes were coming under investigation.

**Haddon's Matrix**

		Factors		
Phase		Human	Vehicle/ Equipment	Environment
Pre-crash	Crash prevention	Information, Attitude, Police enforcement	Roadworthiness Speed m/m, Lighting	Road design & layout, speed limit, pedestrian facility
Crash	Injury prevention during crash	Use of restraints	Occupant restraints, crash protective design	Crash protective roadside objects
Post-crash	Life sustaining	First aid skill, Access to medics	Ease of access Fire risk	Rescue facilities

Source: Haddon 1968

### Behavioral Approaches Predominate Throughout the 1970s, 1980s, and 1990s

Despite increasing exploration into the multiple factors that contributed to crashes and injury, behavioral approaches to implementation remained the norm. Legislative reform, public education, and police enforcement were widely adopted by road safety agencies across Australia in the 1970s and 1980s.

In the early 1970s, the State of Victoria had the poorest road safety performance nationally. Victoria recorded the highest number of lives lost in a year in 1970 with 1061 deaths (equating to a rate of 31 deaths per 100,000 population). Landmark reforms addressing compulsory seat belt wearing and drink-driving were introduced in response. Stepped-up enforcement together with promotional support saw these reforms provide a strong platform for shifting key high-risk behaviors, to achieve the adoption of more protective behaviors and norms across the population.

Legislative change introduced throughout the 1970s, 1980s, and 1990s included:

- **Compulsory Seat Belt Wearing**  
Victoria's first compulsory seat belt law was introduced in 1970 and applied to all occupants where a seat belt was fitted. Following this, further measures were introduced to mandate availability of belts in the rear seat upon resale of a vehicle.

By 1972 all other Australian states and territories introduced compulsory seat belt wearing laws for front seat occupants (Jessop 2009). An evaluation published in 1977 reported that seat belt legislation had effectively reduced the number of deaths and injuries by approximately one-third for car occupants involved in motor vehicle crashes (Trinca and Dooley 1977).

- **Bicycle Helmet Wearing**

In Victoria, public education about wearing a helmet while riding a bicycle began in 1983. There were some improvements in wearing rates among primary school-aged children, but the uptake was lower among older children and adult cyclists (Vulcan et al. 1992). In 1990, Victoria was the first jurisdiction in the world to introduce compulsory bicycle helmet wearing for anyone riding a bicycle. Evaluations showed an increase in helmet wearing and reductions in head injuries (Cameron et al. 1992b).

- **Speed Management**

As speed management emerged internationally as a crucial trauma prevention strategy, speed compliance remained a challenge with general policing capacity. Development of an automated speed surveillance system using a few speed cameras in the late 1980s led to the first large-scale speed camera program in the world (Cameron et al. 1992a). Progressive introduction of 54 speed cameras and an automated Traffic Infringement Notice penalty system increased detection of speeding drivers from 20,000 per month to 40,000–80,000 per month. Combined with an intensive statewide TAC mass media campaign, the camera program significantly reduced casualty crashes and their severity, particularly across arterial roads in Melbourne and on 60 km/h roads in rural Victoria where the majority of the speed camera operations occurred. Public education focused on the difficult task of building a dialogue with community around the legitimacy of speed enforcement, as well as building a community agenda about speeding and safety (Cameron et al. 1992a).

- **Drink-Driving**

Despite Victorian laws introduced in 1966 requiring drivers to have a blood alcohol concentration (BAC) limit under 0.05, drink-driving was rising in the community. In the mid-1970s, around 50% of all drivers and riders killed had an illegal BAC. As a consequence, Victoria introduced a radical new law in July 1976 that would permit random breath testing of drivers at the roadside. This law then provided the impetus for progressively increased and highly visible random breath testing from the mid-1970s and throughout the 1980s. Mass media campaigns educating the public about the level of enforcement and the increased risk of detection created a strong deterrent effect. By 1990, random breath testing (RBT) had increased to 500,000 tests annually, supported by bursts of mass media publicity and a series of legislative reform aimed at behavior and social change (South 1990; Cavallo and Cameron 1992). Experimentally designed evaluations found trauma reductions during intensified periods of RBT. As a result, the number of tests rapidly doubled from 500,000 to 1 million annually through bus-based RBT. This, combined with intensive TAC mass media campaigns, resulted in 19–24% fewer fatal crashes and 15% fewer serious casualty crashes in high alcohol times (Cavallo and Cameron 1992).

### Change Case Study: Drink-Driving in Victoria

Victoria’s drink-driving strategy has been evolving since the late 1970s, combining legislative, policing, and public education activity designed to influence behavior change. The timeline below includes milestones and data outlining the progress made over the past 50 years (sourced from a range of papers: Vulcan and Cameron 1997; Moloney 1995; South 1990; Healy 1997; Cavallo and Cameron 1992; Victoria Police 2016; McIntyre et al. 2011; Watson et al. 2015). The behavioral approach can be characterized by understanding the nature of drink-driving behavior, patterns, perceptions, and risks and progressive targeting of legislative reform where elevated risk demanded. This approach was complemented by an escalating level of enforcement activity capitalizing on new technology and equipment, coupled with public education to further enhance the perceived risk of detection. In parallel, separating drinking and driving has increased in focus through the expanded use of alcohol ignition interlocks and community education.

Year	Measures	Level of trauma
1966	Victoria introduces 0.05 BAC limit	
1976–1980	Random breath testing (RBT) introduced at designated breath testing stations Approximately 40,000 RBTs conducted Increase in tax on alcohol	~50% of drivers killed had BAC over 0.05
1981–1988	Police adopt electronic alcohol detection devices – “breathalyzer” technology Zero BAC limit for learner drivers and first- and second-year probationary drivers Mandatory license cancellation escalating with BAC Immediate license suspension for drivers over 0.15 BAC	~38% of drivers killed had BAC over 0.05 (Cavallo and Cameron)
1989–1999	Police branch established with sole purpose of conducting RBT Roll out of 13 highly visible “booze buses” for RBT “Drink Drive Bloody Idiot” advertising campaign launched in December Number of RBTs increased to almost 1 million Total of 12 advertising campaigns targeting drink-driving	~25–30% of drivers/ motorcyclists killed had BAC over 0.05
2000–2010	Approximately 1.5 million RBTs conducted Alcohol interlocks for repeat offenders, followed by high BAC first offenders Advertising becomes more pointed, focusing on those “only a little bit over” The zero BAC requirement for young probationary drivers extended to four years	~20% of drivers/ motorcyclists killed had BAC over 0.05 (TAC, May 2010)
2011–2019	Expansion of alcohol interlock program to more offenders and by 2019 to all offenders Approximately 3–4 million RBTs per year Advertising shifts focus on separating drinking and driving Mandatory license bans, interlocks, and completion of behavioral change program for all drink-driving offenders	~18% (avg 2015–2018) of drivers/motorcyclists killed had BAC over 0.05 (Austroads)

Legislative reform, generally high levels of enforcement, and ongoing public education were successful in changing some highly problematic, pervasive behaviors and significantly reduced road trauma from the record highs of the early 1970s. Seemingly, the principle underlying the adopted approaches was that “behavioural problems require behavioural solutions,” and this proved successful when levels of serious crashes involving deliberate behaviors were high. However, there remained significant numbers of crashes leading to serious trauma that were not being addressed. In particular, the 1970s and 1980s saw little progress in reducing the high travel speeds across Australia, in recognizing the relationship of travel speed with the quality of road infrastructure, and in improving the relatively poor safety standards of the Australian vehicle fleet.

## **Establishment of MUARC**

Throughout the 1980s, safety problems and solutions were progressively identified and devised, drawing upon the findings of Safety Science and subsequent evaluative work that helped to refine and guide future countermeasure pathways. Safety Science received a boost in 1987 with the formation of the Monash University Accident Research Centre (MUARC) with the support of the Victorian Government. Importantly, the remit of MUARC was to support government, industry, and the community to devise and introduce effective safety measures to reduce accidental deaths and injuries in all settings by marrying academic excellence with practical significance. The Centre’s aim, therefore, differed from that of many university faculties in that it was grounded in practical outcomes in collaboration with key stakeholders. Similar developments had taken place in other jurisdictions with high-quality safety centers having been already established within the Universities of Adelaide and New South Wales together with Curtin University in Perth. A new safety center was later established at the Queensland University of Technology in 1996.

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## **The Beginning of Towards Zero**

### **Moving Beyond Behavioral Approaches**

Despite the significant focus on influencing driver behavior to achieve reductions in road trauma, some Australian road safety professionals were beginning to identify the relationship between decisions regarding the road transport system and questions of risk and morality. Professor Soames Job posited that “*many fatalities occur not because of driver error but because of driver error combined with a negligent designed road system and a politically acceptable but technically substandard vehicle*” (Job et al. 1989).

The most significant catalyst for the adoption of the Vision Zero philosophy in Australia was the arrival of Professor Claes Tingvall, a Swedish road safety expert who was appointed Director of MUARC in 1998. In November of that year, Prof. Tingvall introduced Vision Zero as a new paradigm for injury prevention at the



Australasian Road Safety Research, Policing and Education conference in Wellington, New Zealand (Tingvall 1998).

A year later, Prof. Tingvall together with his MUARC colleague Dr. Narelle Haworth published a paper recommending that Victoria adopt a Vision Zero approach to road safety (Tingvall and Haworth 2000). They advised that the only way to radically reduce or eliminate deaths and serious injuries was to lower vehicle travel speeds and gradually align speeds to the inherent safety of the road system. Lower maximum speed limits for differing types of road infrastructure were recommended, assuming best practice vehicle safety design and 100% restraint use.

In parallel, with a view to providing a beacon into the future and with the support of Prof. Tingvall, the world-first TAC SafeCar project was established in partnership with MUARC and Ford Motor Company (Regan et al. 2001). The aim of the project was to showcase and evaluate human performance with regard to the operation of multiple intelligent transport system (ITS) safety technologies installed within a vehicle. Technologies included haptic Intelligent Speed Adaptation (ISA), forward collision warning, and seat belt reminder systems.

## **Introducing Vision Zero and Safe System to Victorian Decision-Makers**

Many road safety researchers and practitioners who were exposed to Prof. Tingvall’s explanation of Vision Zero were very engaged with the possibility of adopting the approach. In 2003, Eric Howard, General Manager of Road Safety at VicRoads (the Victorian Government’s lead road safety agency), undertook a study tour to Sweden to learn more about Vision Zero. Upon his return to Victoria, Mr Howard shared the concept with senior leaders in Victoria and encouraged the adoption of developing a safe systems approach to road safety and committing to Vision Zero.

Mr Howard and his colleagues at the TAC worked to move Vision Zero beyond research and into a political arena and tried to have the Victorian State Government adopt his approach. However, a key sticking point was the premise of reducing speed limits to align with the inherent safety of the road network. Lowering speed limits is a highly contestable road safety issue with the broader Australian community and one that Victoria’s political leaders at the time were not willing to address. According to Mr Howard, *“the lead road safety practitioners in Victoria understood the logic of ‘Safe System’ and the importance of committing to achieving zero deaths and serious injuries. However, convincing political leaders of the need for lower speed limits was a bridge too far”* (personal correspondence, 14 February 2020). The full adoption of the Vision Zero approach was subsequently rejected by policy-makers.

Instead, Victoria’s road safety leaders decided to adopt the Safe System as the basis for its strategic approach to road safety in late 2003. While this approach raised the fundamental question of how much trauma the community was prepared to accept on our roads, it did not specifically adopt a vision for zero deaths and serious injuries

(Howard 2004). Government endorsement of the Safe System approach and the ensuing Arrive Alive Victorian Road Safety Strategy in 2007 signaled an “in principle” acceptance of the paradigm shift in road safety thinking, research, and strategy. However, full realization of the approach through implementation of safety improvements faithful to the new paradigm was not achieved over the life of the Strategy.

## Use of Safe System Across Australia

As well as Victoria, Western Australia adopted the Safe System approach early on. Iain Cameron, General Manager of Road Safety in Western Australia, together with his Victorian counterpart Eric Howard, were involved in a number of international projects that exposed them to Safe System and Vision Zero thinking. As a result, Western Australia’s Road Safety Strategic Plan for 2003–2007 was underpinned by the Safe System philosophy. Like in Victoria, the actions of the Western Australian government in the early years were concentrated on behavior management, especially speed limit compliance. But unlike Victoria, there was not the significant investment in safe road infrastructure. The Western Australian approach evolved with the establishment of a Parliamentary Reference Group to socialize developments in road safety among decision-makers, and a program of consultations with industry and community was introduced to further build understanding and support for the Safe System approach (Mooren et al. 2011). Iain Cameron reflected that “*the shift to a safe system is a social, political and professional challenge, not a technical or economic one*” (Cameron 2016).

Most other Australian states gradually adopted a Safe System approach to underpin their road safety strategies between 2003 and 2010. In 2004, the Safe System approach was adopted by Austroads (a collective of Australian and New Zealand transport agencies representing all levels of government) as a framework to guide road safety research programs and a prominent guiding principle in the draft National Road Safety Action Plan for 2005–2006.

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## Implementing a Safe System in the 2000s

### Early Implementation of Safe System

While Victoria and other Australian states were quick to adopt the Safe System approach, its implementation fell short of the ideal. The ethical underpinnings of Vision Zero, which sought to place human health and well-being above all other considerations and acknowledged that the road system should be built to accommodate human failings, were not at the heart of the Australian approach. Rather, a simplified “four pillar” interpretation of the Safe System was quickly adopted. Often referred to as “RSVP” (Roads, Speeds, Vehicles, People), this approach saw actions developed under each of the four pillars (see the diagram below). However, the interactions between the pillars were rarely considered, meaning that the road network could not be considered a true system. In addition, not all measures were consistent with the Safe System philosophy.

However, use of the four pillar interpretation of the Safe System did have the advantage of road safety agencies balancing more of their actions across all components of the Safe System. This resulted in far greater emphasis on vehicle safety and Safe System infrastructure and less reliance on behavioral measures than had been seen previously.



A “fifth pillar” addressing post-trauma care is prominent in the application of the Safe System approach in other countries. However, it receives less focus as a road safety pillar in Victoria due to the establishment of the Victorian State Trauma System in 2000, following a major review of trauma and emergency services conducted in 1999 (Victorian Department of Human Services 1999). At the heart of the new system were triage and transfer guidelines that ensure the right patient is delivered to the right hospital in the shortest time. In particular, severe trauma victims across the State were to be transferred to one of the three specialist trauma hospitals based in Melbourne to ensure appropriate triage and expert treatment. Operational and financial support for the Victorian State Trauma System largely came from the Transport Accident Commission (TAC).

The outcomes of this support and other initiatives are captured within a study by Gabbe and Lyons (2015). From July 2001 to July 2011, the Gabbe study investigated the burden of road transport-related trauma in Victoria using a variety of measures of mortality and morbidity. Since the introduction of targeted investment in trauma care systems in Victoria, the annual health cost burden of road transport-related serious injury decreased from AUD\$1.85 billion to AUD\$1.34 billion. The study also demonstrated that while “there was a significant reduction in the incidence of death and an increase in the incidence of hospitalised major trauma over the ten years, there was a rapid and sustained reduction in risk-adjusted mortality for

hospitalised road-related major trauma,” with the overall disability-adjusted life year (DALY) burden of serious injury falling by 28% over that ten-year period.

The TAC’s support for the Victorian State Trauma System provides ongoing funding for trauma research activity such as neurotrauma research to provide sophisticated tools for ambulance care. For example, one such activity piloted the cooling of spinal injury patients to both decrease the severity of damage and extend the time window for likely effective treatment beyond the time for transfer to specialist care. TAC also supported the establishment and operation of an effective Victorian State Trauma Registry (VSTR) and currently supports the ongoing operating costs for data collection (including monitoring of patient outcomes at 6-, 12-, and 24-month intervals after the crash).

## Advancing Vehicle Safety

In the early 2000s, vehicle safety was given attention by road safety agencies for the first time. The Australian passenger vehicle fleet was one of the oldest in the developed world. In addition, many of the vehicle safety features commonly installed in European and North American vehicles were not available on the same models sold in Australia. Across Australia, programs promoting the Australasian New Car Assessment Program (ANCAP) and Used Car Safety Ratings (UCSR) produced by MUARC were developed. Following the establishment of US NCAP in 1978, ANCAP published its first ratings in 1993 and was the first NCAP to conduct a frontal offset crash test. Euro NCAP was to publish its first star ratings in 1997.

The establishment of ANCAP and the production of UCSR were of great significance in promoting the importance of purchasing safe cars across Australia. The aim of these programs was to encourage car buyers to choose the safest car they could afford and to expose the practices of vehicle manufacturers selling vehicles with lower crash safety ratings and fewer safety features than those in North America and Europe. ANCAP safety ratings posited safety as a focal point of competition and promotion for vehicle manufacturers, as was occurring in other parts of the world (McIntosh 2008).

In Victoria, a major mass media campaign and website ([howsafeisyourcar.com.au](http://howsafeisyourcar.com.au)) was launched in 2001. The television campaign introduced the message that “*Not all cars were created equal*” and compelled Victorians to buy the safest car they could afford by searching on [howsafeisyourcar.com.au](http://howsafeisyourcar.com.au). This campaign encouraged greater consideration of safety among consumers’ vehicle purchase decisions and over time assisted in some key safety features such as electronic stability control (ESC) and sidehead protecting airbags being more commonly available and eventually being mandated. The commencement of promotional activities and public education campaigns was associated with an increase in new vehicles sold in Victoria with ESC and curtain airbags, rising from 22% and 24% in 2006 to close to 60% and 50%, respectively, by 2009. Importantly “*public awareness and demand for these safety features encouraged the Victorian Government to mandate ESC in new vehicles sold in Victoria*” (Truong et al. 2010).

## Investing in Safe Infrastructure

The early 2000s also saw infrastructure being considered more specifically as a road safety measure across Australia. Treatments such as flexible barriers and roundabouts (which were already in use) were being encouraged as best practice, while measures such as creating clear zones and concrete barriers were phased out.

The TAC in collaboration with VicRoads began investing in safe road infrastructure in Victoria in the early 1990s, commencing in 1992 with an AUD\$85 million “blackspot” program designed to address sites or lengths of road with high casualty crash numbers (early criteria meant a site needed a minimum of five fatal or serious injury crashes to be considered for funding). By the early 2000s, it was recognized that by targeting crash clustering at specific high-risk locations, the blackspot approach had been highly successful in reducing fatal and serious injuries at treated sites. However, it was failing to address the broader dispersion of crashes and, thus, was not creating a safe road network. After evaluating many of the blackspot treatments under early TAC-funded programs, traffic safety consultant Dr. Bruce Corben concluded that *“results from successive evaluations indicated a need to modify the treatment approach and move from a focus on high crash concentrations to treating more spatially disperse route problems”* (personal correspondence, 10 July 2020).

Environmental scans of international best practice revealed new ways of thinking about the road system. Specifically, the underlying risk and energy across the road system needed to be managed systematically, together with the specific sites where injury crashes clustered. Infrastructure treatments needed to be applied in areas where higher speeds were to be retained, while reduced speeds were appropriate in areas where the installation of tailored Safe System measures would be highly cost-inefficient. Both approaches were concerned with managing system energy such that death or serious injury would not arise. This thinking and practice was not occurring in Australia at this time. Against this background AusRAP internationalized with partner agencies such as IRAP and established a valuable service in providing guidance nationally for investing in road and roadside infrastructure via a star system that rated the risk of the main road network across Australia (Smith et al. 2006). While five stars was the ultimate goal, three stars or better was deemed to be an appropriate performance target.

In 2002, the TAC in collaboration with VicRoads commenced investing in infrastructure treatments through its AUD\$130 million Safer Roads Infrastructure Programs (SRIP1). Treatments addressed run-off-road and intersection crashes, the two key crash types seen in Victoria. Long-length flexible barrier treatments and roundabouts were installed to more systematically address fatal and serious injury crashes. Successive SRIP programs (SRIP2 and SRIP3) invested a further AUD\$760 million in infrastructure treatments between 2004 and 2016. However, these treatments were a mixture of Safe System treatments and more conventional blackspot-style treatments.

Transitioning Victoria to the systematic rollout of Safe System infrastructure required engagement and coordination from all parties involved in planning, design, and delivery of road infrastructure. Initially, this proved very difficult. In presentations

to the Victorian road safety fraternity, Alavi (2019) noted numerous barriers to fully implementing the Safe System approach in the Australian context, including the limited incorporation of Safe System and Vision Zero thinking in current standards and guidelines, and in network and town planning practices. In addition, conventional standards, procedures, and processes were counterproductive to planning investments, as well as to developing, delivering, and evaluating projects. Moreover, investment in Safe System infrastructure was further hampered by a lack of available training in universities and an absence of graduate programs for road safety professionals.

Australian engineers had been trained to work within decades-old standards that guided thinking towards conventional safety treatments, thus creating a barrier to transitioning to planning for a network, designing treatments that aimed to eliminate rather than reduce injury and crash types, and addressing roads and sites that had not yet recorded serious injury crashes.

The development of a new Victorian Road Safety Strategy along with further investment via the Safe System Road Infrastructure Program (SSRIP) saw conventional blackspot treatments finally transition into a program that systematically treated the road network in late 2013 through until 2015.

The key differences from SRIP3 to SSRIP were:

- (a) Transition from conventional safer road treatments to Safe System treatments
- (b) Safe System transformation of some high-risk high-volume highways linking key major towns to Melbourne
- (c) Trials of innovative treatments such as 2 + 1 roads and vehicle-to-infrastructure communication technologies
- (d) Consideration of lowering of speed limits and other traffic calming measures where cost-benefit calculations see other treatments being unaffordable

Similarly, in urban areas where infrastructure investment would prove to be cost-inefficient, safe speeds were advocated, but no wide-ranging review of speed limit setting was recommended. Reduced 40 km/h limits, however, continued to be supported in locations where vulnerable road users congregated including outside schools, in busy shopping centers, and across the Central Business District (CBD) of Melbourne.

In recent times, the only default speed limit to change in Victoria was the reduction in 2001 of the built-up environment speed limit from 60 km/h to 50 km/h. Other states had introduced, or were to introduce, a similar change to the default speed limit in built-up areas.

The transition towards the Safe System was facilitated through the development of engineering tools and the publication of national practitioner guidance on road safety infrastructure, such as Austroads (2018). Victoria adopted Safe System Assessment Guidelines for all VicRoads and government-funded projects “to assist planners, designers and project managers to progress the Safe System approach from theory to practice of determining how well a project proposal aligns with Safe System principles” and “information on design and scope changes that will move a project proposal closer to the Safe System objective of eliminating the risk of fatalities and serious injuries” (VicRoads 2019).



The graph below maps the number of lives lost on Victorian roads since 1970 with some of the significant policy and programmatic measures introduced to reduce road trauma.

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## **Towards Zero**

### **Adopting the Vision Zero Principles**

The Safe System approach continued throughout Australia during the early to mid-2000s. Jurisdictions such as Victoria had undertaken study tours to Europe to understand how some of the best performing countries such as the Netherlands, Norway, and Sweden were achieving their impressive reductions in fatalities. The more principle-based Vision Zero approach was increasingly being understood and coveted by Victorian road safety professionals. However, it was not gaining any traction within the community nor with governments, local government authorities, or the corporate sector (TAC Social Research Centre 2013).

In 2013–2014, Victoria started to consider how it could better adopt and socialize the Vision Zero principles within the community. The key was to address two long-held beliefs among some of those working in road safety and more broadly within the community. The first belief was that it was inevitable, and thus accepted, that Victoria would always have a “road toll.” The second belief, somewhat related to the first, was that most crashes resulted from people taking deliberate risks and “*doing stupid things*” (Truong et al. 2015).

In setting an ultimate goal of zero deaths, it was deemed important to educate the community that most road deaths in Australia (an estimated 57%) were related to simple human error or mistakes which the system failed to accommodate (Wundersitz and Baldock 2011). Via this path, road safety agencies hoped to not only gain community support but also stimulate a greater desire by road network planners and designers to think longer term about eliminating rather than reducing deaths on Victoria’s roads.

### **Adopting Towards Zero**

The use of “Towards Zero” as the brand or name for Victoria’s further adoption of the Vision Zero approach came about through market research undertaken to develop supporting public education campaigns. Victorians felt that “Towards” was inspirational and implied actions would be taken to push the State forward to reach the ideal of zero road deaths. In comparison, they felt “Vision” implied an ideal or aspiration but not a solid plan.

Alongside the public education campaign, individual road safety agencies undertook their own actions to socialize the Towards Zero approach. At an academic level, MUARC commenced a five-day Road Safety Leadership Program available internationally but used extensively by road safety agencies across

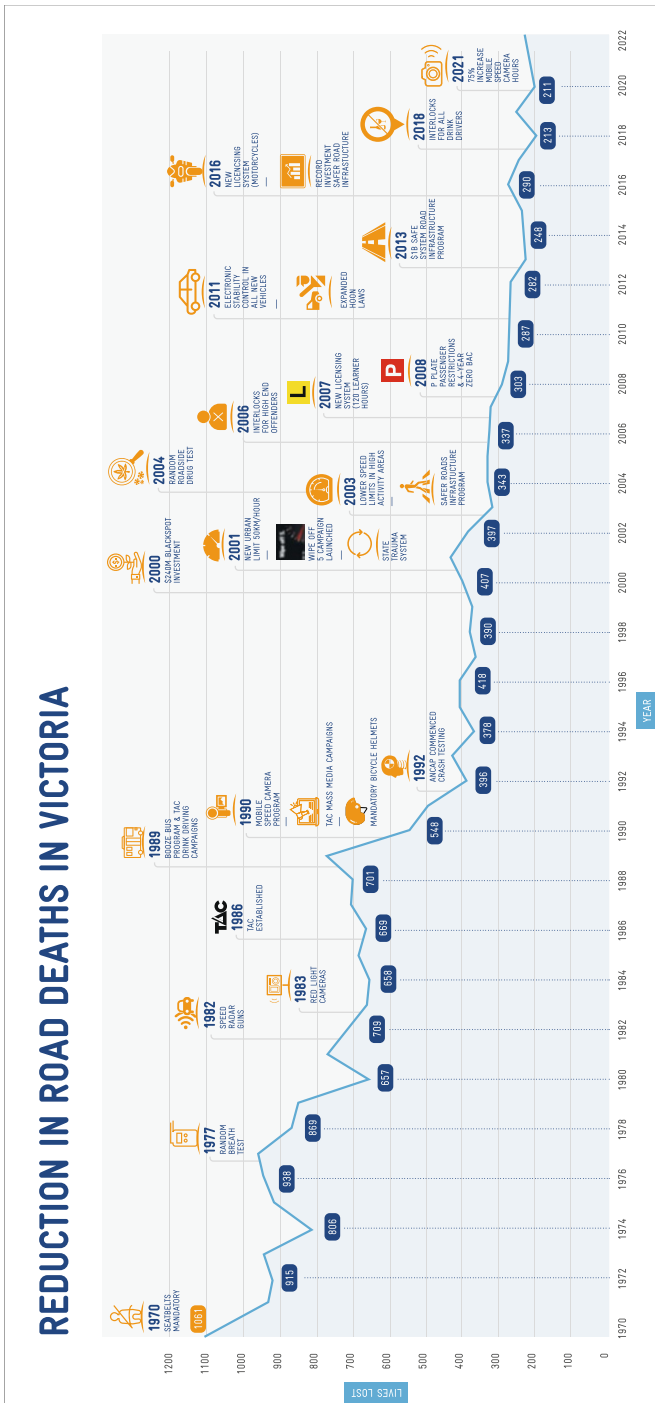


Fig. 1 Road deaths and landmark road safety initiatives in Victoria, Australia Source: Transport Accident Commission



Australia to induct and develop their people. VicRoads refined the MUARC leadership program into a tailored two-day embedment program for all its executive staff. The TAC developed an online learning program that was undertaken by its entire staff and was provided to VicRoads, police, and other agencies to educate their staff. This online learning program has since been used by local government and corporate organizations to create understanding about the Towards Zero approach (Waller and Cockfield 2014).

Towards Zero gained its greatest momentum and acceptance in Victoria with the development of the Towards Zero 2016–2020 Strategy and Action Plan which was endorsed by the Government and sought to further embed some of the key aspects of the Vision Zero approach. Key features of this Strategy included:

- Explicitly endorsing the ultimate aim of eliminating death and serious injury on Victoria's roads
- Clear interim targets for reducing trauma as steps towards the ultimate aim of zero trauma and explicit use of the Safe System approach to reach interim targets
- Adoption of three guiding truths – acceptance of human fallibility, limits of the human body's physical vulnerability to crash forces and impact speeds, and shared responsibility for safety of the road system
- A plan for a systematic network-wide approach to address the key risks faced by road users, specifically:
  - By looking to a systematic roll out of Safe System infrastructure with a goal to gradually treat all high-volume, high-speed roads with flexible barrier treatments
  - Provide interim treatments on medium-volume roads together with speed moderation on low-volume roads in rural and urban areas
  - Complemented by traffic calming and greater separation of active transport movement from motorized traffic
- Community engagement to build understanding of safe speed
- A greater focus on technology to address behavioral issues
- The Victorian Government's introduction of a 5-star purchase policy for its fleet vehicles, with local government authorities and corporate Australia encouraged to become involved

In terms of implementation, not all treatments would be fully Safe System to start, but over time the plan combined large-scale investment in infrastructure with location-specific speed limit reviews being considered for low-volume roads which infrastructure investment wouldn't reach for some years.

However, managing speeds to safe levels consistent with road function and infrastructure treatments across the road network remains a challenge. Within urban areas some gains have been made at specific locations – 40 km/h limits now apply in several local government authorities, outside schools, along busy shopping centers, and within the CBD. A more broad-based systematic approach to speed limit adoption that recognizes human tolerances to injury under differing road and roadside conditions is yet to be realized.

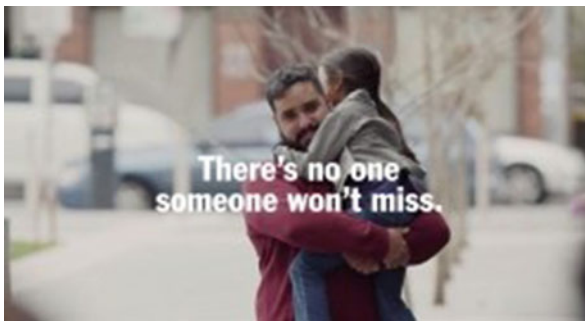
## Public Education and Towards Zero

Under the Towards Zero strategy introduced in 2016, the TAC has also used mass media public education to set the agenda around key principles of the Vision Zero approach, aiming to:

- Challenge the community to think about the acceptability of death and injury on the roads
- Educate the community about human vulnerability
- Inform the community about the value of Safe System road infrastructure and vehicle safety

Specifically, three public education programs relate directly to Safe System concepts:

- *Man on the Street* – a campaign that asks the public to consider if it is acceptable for people to die or be seriously injured on the roads
- *Graham* – an artwork installation that illustrates human vulnerability by portraying what our bodies would have to look like to survive crashes
- *Safety Barriers Save Lives* – mass media campaign demonstrating how flexible barriers work to help build understanding and support for their implementation



TAC Man on the Street Campaign



'Graham' art installation

In 2018, the TAC opened the Road to Zero Education Complex within the Melbourne Museum. The aim of the Education Complex is to engage and empower young people, road safety stakeholders, and the broader Victorian community in understanding what we need to do to achieve Towards Zero’s vision of a future where no one is killed or seriously injured on our roads.

Drawing upon road safety evidence and educational research, the complex was co-created with young people and Victorian road safety and education experts. Road to Zero features:

- A permanent interactive exhibition (open to visitors) that explains the key tenets of Towards Zero
- A curriculum-based education program for secondary school students
- A mobile “pop up” exhibition to visit rural and remote communities
- Programs for other road user groups and road safety practitioners

The intention is that the Road to Zero Education Complex will operate, in partnership with Museums Victoria, until at least 2028. In 2019, over 70,000 people visited the interaction exhibition, and 11,000 young people completed road safety education programs at the Complex.



Road to Zero Exhibition, Melbourne



Speed and Crashes – Road to Zero

## Community Support for Towards Zero

Survey research shows that 87% of the community agrees that Victoria should aim for zero road deaths. However, the high level of in-principle support does not translate into the belief that the zero target is achievable, held by only 18% of the community (TAC 2019).

Over the past three decades, behavior change campaigns have educated the public about road safety risk. Victorians look to the behavior of individuals as the “problem” requiring intervention for improvements in road safety. Surveys show that distracted drivers, drink-driving, and speeding are the road safety issues which are of most concern to Victorians (TAC 2019). Unsafe roads and vehicles are cited by far fewer as issues of concern. Victorians believe that how people drive is more important in saving lives than road design (TAC 2019).

However, there is public support for investing in infrastructure. On average, survey participants asked to allocate \$100 to road safety interventions thought that \$31 should be spent on roads, \$27 on police enforcement, \$23 on public education, and \$19 on treatment for drug and alcohol addiction (TAC 2019). Encouraging the public to look beyond “blaming” driver behavior and to instead understand the contribution of the wider system remains a challenge.

## Adoption of Towards Zero Approach Across Australia

Across Australia there are signs that positive steps are being taken in adopting the Vision Zero approach.

In August 2019, the Transport and Infrastructure Council (TIC) reported that they were “*strongly committed to developing the next National Road Safety Strategy based on a target of zero fatalities.*” They also noted that “*all investments in road infrastructure planning, design and construction will require application of Safe System principles and inclusion of safety treatments that align with these principles.*” This was the first time that all states and territories within Australia had looked to plan for the long term and agreed to the adoption of an ultimate 2050 target of zero road fatalities for Australia. Importantly, the TIC defined “*the principles of a Safe System approach are: Human fallibility – People make mistakes on the road; Human vulnerability – Humans are physically frail with limited ability to tolerate the forces in a crash; and a Forgiving system – a road transport system must be ‘forgiving’ of mistakes within these limitations. (This) applies to all roads and investment sources*” (Australian Transport and Infrastructure Council 2019a).

Across the nation, states, territories, and cities are taking actions to realize the key principles of Vision Zero. Some specific examples are highlighted below.

- In Tasmania, the Safe System approach has been adopted, and action can be seen in its plans to upgrade the Midland Highway, its key north-south road. A combination of speed limit reductions (to 80 km/h) and barrier systems in conjunction with some low-cost tactile edge-lining is being used to make the road safe.
- The Hume Highway, Victoria’s key north-south route and already a divided road, has been upgraded to be completely covered in flexible barrier systems. An early success came in 2019 when this 300-kilometer, high-volume road saw no fatalities, months before the road was fully completed.
- In South Australia, a large project aligning speed limits on rural roads to Safe System principles was undertaken in late 2011. This saw 52 roads (864 kilometers) reduced from 110 km/h to the rural default speed limit of 100 km/h. The public education campaign that accompanied the changes ensured the new speed limits were well understood and supported (Dua et al. 2013).
- Also in Victoria, some local government areas are making great headway. The City of Melbourne implemented a 40 km/h speed limit for the CBD in 2012, and in 2019 its draft transport plan outlined a program to trial lower speed limits on pedestrian priority streets also in the CBD (City of Melbourne 2019).
- Commencing in 2018, New South Wales has aligned the Towards Zero vision with Future Transport 2056, which aims to have a NSW transport network with zero trauma. It has embarked on an ambitious Road Safety Plan 2021 that included:

- Accelerated safety infrastructure investments of \$820 million under “Saving Lives on Country Roads” and “Liveable and Safe Urban Communities” programs. The Plan commits to establishing road safety targets to drive the investment strategy for the state network, including targets for the proportion of travel on four- and five-star roads and the proportion of the road network with safety features, including median and roadside barriers.
- Expanded Fleet Policy with a focus on protective future vehicles to include safety features in the fleet in addition to the existing 5-star policy and new vehicle and technology testing facilities.
- Introduced lower speed zones in high pedestrian areas, a world first MotoCAP safety rating system for motorcycle protective clothing widely promoted to motorcyclists and business engaged to integrate road safety as part of work, health, and safety.
- Introduced the world’s first mobile phone detection camera enforcement technology using artificial intelligence, broad-ranging drink- and drug-driving reforms including immediate sanctions upon detection and vehicle ignition interlocks for most drink-drivers, and a target of 200,000 random roadside drug tests.
- In 2018, the Queensland Department of Transport and Main Roads (TMR) developed a Road Safety Management Plan (RSMP) to embed Safe System principles and culture throughout the organization, meaning Safe Systems frameworks will be actively applied in the planning and design of road infrastructure (Peterson and Harrison 2018).
- Nationally, the Federal Government has committed to the deployment and uptake of proven vehicle technologies, looking to the UN 2022 Regulations and the World Forum for Harmonization of Vehicle Regulations (WP.29) as a guide for what could be adopted through the Australian standards (Australian Transport and Infrastructure Council 2019a).

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## Implications for the Future

### Challenges Remain

The application of Safe System thinking to the road safety problem across Australia over the past two decades has given rise to significant safety gains. The continuing rollout of protective roadside and center-line infrastructure, reduced speed limits in areas of high pedestrian and cyclist concentrations, and the vigorous promotion of safer cars with passive and active safety features have all played a part. Targeted enforcement with supporting public education alongside technologies such as alcohol interlocks has served to nudge behaviors into safer forms.

And yet, across Australia over 1195 people continue to die on the roads each year, and approximately 40,000 more require hospitalization (BITRE 2020). These figures alone are stark reminders that the vision of achieving zero fatalities remains a distant aspiration and that the current road transport system remains inherently risky for the user.



## Road Safety Management

A very detailed and high profile review of the National Road Safety Strategy was conducted in 2018 (Wooley and Crozier 2018) with strong support from the Australasian College of Road Safety, a body of road safety professionals and those interested in road safety that encourages professional development and information sharing while serving as a strong advocate for change at government level (see [acrs.org.au](http://acrs.org.au)). This review escalated the urgency within government circles in attending to a number of key safety priorities. In response to the review’s recommendations, the Federal Government has now established an Office of Road Safety, reporting to a designated Federal Cabinet Minister, with key responsibilities including developing a new national strategy in collaboration with states and territories.

With a view to ensuring the success of these arrangements, a recommended governance review was also undertaken to provide advice with regard to agency structure, charter, and its relationship with external partners. Stronger action was urged in relation to “road safety” becoming “business as usual” across all government departments and related bodies as well as within the private commercial sector. The authority and resources vested in the new Office of Road Safety will be critical to its success.

In relation to the development of the next 10-year national road safety strategy (2021–2030), the review further recommended that a Vision Zero target of zero fatalities be set for the year 2050, consistent with the goal set by the European Commission, and that meaningful performance indicators be developed and adopted that accurately reflect interim safety progress across a range of safety-related domains (Wooley and Crozier 2018). The review also noted that targets have been framed mainly in terms of death and serious injury tallies within defined categories, their interim results rarely giving rise to a substantive change in safety directions. Establishment of safety performance indicators for key elements of the road transport system that will drive and achieve trauma reduction targets is a critical ingredient of effective and transparent road safety management into the future.

The Australian Transport and Infrastructure Council (TIC) that brings together Commonwealth, State, Territory, and New Zealand Transport Ministers as well as the Australian Local Government Association issued official statements in August and November 2019 (Australian Transport and Infrastructure Council 2019b) that confirmed the above commitments. The TIC also stressed that the new national strategy will complement jurisdictional strategies and that responsibility or delivery will be shared across all tiers of government.

History suggests that effective realization of the above recommendations is by no means straightforward. A commitment to a Safe System approach within strategies at the national and jurisdictional levels does not guarantee its full realization in practice. Many of the key road safety responsibilities relating to transport safety and regulation rest with the jurisdictions, while the Commonwealth manages vehicle safety regulations plus funding support for key infrastructure projects. Leadership at each tier of government will be required to realize the commitments made by all Transport Ministers.

Nevertheless, actions taken to date and commitments made by federal, state, and territory governments in response to the National Road Safety Strategy Review findings represent a very promising foundation upon which to build an effective attack on serious road trauma. Achieving genuine cultural change flowing down from the national government through the jurisdictional and local government entities to operational practice reflecting Safe System thinking represents a significant multifaceted challenge.

Furthermore, given the commitment to achieve zero road fatalities by 2050, it is incumbent upon governments to shape a pathway for how this target is to be achieved and what a safe and sustainable transport system should look like in 2050. In so doing, the main external forces that will shape the future together with the key safety and transport developments that will help to achieve the safety goal need active consideration. This issue is discussed further below.

Finally, the efficacy of achieving zero road deaths by 2050 is given a boost in the eyes of system builders and the community alike by achieving staged milestones that reflect genuine progress. To this end, the TIC agreed in principle to interim targets of Vision Zero for all major capital city business centers and high-volume highways by 2030 (Australian Transport and Infrastructure Council 2019c). In the meantime, the Federal Government has introduced a Vision Zero map that presents municipalities with zero deaths over specified time periods across Australia (see the Vision Zero maps at [www.bitre.gov.au/statistics/safety](http://www.bitre.gov.au/statistics/safety)).

## Reporting and Accountability

The role of a strategy is to provide a blueprint for plotting an evidence-based pathway to achieving a defined goal at the end of the strategy's timespan. In the case of the new national road safety strategy under preparation, the aim is to achieve a 30% reduction in serious road trauma by 2030 on the road to its elimination by 2050. Future state and territory strategies concerning trauma targets will need to support these accordingly.

In parallel with the rollout of future national and jurisdictional strategies, a set of intermediate performance indicators needs to be established to track trauma trends at a macro level over time, to help build an understanding of progress in key aspects of the strategy's performance, and to underpin the progress made in reaching the nominated trauma target. The intermediate targets play a vital role in determining which safety programs are successful, which are not, and what adjustments are the most appropriate.

Given the very significant investment in public funds, it is incumbent upon government to be accountable and transparent in terms of progress made against targets and the future directions of implementation. Accordingly, governments need to establish mechanisms to ensure that the public is so informed and the governments are open to public scrutiny and enquiry as appropriate.

Adoption of the principles of accountability and transparency at the government level signals to the community its true commitment to achieving the desired trauma outcomes and its preparedness to accept responsibility for underperformance where relevant.



## Future Challenges and Opportunities

### How to Improve Speed Management and Road Infrastructure?

Australia has one of the largest networks per capita anywhere in the world, with a road network stretching more than 877,000 kilometers. Australians are very car dependent, with 75% of all passenger travel being road-based (Roads Australia 2020).

More than half of the roads in Australia are unsealed roads (IPWEA 2017). As many rural roads across Australia are low-standard, low-volume roads, this makes creating Safe System-compliant roads impossible through infrastructure treatments alone.

Strategically, the approach adopted in Victoria and consistent with many other jurisdictions is to invest in infrastructure treatments where cost-efficient to do so in order to maintain current travel speeds on roads that require a high "level of service." This has involved extensive flexible barrier rollout on high-speed freeways and highways. However, it is simply not financially viable to apply similar treatments to the long stretches of secondary and tertiary roads that crisscross the State. Managing speeds to within Safe System limits on these road types is likely to be the best option but in many instances remains a challenge.

All jurisdictions are facing pushback via intertwined political and sectoral community interests. In urban areas, some success has been enjoyed where speed limits have dropped at locations with high concentrations of pedestrian and cyclist activity. With some notable exceptions, neither the extensive local street system nor high-speed low-to-medium volume roads have enjoyed similar success. In this context, it is critical that revised standards and guidelines for road design including infrastructure support are linked to recommended speed limits consistent with Safe System principles. Improved design standards for roads alone do not guarantee Safe System solutions in many circumstances in the absence of harmonized speed management.

To date in Victoria, and to a large extent across Australia, speed has often been addressed as a stand-alone issue despite being linked to road function and the level of infrastructure support. Yet potentially its salience can grow as it is integrated within a broader sustainability agenda. The issues of climate change, health and well-being, reduced road maintenance, mobility, alternative and public transport, and accessibility are becoming increasingly prominent on the political and community landscape. Their mutual dependence has been little explored and promoted to date. Population growth and migration to the large cities only serve to heighten the need for sustainable solutions.

A future in which speed is integrated within a broader vision for transport holds considerable promise as a fruitful avenue for successfully promoting speed management in the context of a safe and sustainable transport system. This approach has received broad coverage and support internationally through the development and promotion of the Sustainable Development Goals (Trafikverket 2020). Aligning objectives and actions where relevant across environment, health, and transport portfolios represents an outstanding opportunity.

One area of recent progress in speed management that holds promise for the future has been the more active role of local government in agitating for reduced speed limits, especially in local streets on secondary high-speed roads. For example, speed limits are being lowered on nearly 40 roads within a large outer urban municipality of Melbourne as a two-year trial. The Western Australia government has committed to working with local government on an ongoing review of speed limits across the road network (Main Roads Western Australia 2020). In New South Wales, many local government authorities in inner Sydney have reduced urban speed limits in their municipalities to 40 km/h and 30 km/h.

Revising speed management practices to reflect Safe System principles and be more sympathetic to road quality and function ironically represents one of the least costly and most impactful road safety options, and yet receives the most resistance. There is no substitute for leadership committed to achieving a safe road transport system.

Finally, it should be noted that changing the speed limit on the vast network of secondary and tertiary roads does not in itself necessarily achieve a Safe System outcome. Increasingly, active and passive features in the vehicle fleet in conjunction with local travel speeds and infrastructure will assume greater safety importance.

## Realizing the Benefits of Safer and Autonomous Vehicles

Vehicle replacement rates are slow across Australia, with the average age of a vehicle on-road being approximately 10.4 years (Australian Bureau of Statistics 2020). In 2019 in Victoria, the average age across all vehicles involved in fatal and serious injury crashes was 13.5 years (TAC 2020).

As new vehicles replace older vehicles in the Australian fleet, passive safety features such as side curtain airbags and improved cabin integrity will improve the safety outcomes for vehicle occupants (Wooley and Crozier 2018). ANCAP has provided an important advocacy role in reporting the safety performance of new cars and derivatives entering the market to consumers and bringing forward voluntary fitment and purchase.

It is, however, the road to automation in Australia that holds the greatest promise for the future. Given the high dependence on car usage in Australia, the progressive transfer of control from the driver to the vehicle will be particularly important to address the errors humans will inevitably make as well as a vast road network which is almost impossible to make safe. In a submission to the Victorian Parliamentary Inquiry to the Road Toll, Victoria's automobile club, RACV noted, "At the current rate of funding we estimate it would take over 1000 years to upgrade every road to an acceptable safety" (Hewitt 2020).

Technologies such as automatic emergency braking (AEB) and lane keep assist (LKA) are common features of newer vehicles, with evaluations testifying to their safety impact (Fildes et al. 2015; Sternlund et al. 2017). Moreover, technologies may combine to yield an even better safety outcome – for example, ESC (electronic stability control) and AEB together stabilize the vehicle and then reduce the impact speed respectively when a driver mistake cannot be corrected.

However, the uncollected safety dividends are substantial. There is an unacceptable gap between a proven technology being available in the marketplace and stipulating it as mandatory in new vehicles as part of the Australian Design Rule process. Every vehicle that rolls off the assembly line bound for Australia without the proven safety technologies fitted is an opportunity lost. For the life of that vehicle, it will operate at an inherently elevated level of risk that could have been avoided.

We can learn much from the European Union that in 2018, through the European Commission, announced a range of new safety technologies, variously applying to cars, vans, trucks, and buses for introduction by 2022 (European Commission 2019). Encouragingly, the Australian Government committed in August 2019 to streamlining the process of instituting regulatory changes to vehicle safety standards and will endeavor to align Australian regulations with the proposed European safety package (Australian Transport and Infrastructure Council 2019a). Achievement of this commitment in the future will greatly assist in saving lives on Australia’s roads.

Further, there are two areas in the early phases of implementation that can have a very positive influence on vehicle safety in the longer term. The first is shared transport or shared self-driving car services in which the government can play an active role in encouraging its adoption and guided expansion within the private sector (International Transport Forum 2015). In simple terms, shared services can require fewer vehicles with higher occupancy travelling much greater distances in less time leading to faster vehicle replacement rates. Therefore, as new safety technologies enter the market, they will penetrate and benefit the on-road fleet much more rapidly.

The second is demonstrating the efficacy, convenience, and safety of autonomous vehicles through trials conducted with technical partners. Importantly, trials help to align technology advancements and operational practice with the regulatory framework together with supporting infrastructure and communication requirements. The journey towards a fully autonomous vehicle fleet holds great promise if the safety expectations for the future vehicle are clearly and unequivocally set to prevent the patterns of trauma typified in driver-controlled vehicles. A glimpse into the future helps to galvanize action as well as build community acceptance. Safety is an integral partner in this development.

## Improved Data and Research

The value of life and health lies at the heart of Vision Zero, and leading jurisdictions have incorporated measures of injury severity and injury burden in their thinking (e.g., Risk of Permanent Medical Impairment in Sweden; see Berg et al. 2016). The focus on serious injury in Australia remains largely on hospitalization, a coarse measure of injury outcome.

A challenge in the Australian context is to better understand injury outcomes and the factors that contribute to, and which can prevent, the injury burden carried by crash-involved road users. Linkage of hospital data to crash data is required and has

been achieved with some success in Western Australia and New South Wales (see Harrison et al. 2019) and more recently agreed to in Victoria following a linking of one year of data (Ziekemijjer and McIntyre 2018). An in-depth understanding of the long-lasting or permanent health impacts will allow for a more strategic approach to reducing the injury burden on the community and permit more precise measures in the future of safety performance by tracking trends over time in the most severely injured road users by categories of interest.

A constant companion of valid, reliable, and relevant data is the road safety research community. Australia is very fortunate as it has reputable, high-quality research centers in the majority of states. Resourcing a coordinated program of research and development across the safety centers with the focus firmly on advancing the practical application of Safe System principles to the road and traffic system represents a key plank in supporting effective implementation of the next national strategy. Investigations of the interrelationships between all the pillars of a Safe System deserves a strong presence in a future research program.

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## Conclusion

The introduction of Vision Zero, later termed as Safe System, has had a profound influence on road safety thought and practice across Australia.

The professional communities in the government and academia have largely embraced the approach and its ethical underpinnings. Road safety strategies across Australia invariably cite Safe System principles as the approach to guide the various safety measures to be implemented. Significant safety gains have been made, thanks to rollout of protective barriers on high-speed roads, reduced speed limits where vulnerable road users congregate, and vigorous promotion of safer new and used cars. Targeted legislative reform and stepped-up enforcement with public education support have also played a part.

But the Safe System approach has been delivered in part only. The challenge of managing speeds within safety thresholds on roads and streets where infrastructure treatments are cost-prohibitive is one prime example of an undelivered initiative. A reduction of travel speeds on lower-quality roads coupled with the increased prominence of advanced active and passive safety features in the vehicle fleet will greatly assist in the elimination as opposed to reduction of serious road trauma on Australia's roads. Understanding the interrelationships across Safe System pillars is key to plotting the most cost-effective pathway into the future.

Encouragingly, the Transport Infrastructure Committee, which includes the Ministers of Transport federally and from each state and territory, has made significant commitments for the new strategy, which include:

- A target of zero road deaths in 2050 together with intermediate targets.
- All major infrastructure investments will be subject to Safe System compliance.
- The safe vehicle design rule process will be streamlined to close the gap between the safest cars operating in Europe compared with Australia.

Importantly, the principles of Safe System will be faithfully applied in developing the new national 10-year strategy.

These are promising developments, and their realization is a significant challenge to be met as the new strategy takes shape and is then rolled out.

For Australia to succeed in achieving both the interim goals and the ultimate goal of zero road deaths in 2050, there is now no substitute for political will and accountability. People’s lives and health depend on it.

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