

CONNECTED AND AUTOMATED VEHICLES PLAN



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Ministers' Foreword

Around the globe, transport services and the way we move are being transformed by technology. We are already seeing connected and automated vehicles (CAVs) on the road and offering great potential to deliver new transport services, improve road safety, alleviate congestion and increase productivity.

Transformation, like that offered by CAVs, requires vision and community acceptance to ensure the evolution from the status-quo is well-managed. However, we cannot afford to sit back and wait for disruption – action is needed now to make the most of opportunities.

NSW is already well advanced in using new technologies, with the [Future Transport Technology Roadmap](#) setting a vision to make transport a technology business. This is embedded in the Government's [Future Transport 2056](#), our 40-year strategy to deliver customer-focused, technology-driven services to improve the productivity, liveability and sustainability of communities across the state. It also aligns transport with NSW's overarching infrastructure and planning strategies, and outlines opportunities for using CAVs in a range of passenger and freight services.

This Connected and Automated Vehicles Plan builds on these opportunities and outlines how we will achieve the customer, community, productivity and place outcomes that can be delivered by CAVs.

NSW is taking a leadership role to improve transport for customers. Through Transport for NSW's [Smart Innovation Centre](#), we are in the driver's seat for change, with a growing number of trials with industry and research partners to help make CAV services a reality in NSW.

Since August 2017, we have launched a driverless [Smart Shuttle](#) trial at Sydney Olympic Park, the [Automated Vehicle Infrastructure Initiative](#) to assess the compatibility of motorway infrastructure with automated vehicle technology, and also announced [trials in regional NSW](#) – in Armidale and Coffs Harbour – starting by the end of the year.

We're investing in the future, establishing a [\\$10 million fund](#) to expand our portfolio of CAV trials over the next four years.

We have already passed [legislation](#) that allows conditionally and highly automated vehicles to be trialled in NSW, and continue to work with the Australian Government and other local jurisdictions to develop policies and guidelines to ensure that CAVs are used in a safe and secure manner.

By partnering with the sharpest minds in industry, we will continue to lead and think big to deliver the future transport services for our State.



The Hon Andrew Constance MP
Minister for Transport and Infrastructure



The Hon Melinda Pavey MP
Minister for Roads, Maritime and Freight

Executive Summary

The NSW Government is creating a sustainable transport system that improves on safety, efficiency and the customer experience. [Future Transport 2056](#) embraces technology and innovation, to revolutionise the way we live and travel.

Vehicle connectivity and automation are game-changing technological innovations with the potential to transform the future mobility of people and goods. These technologies are advancing rapidly and already appearing in vehicles on the market today.

A connected and automated future – where road fatalities become a thing of the past, journey times are reduced, and customers have access to seamless, affordable, flexible and personalised journeys – is now a tangible possibility.

We believe these exciting technologies and services – together with advances in electric vehicles and shared mobility – will offer better and more personalised mobility options for transport customers.

With technologies changing so rapidly, we will focus our efforts over the next five years on accelerating the adoption of connected and automated vehicles (CAVs), in line with our Future Transport vision for a network that moves people and goods efficiently, creates successful places that improve amenity and liveability, and uses innovation to improve outcomes for customers and the community.

This Connected and Automated Vehicles Plan (or ‘CAV Plan’) supports Future Transport 2056, and also delivers on one of the key strategies in the Future Transport Technology Roadmap – to enable connected and automated vehicles.

This five-year CAV Plan focuses on the opportunity for NSW to lead the way in encouraging the use of CAVs on NSW roads over the next five years. This Plan provides clear goals and actions to put us on the trajectory towards our Future Transport vision. It puts actions in place to embrace the technology as well as address potential challenges, such as cybersecurity and ensuring safe interactions between automated vehicles and other road users.

Successfully delivering on the directions and actions will involve ongoing partnerships and collaboration with industry and academia.

This CAV Plan positions NSW at the forefront of CAVs nationally, and demonstrates to industry and the community our next steps – to drive innovation, accelerate adoption and deliver benefits for customers and communities.

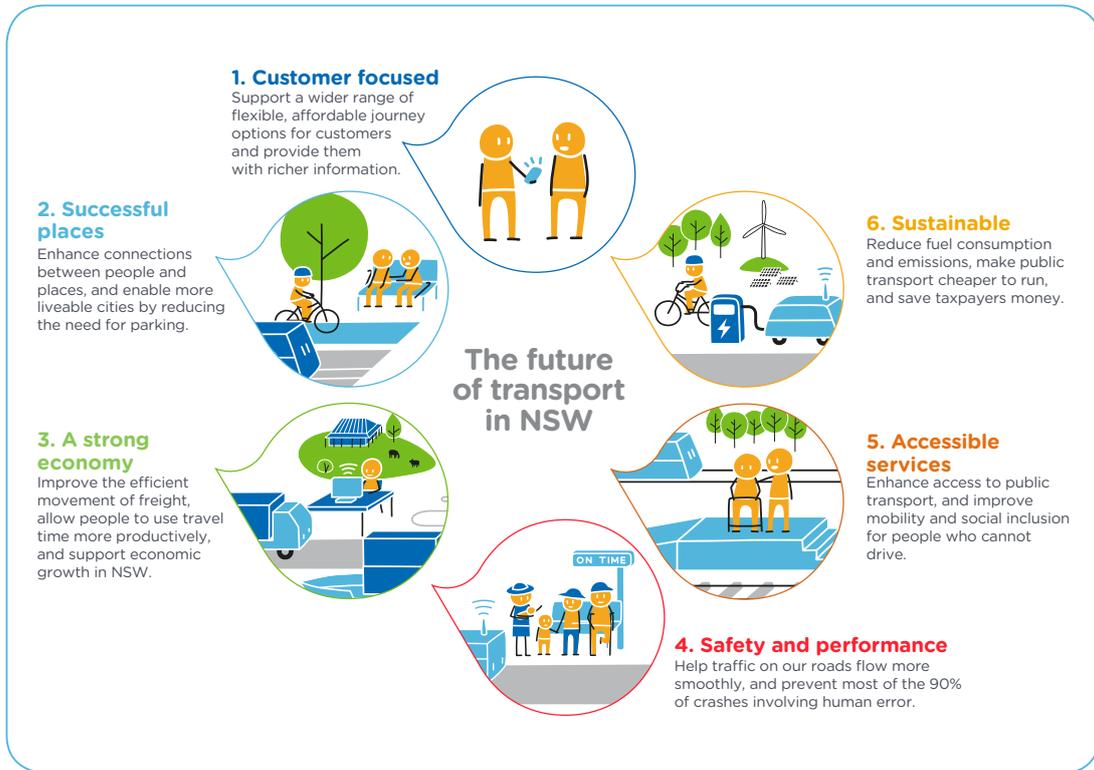


Figure 1: CAVs will deliver on the six key outcomes from Future Transport 2056 (adapted for CAVs)

Our priorities, goals and actions

The NSW approach to CAVs is framed around five priority areas, with goals and actions identified to achieve each priority. In the next 5 years, the NSW Government will, in collaboration with industry, research and community partners, aim to:

| Priorities | Goals | Summary of actions |
|---|---|---|
|  <p>Laws and safety</p> | <ol style="list-style-type: none"> 1. Support implementation of nationally consistent regulation, standards, policies and safety assurance regimes that ensure that conditionally automated vehicles (level 3) can operate safely and legally on NSW roads before 2020, and highly and fully automated vehicles (levels 4 and 5) from 2020 2. Increase the proportion of passenger and freight vehicles in NSW with the latest CAV safety technologies | <ul style="list-style-type: none"> • Establish laws, standards and policies to support the legal and safe introduction of CAVs • Manage safety risks associated with CAVs through safety and cybersecurity management plans and public education • Increase adoption of the latest vehicle safety technologies through communications, consumer incentives and changes to fleet procurement policies |
|  <p>Infrastructure and planning</p> | <ol style="list-style-type: none"> 3. Develop appropriate evidence-based transport, infrastructure and land-use policies and plans that support the optimal use of CAVs and CAV services 4. Build infrastructure capability to support at-scale operations of partially, conditionally and highly automated vehicles (levels 2, 3 and 4) on motorways and major roads | <ul style="list-style-type: none"> • Assess current infrastructure readiness and future requirements to support CAVs • Identify opportunities to use smart infrastructure on major road corridors and in key precincts to accelerate CAV use • Adopt flexible approaches to planning and development that take into account the future needs of CAVs |
|  <p>Transport services</p> | <ol style="list-style-type: none"> 5. Have introduced expanded operations, at scale, of connected and highly automated vehicle (level 4) services that support the most efficient movement of people and goods, and the creation of better places and amenity across NSW | <ul style="list-style-type: none"> • Trial a range of CAV-enabled passenger and freight services in metropolitan and regional areas • Identify opportunities for CAVs to be integrated into transport systems, particularly on-demand and rapid transit services |
|  <p>Data</p> | <ol style="list-style-type: none"> 6. Develop a framework and clear policies, standards and protocols around data sharing, privacy and security relating to CAVs 7. Build digital capabilities and data platforms for CAV data to improve performance and service delivery, and enable smarter approaches such as MaaS 8. Incorporate digital infrastructure into major roads to support connected, and conditionally and highly automated (levels 3 and 4) vehicles | <ul style="list-style-type: none"> • Work with governments and industry to establish regulations and policies on data security and privacy • Support the development of smart infrastructure and digital connectivity on major road corridors, and data platforms, to support CAVs |
|  <p>Customer readiness</p> | <ol style="list-style-type: none"> 9. Have trials and policies in place that support the best customer and community outcomes with CAVs – aligned to Future Transport 2056 outcomes 10. Increase customer information, acceptance and use of CAVs through communications, demonstrations and trials | <ul style="list-style-type: none"> • Engage customers through trials and communications to build awareness, acceptance and use of CAVs • Improve understanding of customer behaviour and human factors considerations associated with CAVs |

Transport is a technology business

Digital technology is reshaping society

Transport plays a vital role in shaping the future of our state. At the same time, technology is changing the way we plan and deliver transport services and mobility.

Connected devices like smartphones have already changed the way we communicate and go about our daily lives.

More than 12 million people are expected to live in NSW by 2056. Around three-quarters of this growth is expected to be in Sydney. High economic productivity, advancements in technological innovation and a strong services economy will lead NSW to become Australia's first trillion dollar state economy by 2056.¹

Our road and public transport networks are expected to handle 28 million trips a day and double the current metropolitan freight loads. Technology will be the key to successfully managing this increasing pressure on our transport networks, and delivering safe, efficient and accessible transport in the future.

Transport is already being transformed

We rely on global positioning systems (GPS) instead of street directories, use Opal cards and contactless payments instead of buying paper tickets, and look to mobile apps for our real-time transport information.

Ports and distribution centres are becoming fully automated, and freight is heading toward movements being tracked electronically at every step, in order to pass on efficiency gains to customers in the form of lower shipping costs and faster deliveries.

New ridesharing services, such as Uber, Taxify, and Ola, are reshaping the market for point to point travel in NSW. The growing trend of carsharing and carpooling, driven by services such as GoGet, Car Next Door and Liftango, offer convenient choices for people who do not drive very often or do not own a car, for instance older people and young adults. GoGet - the pioneer of carsharing in Australia, currently has over 100,000 members who have made over five million trips using its services.² Car Next Door, which now has over 90,000 members, estimates each carshare vehicle represents ten cars that have been disposed of or avoided, resulting in a net reduction of nine vehicles on the road.³

Policy Reform

NSW Point to Point Transport reforms

The emergence of ridesharing services, such as Uber, Taxify and Ola, has significantly changed the point to point transport market, with innovative technologies being embraced by customers.

37 per cent of Australian customers reported using a ridesharing service in 2017⁴ – a service type that relies heavily on technology and did not exist in Australia five years ago.

The NSW Government implemented an industry wide reform in 2015, which in effect legalised rideshare services, modernised regulation for point to point transport services and increased choice for customers. A new regulatory framework was introduced with a pivotal shift away from prescriptive regulation to give industry greater autonomy to use innovative technologies and embrace point to point transport models in response to customer demand, while ensuring the strict safety standards are met.

The pace of change is accelerating. The four major trends of automation, connectivity, electrification and sharing will transform the future of mobility in a way not seen since we swapped the horse for the car. New mobility services will increasingly operate using connected, automated and electric vehicles. This shift will bring new opportunities to improve transport, while updating the way transport is currently delivered and introducing new challenges.

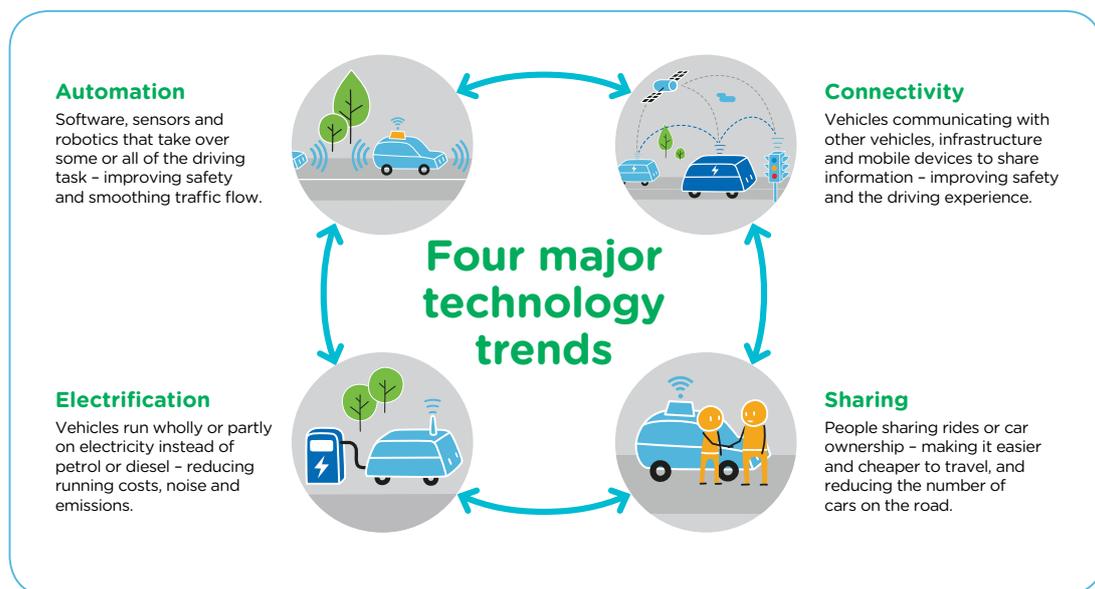


Figure 2 The four major technology trends shaping the future of mobility

NSW is leading this transformation in Australia

NSW is open for business and we are taking a leadership role in the application and use of technology to improve transport for customers and shift our thinking towards transport as a technology business.

Our transport system in NSW needs to prepare for these changes, be flexible and adapt to future developments. That is why we developed [Future Transport 2056](#) – our strategy for delivering services, infrastructure and technology in NSW over the next 40 years.

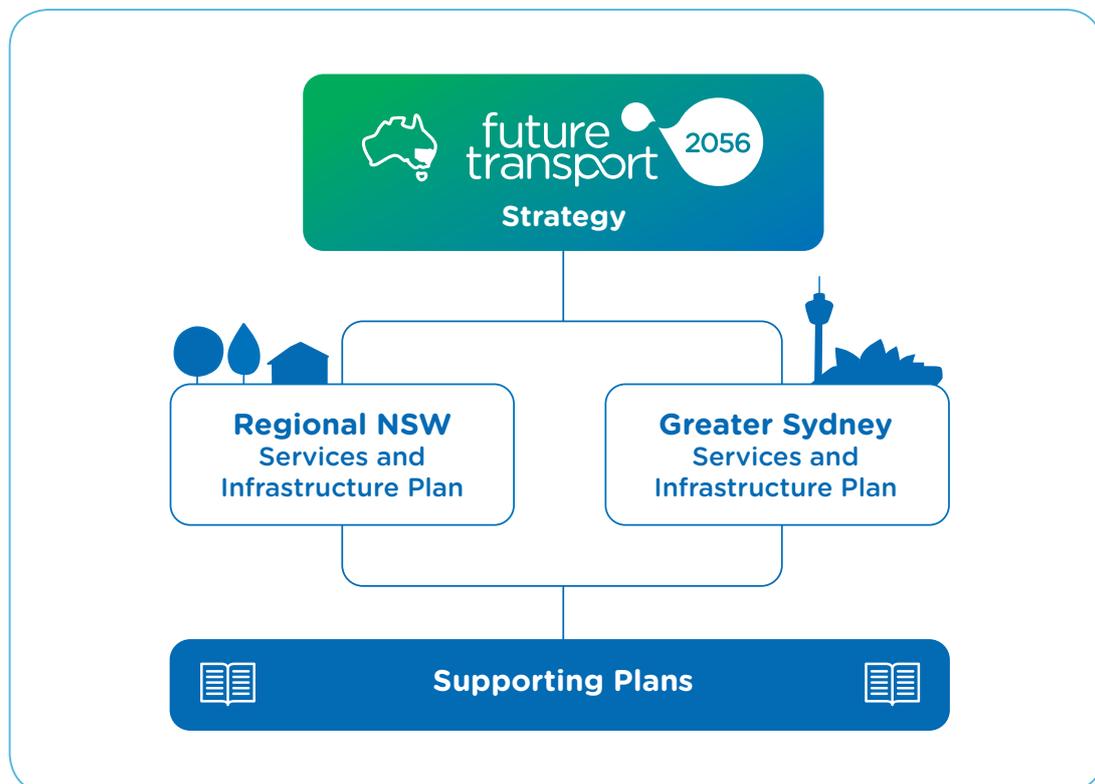


Figure 3 Overview of Future Transport 2056

In addition, our [Future Transport Technology Roadmap](#) identifies the key technologies we will harness to unlock the full value of our transport networks and personalise services for customers. It sets out five key strategies to take advantage of the unprecedented opportunity technology offers – one of which is to enable CAV platforms.

This CAV Plan supports both Future Transport 2056 and the Technology Roadmap by setting out the opportunities and challenges of CAVs, and the steps NSW will take to prepare for and support CAVs to benefit the community.

Our legislative framework allows highly automated vehicles on our roads

The NSW Government has already established a legal framework for trialling CAV technology in NSW. The [Transport Legislation Amendment \(Automated Vehicle Trials and Innovation\) Act](#) was enacted in 2017 and empowers the Minister for Roads, Maritime and Freight to approve applications to conduct CAV trials subject to certain safety and operating conditions. The Act also sets out insurance and vehicle supervision requirements, allowing for highly and fully automated (levels 4 and 5) vehicles, including driverless vehicles, on public roads.

Our Smart Innovation Centre leads collaboration

We have also established Transport for NSW's [Smart Innovation Centre](#), which leads and facilitates collaboration across government, industry and the research sector to carry out research, testing and piloting of emerging transport technology in NSW.

The Smart Innovation Centre is co-funding and co-delivering a number of [CAV trials in metropolitan and regional areas](#), with industry, university and other partners.

The State's \$10 million fund will drive trials and collaboration

In June 2018, the NSW Government announced [\\$10 million in funding](#) to support the expansion of CAV trials in NSW over the next four years. Having a dedicated fund will provide greater opportunities for us to partner with industry and universities to test and gain insights into how these technologies could shape our future cities and regions.

Our Research Hub drives collaboration with universities

We are also undertaking a number of collaborative research projects, through the [Research Hub](#), to assess the safety, network, transport planning and wider socioeconomic implications of CAVs, and the opportunities to improve the amenity and liveability of our cities and towns.

Further research and trials will assess and demonstrate these multi-dimensional issues associated with CAVs, across a range of applications and uses – and support the customer-centric design of future CAV services.



Case Study

Smart Shuttle Trial – Sydney Olympic Park

The NSW Government is partnering with HMI Technologies, NRMA Motoring and Services, Telstra, IAG and Sydney Olympic Park Authority to trial an automated shuttle bus.

The trial, which commenced in August 2017, is the first precinct-based trial of an automated shuttle in NSW, with a focus on testing CAV technology that could improve customer mobility.

The trial, managed by Transport for NSW's Smart Innovation Centre, aims to understand what supporting technology and infrastructure is needed to operate an automated shuttle in this environment, how it interacts with other precinct users (such as pedestrians and cyclists) and with traffic signals and roadside infrastructure, and how it integrates with the broader transport network. We will also better understand passengers' responses to this type of vehicle and the services it can enable, like on-demand transport in off-peak times.

The trial will run for two years and is being completed in three phases. The first stage of the trial involved testing in an enclosed off-road environment. The second phase progresses to initial operation at a closed section of the precinct. The third phase will see the shuttle operating in live traffic for public use.

Case Study



Regional automated shuttle trials – Coffs Harbour and Armidale

In July 2018, the NSW Government announced connected and automated shuttle trials in two regional locations – Armidale and Coffs Harbour.

The trials will focus on customer mobility use cases and investigate the benefits and challenges involved in introducing emerging CAV technology to regional NSW. The trials will commence by end of 2018 and initially run for 12 months in three phases with gradually increasing levels of operational complexity in real world environments.

In Armidale, the trial will run in three phases, each targeting different customer groups in the local community. The first phase will involve testing of technology by students at the University of New England. The second phase will introduce a shuttle service for local residents around the Armidale CBD area. The third phase will expand operations in the CBD area and provide transport links for tourists. The project partners include Armidale Regional Council, EasyMile, The University of New England, Edwards Coaches, Transdev and WSP.

In Coffs Harbour, the three phases of the trial are: Northern Breakwall – connecting Coffs Harbour International Marina and Muttonbird Island; Marian Grove Retirement Village; and Harbour Drive in Coffs Harbour CBD. The service trials will help connect local precincts and test the integration of CAVs with existing transport in the region. The project partners include Busways, Coffs Harbour City Council, EasyMile, Via and Southern Cross University.

Both trials will provide valuable insights on the potential for CAVs to improve customer outcomes in regional areas, how CAVs could operate as part of an integrated regional transport network, and the physical and digital infrastructure requirements to support the operation of CAVs in regional areas.

NSW offers an attractive startup and technology culture for CAV trials and collaboration

The strong startup and technology industry base, community of early adopters of new technologies and varied road network make NSW an ideal environment for scaling up trials and operations of CAVs in new passenger and freight mobility services.

NSW has significant strength in robotics and automated systems research and the highest percentage of technology start-ups in Australia (over 45 per cent). We have significant expertise in cybersecurity as part of a strong defence sector, while Sydney is also a centre for the financial technology, legal and insurance sectors in Australia.

Transport for NSW is working with the NSW Department of Industry, universities, industry groups and businesses to build on NSW's key strengths and opportunities to develop CAV-related technologies, and attract global talent and investments. This will enable our innovation activity around CAVs to reinforce these strengths, support emerging opportunities and deliver the learnings we need to prepare our transport system for the full integration of CAV technologies.

The key opportunity for NSW is to lead and encourage the adoption of CAVs, and provide national and global leadership in the area of safety assurance and regulation, with particular advantages for NSW including:

- ▶ a clear and progressive transport vision in Future Transport 2056, with customers as the focus and technology at its heart
- ▶ a coherent State approach to improving liveability, productivity and sustainability of our cities and regions, which are aligned through Future Transport 2056 and its Supporting Plans, [NSW State Infrastructure Strategy 2018-2038](#), [Greater Sydney Region Plan](#) and [20-Year Economic Vision for Regional NSW](#), which offer opportunities to better balance movement and place objectives
- ▶ a strong road safety focus, supported by a Safe System⁵ approach to safety assurance and regulation
- ▶ a large community of early adopters of new technologies and a strong industry sector
- ▶ diverse road environments – including motorways, highways, freight corridors, local streets and shared zones (road space shared by vehicles and pedestrians) – meaning if we can make it work in NSW, it paves the way for implementation elsewhere.

NSW is positioned as a leader in the adoption of CAVs, allowing us to attract innovative technologies, new skills and industries to our state.

Case Study



Semi-automated port operations, Port Botany, NSW

Sydney's Port Botany has a semi-automated stevedoring operation that is one of the first and largest in the world. The port, which was automated in 2015, has AutoStrads that load/unload the shipping containers into stacks and onto trucks, without any human interface.

The automated system, developed in conjunction with the Australian Centre of Field Robotics at the University of Sydney, has made the stevedoring operation much safer, with minimal risk of human injury. The whole process can occur continuously and without the need for expensive overhead lighting – AutoStrads do not need to see to navigate. They use 20 per cent less fuel and incur lower maintenance costs. Algorithms are used to automatically redirect AutoStrads from other tasks to the most pressing job.

Image: Patrick terminal ⁶

What are Connected and Automated Vehicles?

Automated vehicles

Automated vehicles use technologies including robotics, sensors and advanced software to automate one or more elements of driving, such as steering, accelerating or braking. Vehicle automation is not new. Features such as electronic stability control and electronic brake assist have been part of a gradual increase in automated systems over many years.

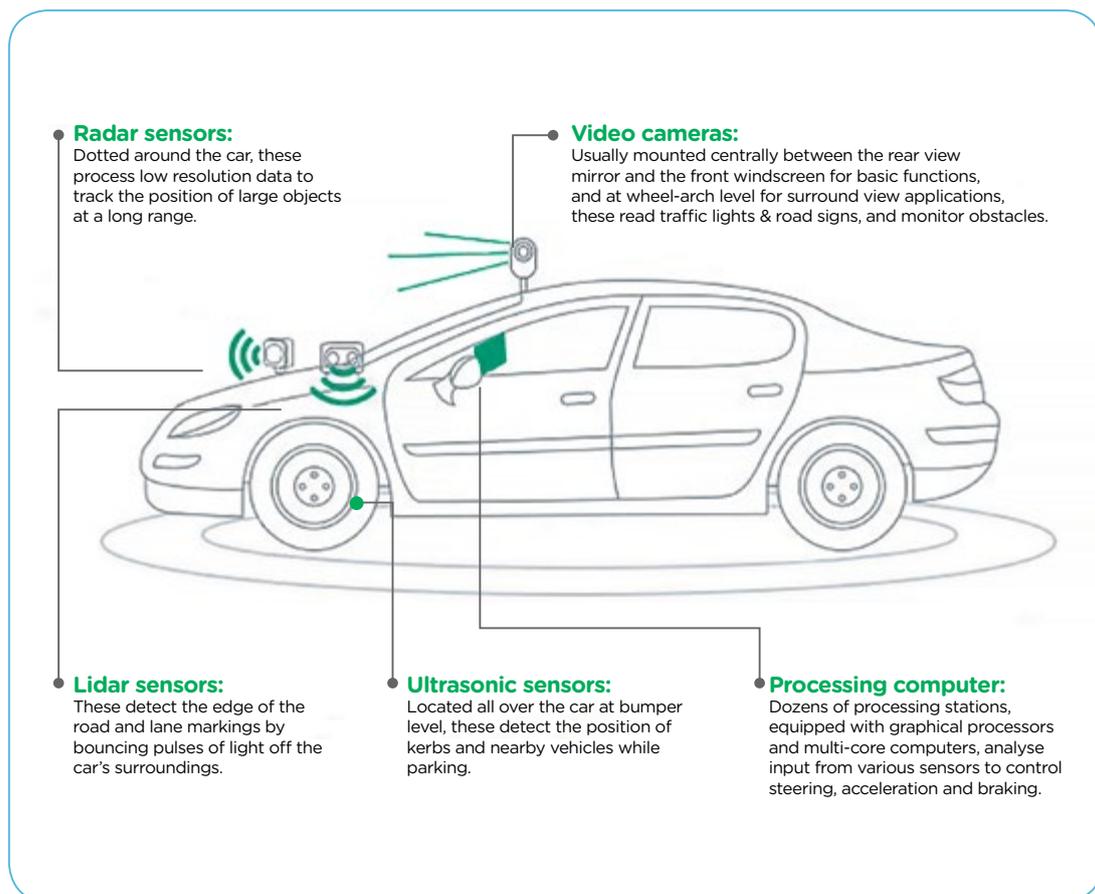


Figure 4 Some of the technologies that support automated driving⁷

There are six levels of driving automation that are defined by an internationally-recognised standard, issued by the Society of Automotive Engineers (SAE) International.⁸

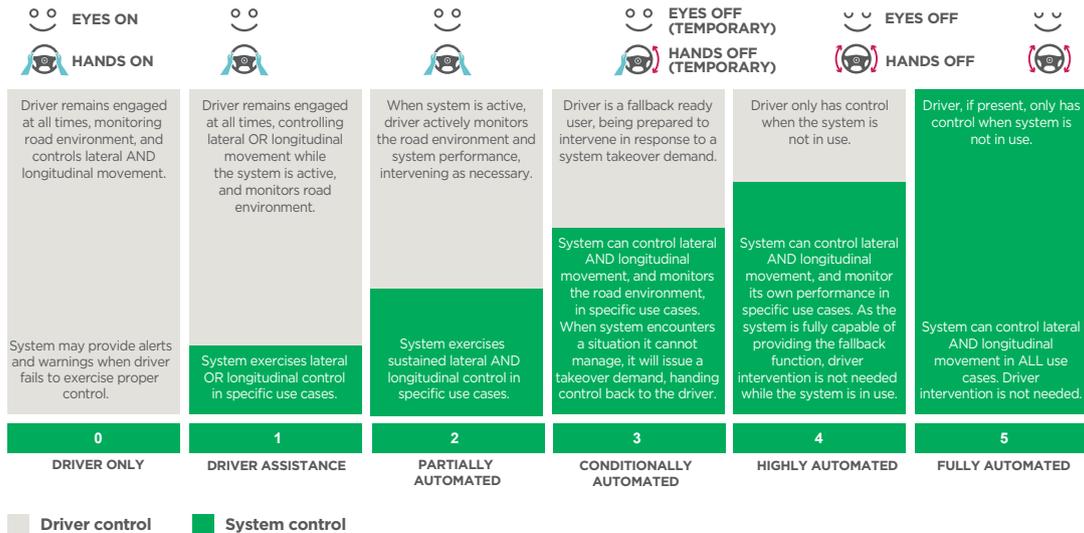


Figure 5 Levels of driving automation (based on the SAE International J3016 Standard)⁹

A small but growing number of new cars and trucks sold in Australia already include **partially automated systems (Level 2 automation)** such as adaptive cruise control, lane keeping assist and automated emergency braking. These technologies offer significant safety and other benefits to road users today in cars and heavy vehicles.

NSW light vehicle fleet with advanced driver assist systems

| | 2016 | 2017 | Change |
|------------------------------|-------|-------|---------|
| Automated Emergency Braking | 2.1% | 4.3% | +104.8% |
| Electronic Stability Control | 56.8% | 60.7% | +6.9% |
| Lane Keeping Assist | 2.4% | 4.0% | +66.7% |
| Pre-collision Warning | 4.2% | 6.5% | +54.8% |
| Adaptive Cruise Control | 1.9% | 3.0% | +57.9% |
| Reversing cameras | 21.2% | 26.7% | +25.9% |
| Fatigue warning | 2.4% | 3.4% | +41.7% |

Note: the data comprise light vehicles with a compliance plate of 2000 to 2017 (excluding motorcycles, plant vehicles, and trailers). Total fleet: 4,734,969.

Source: NSW Centre for Road Safety

Vehicles entering the market within the next year or two will combine and enhance these capabilities to enable **conditional automation (Level 3 automation)** – where vehicles can operate themselves in limited situations, such as driving from on-ramp to off-ramp on a motorway, with a human driver remaining responsible for the driving task.

A number of car manufacturers have or are soon introducing models with conditionally automated systems, such as the Traffic Jam Pilot feature in the Nissan Qashqai and upcoming Audi A8, which will allow for 'hands free' driving in heavy traffic on highways at certain speeds.

As per existing NSW legislation, the human driver of an automated vehicle will still be expected to keep their hands on the steering wheel at all times, be alert and ready to take over.

National laws are being established to allow an automated driving system to be in control of the vehicle at conditional, high and full automation (levels 3, 4 and 5) when it is engaged, and set out any legal obligations and responsibilities on human drivers or users of automated vehicles. This is important for ensuring a safe transition through increasing automation and a mixed fleet.

Highly automated vehicles (Level 4 automation) take this further, and can operate without a human driver (i.e. as a driverless vehicle) in specific conditions. For example, in a specific precinct or road, in certain weather conditions, and/or at limited speeds. The human driver or operator is only responsible for driving when the vehicle is not in automated mode or if required to take back control in changed conditions.

Examples of highly automated vehicles include automated ridesharing service vehicles being developed by companies such as Waymo, nuTonomy and GM Cruise, automated passenger shuttles like the ones currently being trialled at Sydney Olympic Park, Armidale and Coffs Harbour, and footpath-based delivery drones. These technologies are still in development and usually operate with some level of human supervision during testing to ensure safety.



Sydney Olympic Park shuttle



Australia Post's footpath-based delivery drone¹⁰

Fully automated vehicles (Level 5 automation) will be capable of travelling on any road, at any time, in all weather conditions, as a fully driverless vehicle without any human control. These vehicles may also allow a human driver or operator to take control if needed. While fully driverless technology does not yet exist and is expected to take many years to achieve, major automotive and technology companies are investing significant resources to develop and commercialise this capability.

Connected vehicles

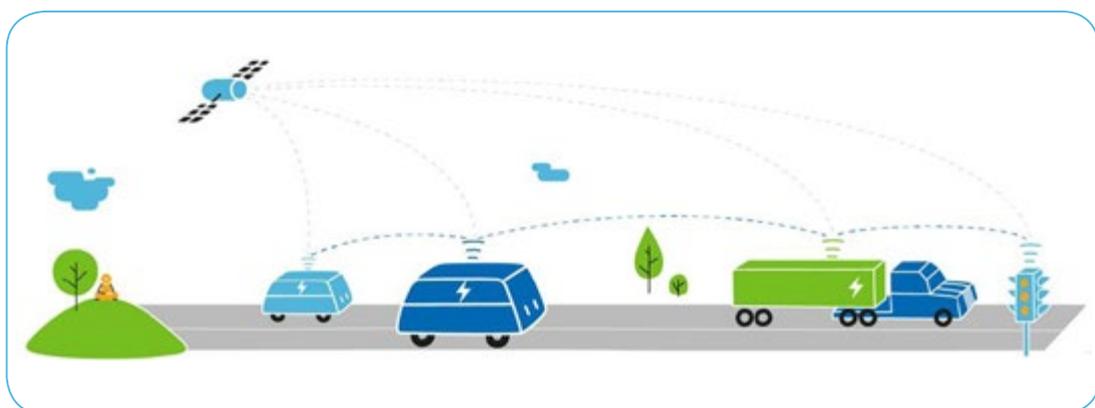
Connected vehicles use wireless technology to communicate with other vehicles, the road and other infrastructure, and even personal devices. These communications use a mix of technology – including commercial telecommunications networks (4G and 5G), global navigation and satellite technologies, and Dedicated Short Range Communications (DSRC) – depending on the operating area and use.

By combining these communication technologies with Intelligent Transport Systems (ITS), such as smart traffic signal controls and sensing technologies, this connectivity is a powerful tool for gathering and processing data into timely information and services for people, businesses and network operators. This means vehicles can operate more safely and intelligently by sharing information or alerts on safety hazards and congestion.

Most new cars today are already ‘connected’ in some way. Even smart phones are part of the connected vehicle ecosystem, enabling real-time traffic information and allowing you to track the location of a bus, taxi or delivery.

As more vehicles become connected, this ecosystem will grow and mature to help improve road safety and traffic flow, provide better customer information, and enable automated vehicles to drive safely and cooperatively in the future.

The coverage and capacity of existing commercial communication networks vary in their ability to cater for the increasingly connected fleet in all locations and for all services. Our understanding of the communications infrastructure needed to support longer term adoption of CAVs is still emerging – and will be informed by ongoing research, real-world trials and continued engagement with governments and industry in Australia and overseas.



CAVs will change the way we travel

Transforming mobility and reshaping urban centres

Connectivity and automation are distinct technologies, developing in parallel and converging to offer greater benefits. Together they will enable safer, smoother and more reliable journeys for passengers, and more efficient and productive freight movement.

Connected, automated, electric and shared mobility services will provide a wider range of transport options. Automated ridesharing services may offer customers affordable and convenient point to point journeys and flexible, on-demand public transport. This would improve first and last-mile connections and enhance mobility for people in underserved areas.

CAVs could drop you off and park themselves, or move on to the next ridesharing passenger. This would help to reduce congestion, the need for on-street and off-street parking, the need to own a car, and help to create more liveable urban centres.

Buses and trucks could run together in 'platoons' – linked by technologies and travelling close together in convoys, led by a human-controlled vehicle, to improve productivity and lower costs.

Small, footpath-based automated vehicles could handle many last-mile freight deliveries, helping to reduce congestion, cut costs for people and businesses and offer faster access to goods, particularly out of normal business hours, as long as pedestrian safety is addressed. These could also support 'hub and spoke' models of freight deliveries, aided by centralised distribution and storage – flow-on effects will improve efficiency and productivity in freight movements, particularly in urban centres. Smaller, cleaner and quieter vehicles will also be more suited to developing high-quality mixed use urban environments and 24/7 commercial operations.

In the coming years, CAV technologies will support a growing variety of passenger and freight vehicles of all sizes, using technology in different ways, to serve different customer needs in different places.

CAVs may also potentially change the way our urban centres operate – requiring fewer traffic signals, signage, kerbs and lines to guide the movement of cars (i.e. reduce 'street clutter'), as well as less parking to make extra space for street trees, cycleways and wider footways.

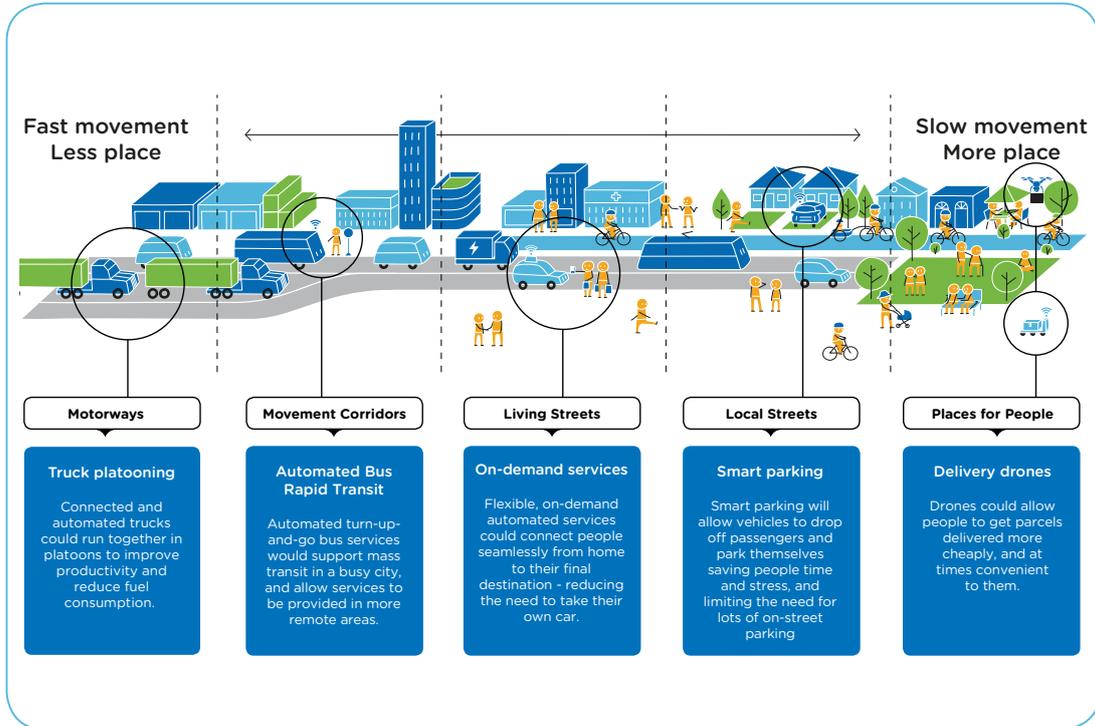


Figure 6 CAVs can support different customer needs in different places

Preparing for a range of outcomes

CAVs may take some years to emerge and become widely adopted for a range of uses. Australian and global estimates of the adoption of fully automated vehicles range from 30 per cent to 100 per cent of total vehicles by 2036.

How the community uses the technology is hard to predict and will be influenced by many factors, such as personal attitudes, costs and security concerns. The National Transport Commission estimates that there could be up to 1.7 million conditionally and highly automated vehicles (levels 3 and 4) in the Australian fleet by 2020 (9 per cent of total fleet), and almost 9.5 million by 2030 (42 per cent of total fleet).¹¹

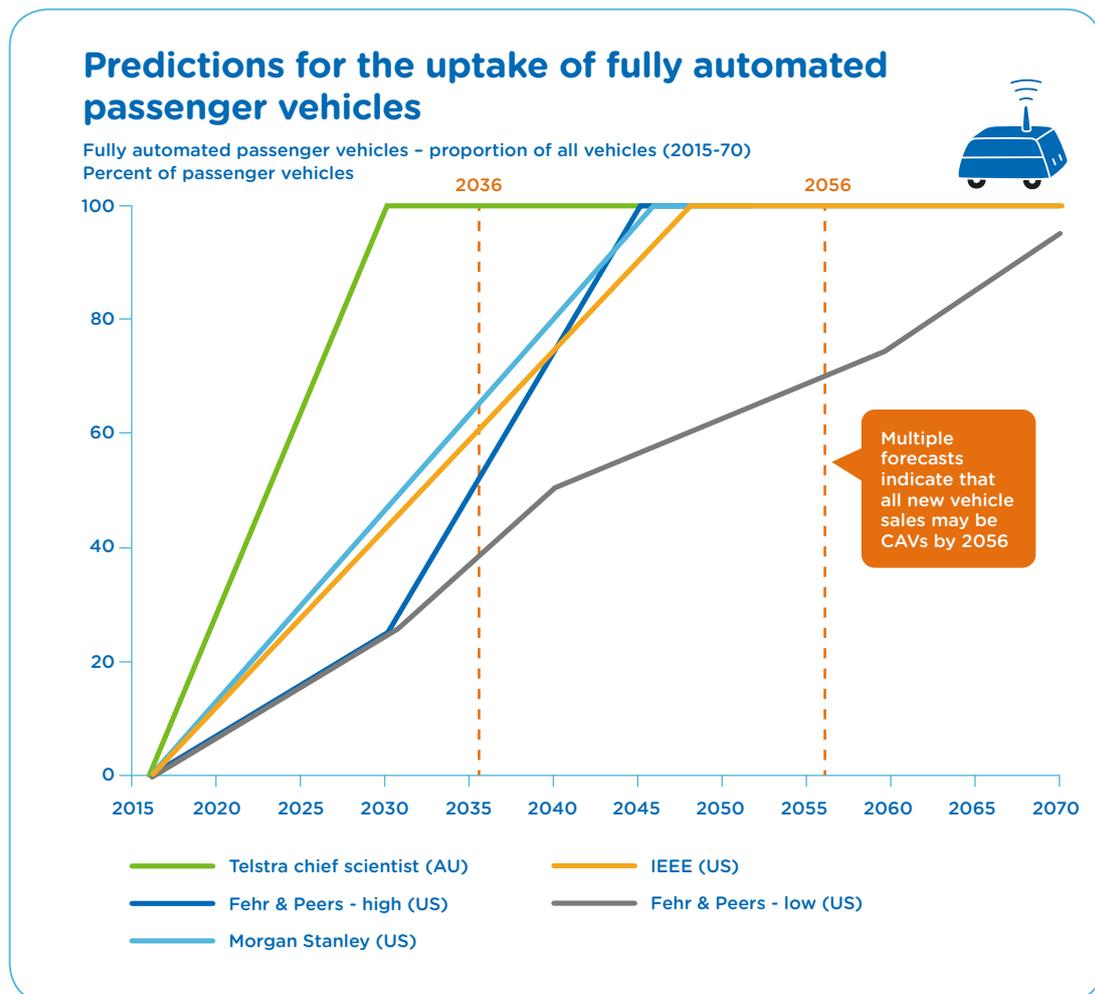


Figure 7 Predictions for the uptake of fully automated vehicles

In our [Future Transport Technology Roadmap](#), we identified four scenarios for how the evolution of CAVs and other technologies could bring about different outcomes for customers and the wider community, the urban and regional environment, and how we live and do business beyond 2030.

The four scenarios below show how alternative trends and behaviours around private versus shared use, and how CAVs integrate with public transport, create different benefits and challenges – leading to different outcomes around demand, congestion and sustainability.

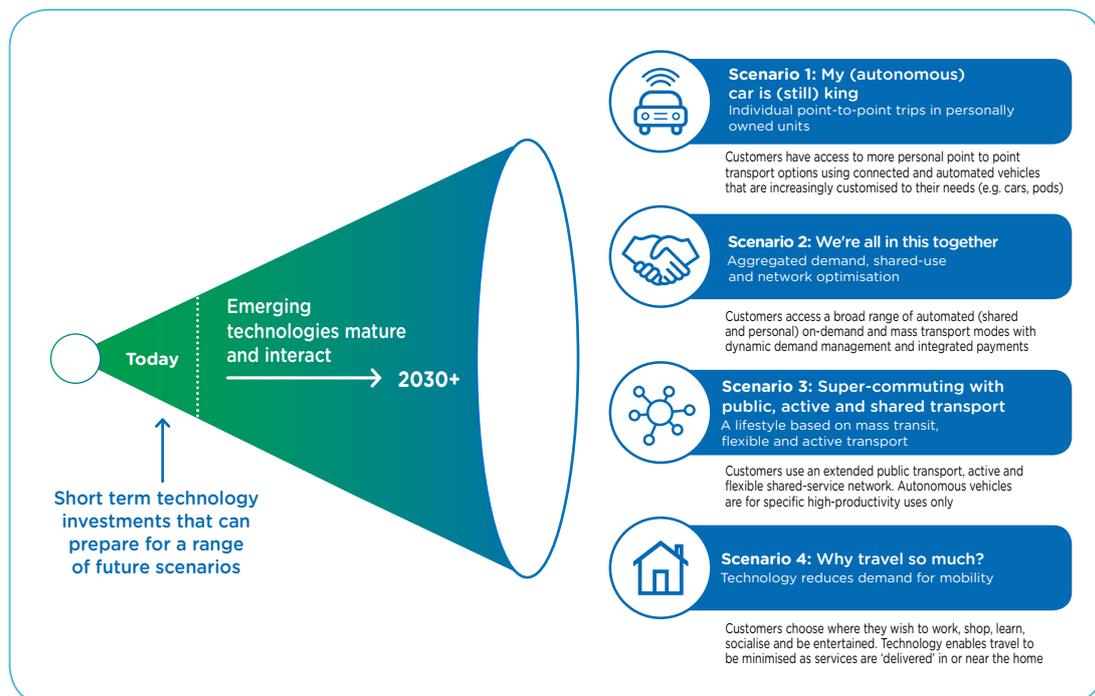


Figure 8 Four scenarios for how technology could influence the future of transport

In the first scenario, high levels of personal car ownership and private use continue to grow, with limited use of shared services. This could lead to high levels of individual convenience, but less use of public transport and an increase in congestion as a result, even with CAVs. The demand for parking could potentially increase and there will be increasing pressure to release more land for roads to support the growth in traffic.

In the second and third scenarios, the network is built around advanced, optimised and heavily integrated public and shared transport. CAVs are a central feature of the second scenario, but not the third. These scenarios could lead to a much cheaper and more environmentally friendly network, and potentially reduced congestion and need for parking. There is also increased potential to improve liveability and better balance movement and place objectives. However, they would require significant investment and changes in customers' travel habits.

In the fourth scenario, technology enables and encourages more people to work, shop, learn and socialise from home or closer to home in local centres. This could reduce the amount people travel, support more responsive transport services that can adapt to meet changing customer needs, and grow demand for last-mile freight deliveries.

The evolution of CAVs will be shaped by a broad range of human responses. The future will be a blend of these scenarios, and we do not yet know which may come to dominate the future of mobility. However, this CAV Plan sets out directions and actions that prepare for and capture the benefits of CAVs in a range of potential outcomes, while providing future flexibility.

The benefits and challenges

CAVs are exciting technologies that could help us address current and future challenges around the safe and efficient movement of people and freight, improve transport services and experiences for customers, and achieve better outcomes for society and places.

Safety is expected to be a major area of benefit of CAVs, which could also help us make better use of our road networks to reduce congestion and improve customer journeys, as well as support a range of wider benefits for the NSW economy and community.

Nevertheless, how CAVs will evolve and the impacts they will have, is still unclear. As explained below, these benefits are not assured and realising them depends on a concerted effort across governments at all levels, together with industry, researchers and the wider community. This CAV Plan sets out actions that NSW is taking to maximise the benefits and get the right outcomes.

Safety

Someone is killed or hospitalised every 41 minutes because of a crash on NSW roads. In 2017, 392 people were killed, and more than 12,000 suffered serious injuries on NSW roads.¹² CAV technologies are already improving road safety and have the potential to significantly reduce our road trauma. Automated emergency braking technology could deliver a 38 per cent reduction in rear-end crashes, while fleet-wide use of blind spot detection, lane departure warning and forward collision warning could prevent or reduce the severity of 24 per cent of all crashes.¹³



As technology advances, CAVs are likely to further reduce or even eliminate driver error and risky behaviour altogether – a factor in around 90 per cent of road crashes – saving lives, reducing injuries and easing the burden on health services.¹⁴

However, CAVs alone are unlikely to remove all risks to road safety. In the short to medium-term, there will be challenges to managing the complex interactions between automated vehicles, human-driven vehicles and other road users, in a mixed fleet environment. Until the technology becomes more sophisticated, CAVs will have to navigate through situations that will be complex and difficult to diagnose – for instance, pedestrians crossing the road without looking or drunk drivers.

CAVs may also introduce new risks, such as potential over-reliance on vehicle technology, and growing cybersecurity threats, that will need to be carefully managed. We know from recent overseas incidents involving automated vehicles, a strong safety assurance framework is not only important but is the core of NSW's approach to trials.

Traffic flow and congestion

At this stage, the impact that CAVs will have on congestion is unclear. For example, CAVs are likely to allow vehicles to travel closer together, behave cooperatively and avoid incidents that often disrupt traffic flow – delivering faster and more reliable journeys to customers. CAVs could therefore reduce freeway congestion by 15-60 per cent and arterial road congestion by 5-15 per cent, depending on how many people make use of the technology.¹⁵



However, research from the Australian Government’s Bureau of Infrastructure, Transport and Regional Economics (BITRE) suggests that the effect of a fully automated vehicle fleet on congestion is highly variable, and congestion could get much worse due to increased vehicle kilometres travelled (VKT).¹⁶ Changes in total VKT combined with expected changes in road capacity and efficiency determine travel time and congestion outcomes.

The type of use or operating model for CAVs will ultimately determine the way these vehicles affect congestion. As with the ‘My car is still king’ scenario, predominantly single-occupant CAV use could contribute to congestion if it lowers travel costs and increases acceptance of longer journey times because the occupant is able to use their time in other ways en-route. This, therefore, may encourage use of private cars over more efficient public and on-demand transport services.

CAVs may also behave more cautiously than human drivers, improving safety but slowing down traffic flow, and even travel empty on some trips, which is why we will need to proactively manage the potential adverse impacts of CAVs on traffic flows and congestion.

However, new shared mobility services such as NSW’s [On-demand public transport](#) trials are exploring a more flexible approach to delivering services when and where people need them, and by improving connectivity to the public transport network. If CAVs are used in this way in the future, then they will make more efficient use of road space and meet customer needs, and we expect to see reduced impacts on congestion and the amenity of places.

Productivity

CAVs would improve productivity for businesses and industry by making long-distance and last-mile freight more efficient. They would improve worker productivity if people are able to carry out work-related tasks while commuting, e.g. making phone calls, video conferencing, emailing and reading documents, as is possible on public transport. They could also reduce demand for parking, opening up valuable urban space for more productive uses.



A recent study estimates that when the autonomous truck market in Europe matures, the total cost savings could reach 30 to 35 per cent over the lifetime of each truck.¹⁷ McKinsey estimates that the costs of parcel deliveries could reduce by up to 50 per cent through automated last-mile deliveries.¹⁸

CAVs have the potential to disrupt some transport industries, but also offer opportunities to create new business development, investment and employment opportunities in a range of transport and non-transport sectors.

Access and mobility

CAVs have the potential to significantly lower the cost of transport – full automation could make travel 54 per cent cheaper for a single user, and 68 per cent cheaper if they share a ride.¹⁹ CAVs could support a range of more personalised, convenient and affordable transport services, and extend the reach of public transport through better last-mile connections to home, work and other activities. This could also improve mobility and social inclusion for people who may find it difficult to access transport today, including older people and people with a disability.



However, care is needed to ensure that the cost and usability of technology and the physical and digital infrastructure needs do not delay the benefits for communities, particularly those from low socio-economic backgrounds and those living in regional and remote areas.

Data

CAVs will generate large volumes of data – such as on vehicle location, diagnostics, traffic, road condition, crashes and travel patterns. This means customers can benefit from rich, timely and context-specific information about routing, disruption and hazards, as well as providing benefits to road operators, enforcement authorities, fleet managers and service providers.



But making the most of this means finding ways to integrate and share large volumes of complex data while protecting personal data and privacy, and managing security risks. Digital infrastructure will also need to be ready to support the growing volume of data and communications flowing between vehicles, infrastructure and other connected devices.

Sustainability

CAVs may reduce energy consumption and emissions by up to 45 per cent through more efficient driving – including smoother braking and acceleration.²⁰ CAVs will also increasingly be powered by electricity, producing cleaner and quieter trips, and more liveable and attractive environments. CAVs may create opportunities to operate transport services more cheaply and allow services to extend into more locations and for more operating hours.



However, energy consumption could rise by up to 70 per cent if people travel more in CAVs.²¹ The impact of increased electric vehicle charging on environmental sustainability depends on the energy source and user charging behaviour. Yet it also results in less CO₂ and greenhouse gas emissions than equivalent petrol or diesel vehicles.²²

The environmental, sustainability and public health benefits of CAVs are more likely to be realised if they are part of an integrated transport offering that includes accessible public transport and strong support for active travel (walking and cycling). This integrated approach will mitigate the risk of CAVs having adverse implications for congestion or public health.

A strategic approach for NSW

NSW is embracing connectivity and automation to achieve safety and efficiency benefits and service improvements for customers.

Future Transport 2056 and its supporting Plans identify how our long term priorities for transport can capitalise on emerging technology and service models to better meet customer needs.

The CAV Plan sets out our goals to support and accelerate CAV take up in NSW and the actions we will take to help us realise the benefits, overcome the challenges involved and support our long-term transport vision.

Our strategic approach to CAVs focuses on enabling and supporting others to develop these technologies and bring them to market – in a way that is legal, safe and delivers the best possible benefits to our customers and the community.

We have identified priority areas for action to address barriers, prepare for and support the adoption of CAVs in NSW. Successfully harnessing the benefits of CAVs – and managing the risks – requires a partnership approach, and we are already working closely with other governments, industry and academia in each of these areas to make this happen.

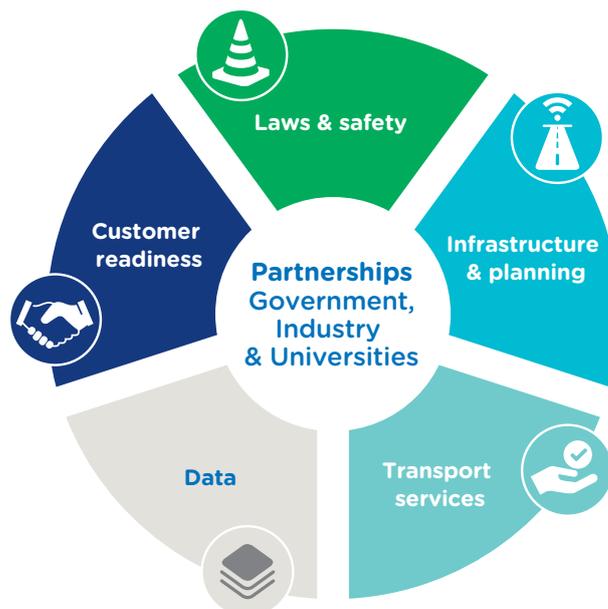


Figure 9 NSW's five priority action areas for CAVs



Priority 1: Laws and safety

Adapting our laws

Regulation plays a vital role in allowing products and services to come to market and protecting the safety and interests of society.

NSW has established a legal framework for the safe testing of conditionally, highly and fully automated vehicle trials (levels 3, 4 and 5) on NSW roads, including driverless vehicles.

As design standards for Australian vehicles are regulated by the Australian Government, we need consistent national regulations and guidance to provide confidence and certainty to industry and the community.

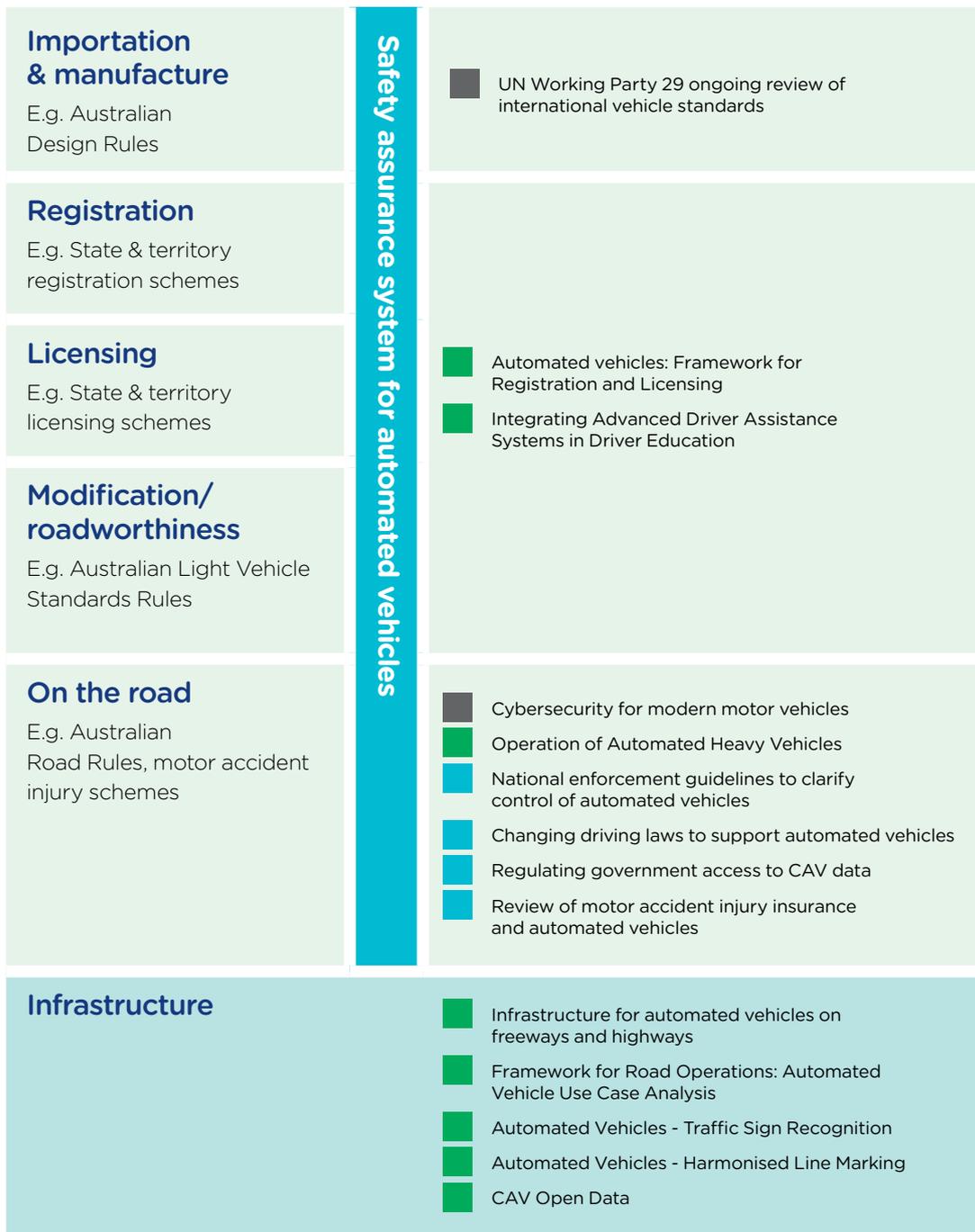
This is particularly important for CAVs, an area of rapid technological change with clear implications for laws and processes for roads, drivers, vehicle importation, insurance and other issues, where regulation could act as either a barrier or an enabler for positive change.

Our priority is to work with the Australian Government to establish regulations to support the safe adoption and use of CAVs. The regulatory framework will need to be consistently applied across Australia and flexible enough to remain effective during the complex transition to a CAV future.

We are working with the Australian Government, the National Transport Commission (NTC) and other jurisdictions to put in place harmonised national laws and policies for CAVs, including to assure their safety. In November 2017, national Transport Ministers agreed to:

- ▶ have a national end-to-end regulatory framework in place by 2020 (subject to change at Ministerial discretion) to support safe, commercial deployment and operation of automated vehicles at all levels of automation
- ▶ develop a national safety assurance system for automated vehicles, based on mandatory self-certification, transitioning to pre-market approval when international standards for automated vehicles are incorporated into Australian laws and standards. Figure 10 shows the projects underway at the national level.²³

Current initiatives 2018 - 2022



■ National Transport Commission
 ■ Austroads
 ■ Federal

Note: Timeframes are regularly updated to reflect policy and market developments, and are subject to change at Ministerial discretion. More information is available on the NTC website.

Figure 10 CAV initiatives underway at the national level (adapted from NTC)²⁴

While the national regulatory framework focuses on longer-term mass market deployment, the NSW legal framework is focused on enabling and supporting trials in NSW, so we can learn from the technology in real-world applications as soon as practicable, and is aligned with the national guidelines for trials of automated vehicles in Australia.²⁵

Legislation to allow the trial of automated vehicles in NSW

Automated vehicles that do not meet current Australian Design Rules (ADRs) and/or could operate without a driver (for e.g. level 3, 4 or 5 vehicles), cannot be operated on Australian roads as current vehicle standards and laws require that vehicles meet the ADRs and have a driver in control of the vehicle at all times.

Under the [NSW Transport Legislation Amendment \(Automated Vehicle Trials and Innovation\) Act](#), which commenced in August 2017, the NSW Minister for Roads, Maritime and Freight can approve applications to conduct trials of automated vehicles in NSW, by Ministerial Exemption Order which specifies the trial location, vehicle(s), scope, conditions, and most importantly, responsibility for the vehicle(s) used in the trial. The Act also sets out insurance and vehicle supervision requirements and contains penalties for improper vehicle use or interference.

This legislative framework has already been used to enable the Smart Shuttle trial at the Sydney Olympic Park and will also be used to facilitate further trials, including the regional ones.

Policy Reform

Together, these measures will provide for the safe and smooth introduction of CAVs in Australia and support the best outcomes for industry, customers and the community.

We also need to stay flexible, ensuring our regulations for vehicles and services, including passenger transport legislation, are able to respond to future technology and market developments.

Safer vehicles – now and in the future

NSW has a State Priority target to reduce road fatalities by 30 per cent by 2021 (compared to 2011 levels) and, as outlined in Future Transport 2056, a longer term goal to have zero road trauma by 2056.

'Safer vehicles' is a key component of the Safe System approach that underpins the NSW Government's [Road Safety Plan 2021](#). Automated safety systems – such as lane keeping assist, forward collision warnings and automated emergency braking – are increasingly important in helping to avoid a crash or reduce the impact when a crash occurs. These technologies are already available in some of the newest vehicles on the road. Increasing their use will be vital to improve safety – especially in regional NSW, which accounts for one-third of NSW's population but two-thirds of the State's fatalities.

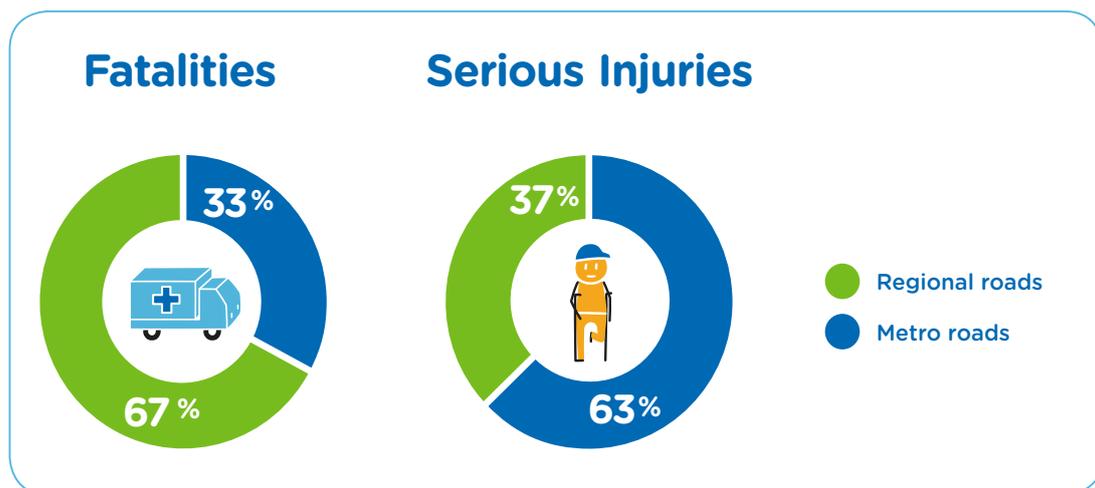


Figure 11 Fatalities (2015-17 average) and serious injuries (2014-16 average) on NSW roads²⁸

NSW is already facilitating the uptake of safer vehicles through supporting the Australasian New Car Assessment Program (ANCAP), truck and bus safety features and standards, and testing and harnessing emerging advanced safety technologies – including via our [FleetCAT](#) trial and [Cooperative Intelligent Transport Initiative \(CITI\) project](#). The [NSW Road Safety Plan 2021](#) also includes measures to promote adoption of automated safety technologies, such as changing the government fleet procurement policy with the subsequent benefit of increasing the technology available in the used car fleet.

Given that we are a relatively small marketplace in terms of global volume, there may be a need to prioritise measures that will encourage manufacturers to supply a broad range of affordable models with advanced safety features for purchase.



Case Study

Cooperative Intelligent Transport Initiative (CITI)

The CITI project in the Illawarra Region is Australia's first cooperative ITS testing facility and one of the largest connected heavy vehicle safety trials in the world. Operating since 2014, the trial has fitted connected vehicle technology to around 60 heavy trucks, 11 buses, 50 light passenger vehicles, and 1 motorcycle. 7 signalised intersections, 4 roadside stations, and 1 rail level crossing have so far been equipped with cooperative ITS. The technology will allow vehicles to 'talk' to each other and traffic signals up to 10 times a second, and alert drivers to upcoming hazards, improving road safety.

Watch the [CITI project video here](#).

In January 2018, the NSW Government announced an investment of \$1.6 million to upgrade the [Crashlab](#), which will provide NSW with world-class vehicle safety testing capabilities to assess new and emerging safety technologies, such as automated emergency braking and other advanced driver assistance systems.

The NSW State Insurance Regulatory Authority (SIRA) has announced [a six-month telematics trial to encourage safer driving behaviour by young drivers](#), with participants receiving \$100 via the NSW Green Slip scheme.

As technology advances, CAVs will offer even greater potential to improve road safety. We want to remove barriers to adoption and accelerate uptake to capitalise on the potential of these technologies to make NSW roads safer for all.

Priority 1: Laws and safety

In the next five years, NSW will aim to:

1. Support implementation of nationally consistent regulation, standards, policies and safety assurance regimes that ensure that conditionally automated vehicles (level 3) can operate safely and legally on NSW roads before 2020, and highly and fully automated vehicles (levels 4 and 5) from 2020
2. Increase the proportion of passenger and freight vehicles in NSW with the latest CAV safety technologies

Actions:

Trials and projects:

- 1.1 Undertake trials to:
 - ▶ test the safety benefits of advanced driver assistance systems, such as collision avoidance systems, on NSW fleets, including buses
 - ▶ test physical separation of highly automated vehicles (level 4) from other road users on roads where this could accelerate deployment, without impacting safety or congestion
 - ▶ assess how advanced driver assistance systems, including driver monitoring systems, and connected vehicle technology could promote safer driving, including reducing driver distraction
- 1.2 Partner with industry to prepare educational safety material for drivers in NSW who purchase partially, conditionally or highly automated vehicles (levels 2, 3 and 4)
- 1.3 Work with governments, industry and academia to manage the safety challenges posed by CAVs, including through the Cooperative Intelligent Transport Initiative, Automated Vehicle Infrastructure Initiative and FleetCAT initiative

Policies:

- 1.4 Continue work with the Australian Government, other states and territories, industry and academia to develop national laws, standards, road rules and policy guidelines to support the safe introduction of CAVs
- 1.5 Work with the Australian Government to establish clear, nationally-consistent processes for obtaining special import approval for non-standard (including left hand drive) and highly automated vehicles (level 4)
- 1.6 Have safety and cybersecurity management plans and frameworks in place for managing use of connected and highly automated vehicles (level 4) on NSW roads, including interaction with human-driven vehicles and other road users
- 1.7 Review and, where necessary, adapt arrangements for vehicle registration and licensing, and driver licensing, testing and training, to account for CAVs

In addition to the above actions, the [NSW Road Safety Plan 2021](#) outlines several actions to improve road safety through the adoption of new and proven vehicle technologies. These include:

- ▶ Updating NSW Government fleet vehicle policy to increase the proportion of the fleet with the latest safety technologies
- ▶ Increasing uptake of safer new and used vehicles, particularly by younger and older road users, country residents and fleet managers through new public communications
- ▶ Investigating opportunities with the insurance industry to reduce premiums for customers who adopt safer vehicle technologies and telematics.
- ▶ Partnering with the heavy vehicle industry to increase safety features in the fleet and enhance integration of fleet safety into heavy vehicle access policy
- ▶ Working with the Australian Government to fast-track the adoption of new technologies into vehicle standards, including for commercial and heavy vehicles



Priority 2: Infrastructure and planning

Preparing our roads

CAVs offer an opportunity to revolutionise the performance and efficient use of our road infrastructure, and deliver faster and more reliable journeys for customers. For example, CAVs could allow vehicles to travel closer together, behave cooperatively and avoid incidents that often disrupt traffic flow.

But if not well managed, there are potential risks of making congestion worse in metropolitan areas, if CAVs encourage people to travel further or more often by private car. With CAVs estimated to free up 52 minutes a day for car commuters,²⁸ along with the benefits of lower costs and greater convenience, this might encourage more private car ownership and use, and therefore increase demand for road space and parking.²⁸ To manage this, we are planning how to best integrate CAVs to make better use of our existing road infrastructure, support public transport and shared ride passenger mobility such as the On Demand transport services, enable aggregated end-to-end freight deliveries, and prioritise walking and cycling in urban centres.

As far as possible, CAV technology needs to work with existing road infrastructure. While the onus must be on those developing the technology to make sure it can work for a range of different road types and environments, without forcing unreasonable costs onto road authorities and taxpayers, some changes to roads will be needed for CAVs to operate safely and deliver benefits.

In the next few years, we will need to investigate which modifications to existing infrastructure may be needed, such as lane markings, roadside signage, interchange facilities, road geometry (e.g. lane width) and construction and maintenance, or whether CAVs can manage existing infrastructure without imposing a cost on taxpayers.

We will also need to plan for the future needs of CAVs and other emerging technologies and services into precinct and project plans. In the longer term, this could extend to larger scale changes to our infrastructure needs and the shape of the future road network, such as repurposing land currently used as parking spaces.

We are working closely with industry and other states on research and trials to inform the minimum infrastructure changes needed to support CAVs, as well as at a national level to align Australian standards with international standards where appropriate.

We are also working with other government agencies and industry to embed CAVs and other technological developments into our approach for developing “smarter cities” – i.e. leveraging CAVs to improve overall safety, productivity, accessibility and social inclusion, and environmental sustainability of our cities and communities.

Case Study



Automated Vehicle Infrastructure Initiative

In March 2018, the NSW Government launched a joint project between Transport for NSW, Roads and Maritime Services, Transurban and eight vehicle manufacturers (BMW, Tesla, Hyundai, Volvo, Mercedes-Benz, Audi, Range Rover and Lexus) to assess the compatibility of Sydney's motorway infrastructure with automated vehicle technology.

These vehicles, with varying automated driving system capabilities, have been used to test for technology accuracy and reliability in recognising and interpreting line markings, on-off ramps, and traffic signs including roadside (fixed) and variable speed limit signs, among other things, in different road and weather conditions.

The trial will provide learnings to both road managers and vehicle manufacturers to improve how the emerging technology operates on the existing road network. Learnings will be used to establish an infrastructure readiness database, which will detail automated vehicle readiness for different parts of the motorway network.

The trial was run from March until October 2018 across the Sydney Orbital Network including the Lane Cove Tunnel, the Hills M2 Motorway, Westlink M7, the M5, Eastern Distributor, the Sydney Harbour Bridge and Sydney Harbour Tunnel.

The next phase of the Initiative has commenced with Transport for NSW's SAFET1 research vehicle (pictured above) being used to extend the project to regional highways.

A flexible approach to planning

The impacts of CAVs on future infrastructure needs and land-use are uncertain. The range of issues associated with CAVs around infrastructure, services and land use makes long-term planning more complex than in the past.



This requires a more flexible approach to planning that allows us to quickly identify how customers are responding to innovative mobility solutions, and adapt our plans in a rapidly changing environment to optimise outcomes for customers and the community.

We are already looking at ways to build flexibility into the planning and design of infrastructure projects, such as roads, transport interchanges and commuter car parks, so these can be adapted for emerging technologies. The M4 Smart Motorway, for instance, incorporates design standards to support digital connectivity and automation.

Flexibility will be needed when making infrastructure project investment decisions to ensure they make provision for testing or adoption of new technologies and emerging service models, as well as preparedness to alter plans if needs change.

We are also considering how CAVs and other innovations, such as electric vehicles and Mobility as a Service (MaaS), have the potential to physically reshape the design of our cities and towns, and improve the amenity for all users of streets and roads, particularly pedestrians. This includes changing parking, the form of our streets and how people interact with vehicles and the streetscape. This will help shape amenity, liveability and social experiences, and support development of smarter, more successful places in cities and regional areas

Similarly the need for garages and driveways could be reduced, which would improve building design, their relationship and natural surveillance of the public domain and overall streetscape opportunities.

Research is required on the changes to the physical environment of metropolitan and regional areas that might improve liveability, productivity and sustainability, and for policy guidance on how to ensure those benefits are realised as CAV uptake increases.

Transport planning and economic appraisal techniques will need to be updated to reflect potential changes from CAVs to individuals' demand for travel, value of time, and travel costs.

Further research on network performance as well as the social and economic implications of CAVs is also needed to help identify and prioritise needs, plan investments, and support the realisation of benefit opportunities.

Priority 2: Infrastructure and planning

In the next five years, NSW will aim to:

1. Develop appropriate evidence-based transport, infrastructure and land-use policies and plans that support the optimal use of CAVs and CAV services
2. Build infrastructure capability to support at-scale operations of partially, conditionally and highly automated vehicles (levels 2, 3 and 4) on motorways and major roads

Actions:

Trials and projects:

- 2.1 Undertake research and trials, in collaboration with industry and universities, to:
 - ▶ model potential traffic and congestion impacts of CAVs to inform future policy and planning
 - ▶ assess compatibility of NSW road infrastructure for CAVs and identify short-term infrastructure enhancements required to support CAV operations, including automated on-demand and shared ride services
- 2.2 Expand the Automated Vehicle Infrastructure Initiative to regional NSW, to test and further enhance the compatibility of CAV technologies with the regional road network
- 2.3 Work in partnership with industry and local councils to help establish test beds and CAV-ready smart city precincts, including drone delivery zones, in key metropolitan and regional areas - including The Bays Precinct and the Western Sydney Airport-Badgerys Creek Aerotropolis

Policies:

- 2.4 Work with government agencies and industry to assess longer-term infrastructure requirements to support CAVs, including new standards
- 2.5 Take into account the optimal use of CAVs in developing policies, including:
 - ▶ road use and parking policies and standards - including the Road Space Allocation Policy and the Greater Sydney and Regional Parking Guidelines ²⁹
 - ▶ Regional Transport and Place Plans to ensure CAVs can support improvements to transport networks and places in regional areas ³⁰
 - ▶ public transport service planning guidelines and modal strategies
 - ▶ approaches to transport and land-use modelling and forecasting, including the Strategic Travel Model, Public Transport Project Model and Strategic Freight Model
 - ▶ principles and guidelines for transport impact assessment and economic appraisal of transport investments
- 2.6 Work with the Department of Planning and Environment, the NSW Government Architect, Infrastructure NSW and local councils to develop a CAV Built Environment Guide to identify the opportunities and impacts CAVs will have on urban design and planning for the built environment

To support actions in the [NSW State Infrastructure Strategy 2018-2038](#), we will also:

- 2.7 Develop business cases for the deployment of smart motorway technology, including connected vehicle infrastructure, along the M1 - Newcastle and M1 - Princes Motorways
- 2.8 Work with Infrastructure NSW in developing a Smart Cities Strategy for NSW that identifies opportunities to deliver better public services through CAVs and smart infrastructure



Priority 3: Transport services

Accelerating towards the future of mobility

By embracing technology and innovation today, we can open up an exciting future of personalised passenger transport for customers, new freight services, and smarter mobility that fully unlock the value of investments in the transport network.

We have fully automated Sydney Metro trains ready to start operating in 2019, and an automated passenger shuttle already being trialled at Sydney Olympic Park. Regional shuttle trials in Armidale and Coffs Harbour will also test the potential for CAVs to improve customer outcomes and operate as part of an integrated regional transport network in regional centres.

The freight industry already uses automation at container ports and in distribution centres, such as Patrick's automated terminal at Port Botany, which uses AutoStrads, or automated straddles, to automate the safe unloading and movement of containers.

Wider introduction of automated vehicles – such as automated passenger shuttles, buses, trucks and commercial ridesharing fleets – could deliver safer and more reliable services to customers, reduce operating costs and allow new services to be offered in areas where they are not currently viable.

Customer expectations of transport are increasing. Flexible service models such as ridesharing and carsharing are already disrupting traditional services and offering new choices to customers. Automation and digital connectivity are changing the way we consume transport, bringing more flexibility, choice and integration.

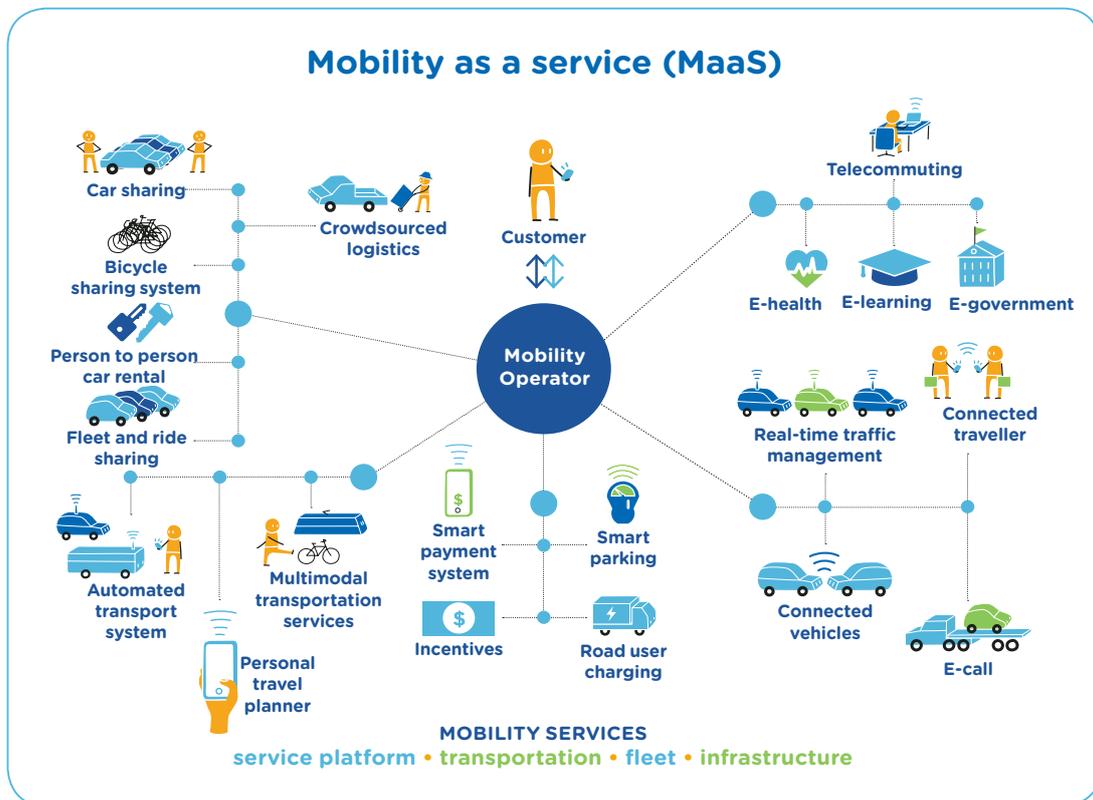


Figure 12 Elements of Mobility as a Service (MaaS)³³

CAV technology will support emerging mobility services by increasing their affordability and availability, for example in the form of automated ridesharing and first/last mile passenger shuttles, and integrating with other transport modes.

When used in shared ride services, such as on-demand transport, ridesharing (e.g. UberPOOL) and carpooling (e.g. Liftango), CAVs offer affordable and personalised point to point transport that meets growing demand for travel, eases congestion and offers a viable alternative to the high costs of private car ownership.

Freight and logistics also stand to benefit from CAVs, which could improve safety and efficiency, and cut operating costs. NSW is already [trailing freight priority technology using connected trucks](#) in a Premier's Innovation Initiative Freight Signal Priority trial, to test its ability to ease congestion. Small automated vehicles or footpath-based drones, such as the one trialled by Australia Post for mail delivery, could cut the cost of last mile parcel delivery³², and offer faster and more flexible delivery options.

Priority 3: Transport services

In the next five years, NSW will aim to:

1. Have introduced expanded operations, at scale, of connected and highly automated vehicle (level 4) services that support the most efficient movement of people and goods, and the creation of better places and amenity across NSW

Actions:

Trials and projects:

- 3.1 Complete the [Smart Shuttle](#) trial at the Sydney Olympic Park, and the [regional CAV trials in Coffs Harbour and Armidale](#)
- 3.2 Undertake an automated ridesharing service trial in NSW
- 3.3 Partner with industry and universities to develop further CAV trials, focusing on:
 - ▶ 'turn-up-and-go' high-capacity bus services
 - ▶ flexible and on-demand services
 - ▶ first and last-mile service connections to public transport, including linkages with commuter car parks
 - ▶ services that improve accessibility for older people and people with a disability, including community transport
 - ▶ last-mile freight delivery services
 - ▶ heavy vehicle truck platooning
- 3.4 Investigate the potential for automation of freight movements between ports and inland terminals, including heavy vehicle platooning

Policies:

- 3.5 Take account of CAVs in developing and implementing a Last Mile Freight Policy, to ensure CAVs can support the optimisation of freight movements in centres³³
- 3.6 Update fleet procurement and service contracting policies to incentivise the use of connected and automated buses and shuttles for public transport services
- 3.7 Work with universities and industry partners to research new connected and automated mobility services, such as ridesharing, MaaS and carsharing, and their integration into our future transport network
- 3.8 Work with NSW Department of Industry to understand implications of CAVs on future skills and workforce

To support actions recommended in the [NSW State Infrastructure Strategy 2018-2038](#), we will also:

- 3.9 Investigate opportunities for automated bus rapid transit on the North West and Liverpool-Parramatta T-ways and other key transit corridors



Priority 4: Data

The digital transformation of transport

Unparalleled developments in digital technology are revolutionising the way we access and pay for services, operate the network, manage assets and plan for future transport systems.

Data analytics, machine learning and artificial intelligence are advancing rapidly and NSW will be ready to incubate and trial new uses, to adopt technology where it can benefit customers and improve performance. Freight customers will also harness data and analytics to improve efficiency and competitiveness.

Future transport services will need an extensive and sophisticated technology-enabled network. The NSW Government is investing \$470 million to upgrade the M4 to a 'smart' motorway, which will introduce ITS between Mays Hill and Lapstone. Work on Stage 1 of the Project, which will upgrade the section between Mamre Road, St Marys and Reservoir Road, Prospect, is expected to be completed in 2019.³⁴ Future Transport 2056 commits to delivering 'smart motorways' on additional NSW motorways.

Embedding sensors and technologies across key assets – such as bridges, roads and traffic lights – will generate valuable data on assets, incidents, road conditions and traffic patterns. This will support efficient management and maintenance of the transport system, improve road safety, and generate real-time road and public transport information for customers to help personalise their journeys.

Capitalising on this rich data requires us to modernise our digital infrastructure. Our IT, traffic management and control systems that manage network operations and prioritise traffic movements will incorporate new sources of data from CAVs and other sources, and make best use of this data to better manage infrastructure and optimise network planning and operations.

The NSW Government is also prioritising efforts to improve digital connectivity in regional areas. The NSW Government's [20-Year Economic Vision for regional NSW](#) will accelerate the deployment of digital infrastructure, expanding mobile network coverage, and smart cities technologies across regional NSW. This will be critical in supporting the scaling up of technology-enabled transport services, such as on-demand public transport and automated shuttles, in regional areas.



Case Study

Intelligent Congestion Management Program

The NSW Intelligent Congestion Management Program is implementing a system which will use advanced data analytics and predictive capabilities to monitor the performance of the network, across all modes of transport, in real time, and improve planning and coordination of the network to enable seamless, safe and reliable journeys for our customers across all modes of transport.

Improving these capabilities is key to capturing the benefits from CAVs and the data they will generate, supporting better decisions, providing richer information to customers, and contributing to a data ecosystem that supports Mobility as a Service applications.

The Program is being delivered in collaboration with a number of major technology companies, including Cubic Transportation Systems, WSP, PTV Group, Mentz, Microsoft and Data 61.

While data presents major opportunities to improve mobility, it also represents an area of concern and uncertainty for the community. Regulatory and policy frameworks around data that relate to CAVs, which govern issues such as ownership, access and use, data protection and security, and privacy will need to be established, adapted and reviewed in conjunction with national, state and local governments, as well as industry and subject matter experts.

Cybersecurity controls will need to be in place to ensure that CAVs have sufficient protection from cyber or hacking attacks, and to ensure integrity, accuracy, and reliability in the way information is exchanged with CAVs. We will continue to work with Australian governments and industry to investigate cybersecurity issues, identify best practice regulatory approaches, and develop capabilities of road operators and law enforcement authorities to effectively manage cybersecurity incidents on the transport network.

The NSW Future Transport Technology Roadmap and [NSW State Infrastructure Strategy 2018-2038](#) outline that data, as a new infrastructure asset, will be critical to developing new services, improving existing services, and better managing the performance of assets. However, our infrastructure and systems will need to be resilient to cyber-attacks, as well as potential data breaches.

Priority 4: Data

In the next five years, NSW will aim to:

1. Develop a framework and clear policies, standards and protocols around data sharing, privacy and security relating to CAVs
2. Build digital capabilities and data platforms for CAV data to improve performance and service delivery, and enable smarter approaches such as MaaS
3. Incorporate digital infrastructure into major roads to support connected, and conditionally and highly automated (levels 3 and 4) vehicles

Actions:

Trials and projects:

- 4.1 Undertake research and trials that assess CAV data needs in relation to:
 - ▶ digital infrastructure and data systems to enable vehicle-to-everything (V2X) communications
 - ▶ next generation of network management, including incident response capabilities, through the Intelligent Congestion Management Program and Advanced Data Analytics projects
- 4.2 Collaborate with industry to trial real-time data exchange and open data platforms for CAVs and emerging service models, such as MaaS, to better understand how they could be leveraged for network optimisation
- 4.3 Work with industry partners and technology companies through Transport for NSW's Digital Accelerator at the Sydney Startup Hub, to develop CAV-related digital products and solutions to address transport challenges
- 4.4 Collaborate with Geoscience Australia and industry to test how more accurate positioning technologies, such as satellite-based augmentation systems,³⁵ could enhance the safety and network efficiency benefits of CAVs

Policies:

- 4.5 Work with the Australian Government, other states and territories, road operators and industry to develop policies and guidelines on data sharing and cybersecurity management – including through the 'Regulatory access to C-ITS and AV data', 'C-ITS Security Credential Management System' and 'Best Practice Cybersecurity for Modern Road Vehicles' projects³⁶
- 4.6 Investigate strategies for collection, management and use of CAV data to deliver benefits for customers, operators and planners



Priority 5: Customer readiness

Customers will shape adoption

Customers are increasingly interested in the potential benefits of CAVs, and will ultimately determine how and when this technology and related services are adopted.

In 2016, 47 per cent of Australians surveyed by the Australian Driverless Vehicle Initiative (ADVI) believed fully automated vehicles would be safer.³⁷ In 2017, research by the University of Sydney revealed that around 40 per cent of NSW residents would use a fully automated vehicle, either as a privately owned vehicle or as part of shared mobility service.³⁸

The same studies also show that people have common concerns around safety, liability, privacy, and data security – issues that are now being addressed through coordinated efforts by the Australian, state and territory governments.

Sydney residents are relatively early adopters of innovative mobility services, and a third of them reported using ridesharing services like Uber in the two years after introduction. Recent research by Ernst & Young (see figure 13) indicates that Sydney residents are the most attracted to using ‘self-driving’ or fully automated vehicles – for both cars and public transport vehicles – compared to the rest of the country.³⁹

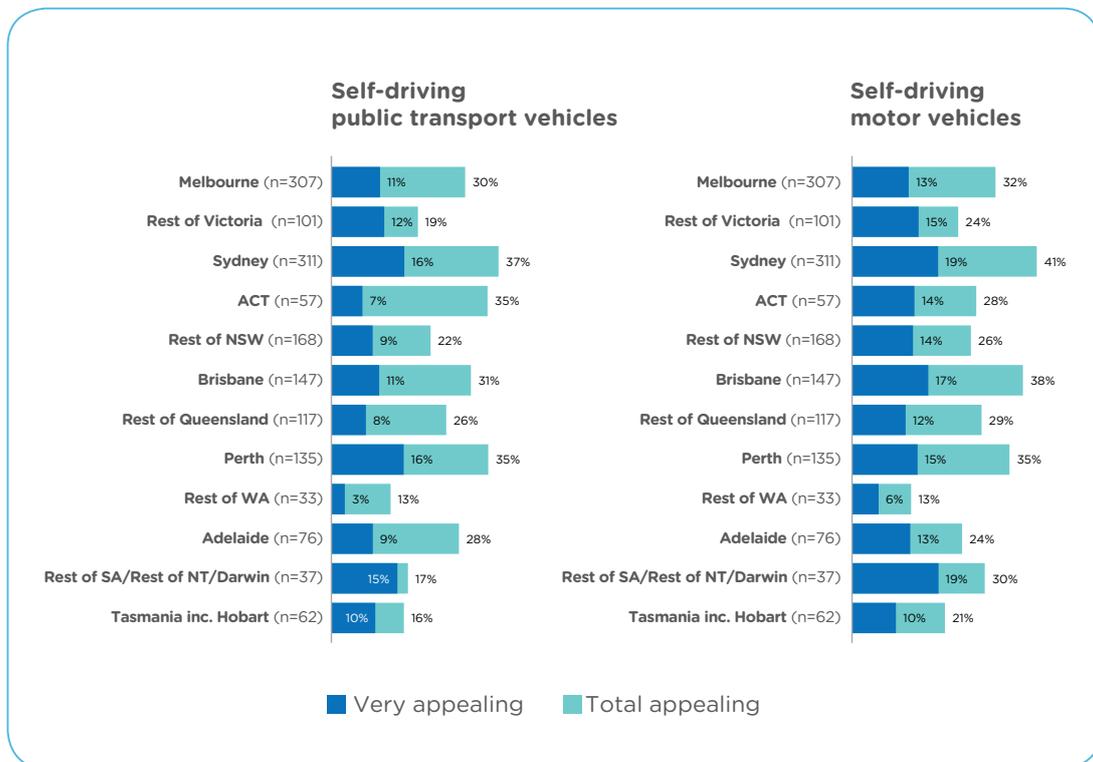


Figure 13 Attitudes to self-driving vehicles across Australia (adapted from Ernst & Young)⁴⁰

Governments and industry have an important role to ensure that the community understand the benefits and limitations of these emerging technologies, and are informed in how to use them to improve their safety and travel experience. Public education and first-hand experience in trials and demonstrations will be important in achieving this.

The emergence of new services offers customers greater choices and the opportunity to influence what services are offered in future. The attitudes of customers and communities towards innovative CAV technologies and services will be critical to whether they succeed. Transport providers will need to understand customer needs and expectations, build trust and acceptance of newer technologies, address concerns about safety and privacy, and design the introduction of new services that place customer needs at the centre.

Customer adoption of CAVs will also determine how long we continue to have human-driven vehicles. A modern vehicle has an average life span of 10-15 years and it could take decades for the majority of human-driven vehicles to be replaced or taken off the road. Ongoing education to address public concerns about safety and security, and ensuring our regulations are adapted quickly, can help streamline this process.

We must also work to ensure that our regional customers are able to fully access the safety and mobility benefits of CAVs. Regional and remote customers face a distinct set of mobility challenges compared with metropolitan customers – they suffer from higher road fatality rates, have limited access to flexible and affordable public transport services, and have a broader range of road conditions and digital connectivity gaps in many regions that inhibit connected and highly automated vehicle operations.

We will continue to facilitate more trials of CAVs, such as the ones in Armidale and Coffs Harbour, and flexible, on-demand services to demonstrate and assess the potential uses and benefits for regional communities.

Priority 5: Customer readiness

In the next five years, NSW will aim to:

1. Have trials and policies in place that support the best customer and community outcomes with CAVs – aligned to Future Transport 2056 outcomes
2. Increase customer information, acceptance and use of CAVs through communications, demonstrations and trials

Actions:

Trials and projects:

- 5.1 Work with government agencies, industry and community organisations to promote awareness of CAV technologies and their proper use, and on current and upcoming CAV trials and services
- 5.2 Use CAV trials to enable customers to see and experience CAVs operate in different services, and collect customer feedback to inform future services, including for customers with different needs
- 5.3 Work with universities to research and share insights on customer attitudes and choices around different CAV service models, to inform future services and investment decisions

Implementing our Plan

NSW is 'Open for Business'

Given the rapid pace of change in CAV technologies and wider transport innovation, this CAV Plan will be kept under review to ensure it remains current. It will be refreshed as needed - initially in 2020 - so it keeps pace with the latest CAV developments and opportunities.

Transport for NSW will implement the actions set out in this CAV Plan, in collaboration with relevant government and industry partners, experts and stakeholders. We will continue to engage customers and the community on CAVs as we progress the plan to help us shape the future of transport in NSW.

We will also continue to collaborate with our partners to identify investment opportunities and leverage funding for trials, infrastructure and services that deliver the greatest benefit to the community.

Successfully harnessing the benefits of CAVs will require a collaborative approach across government, industry, academia and the innovation community.

The NSW Government recognises the need to be prepared for connectivity and automation and welcomes investment into new and emerging technologies. We have already partnered on a number of trials and want to continue that approach - working with leading industry and researchers to undertake testing and trials of CAVs and related services, to better understand their requirements and their implications for our transport and road network, and better engage with customers on what these technologies will mean for them.

We are always keen to hear from communities, businesses, innovators, and researchers about how to apply new and emerging technologies to improve transport.

Smart Innovation Centre

If you want to operate a CAV in NSW, the primary pathway is through the [Smart Innovation Centre](#) - Transport for NSW's one stop shop for CAV trials. The Centre can facilitate and guide you through the process to gain approval under relevant legislation to get your CAV on the road.

The Centre is NSW's hub for collaborative research and trial of safe and efficient emerging transport technology and periodically requests Expressions of Interest for trials that address key transport challenges.

We are always open to new ideas and partnerships, and if you are interested in collaborating with us, please email: smartinnovationcentre@transport.nsw.gov.au.

Information on CAV-related research activities at Transport for NSW is also available at the [Research Hub](#), which provides information on current research priorities and is an initial engagement point for developing research projects that reflect these priorities.

Through the Future Transport Technology program, Transport for NSW also runs [Innovation Challenges](#), [Pitchfests](#) and [Hackathons](#) on specific problems to be solved. In addition, the [Transport Digital Accelerator](#) facilitates collaboration between public and private sectors, connecting teams from the NSW Transport cluster with industry, researchers, entrepreneurs and startups in the digital space. You can get involved with the Future Transport Technology program at: future.transport.nsw.gov.au/technology/get-involved/

You can also sign up for the [Transport for NSW Industry newsletter](#) and the [Freight Industry newsletter](#) for updates on upcoming projects and industry engagement opportunities.

If you would like to find out more about how to engage with us, please email: stakeholder.relations@transport.nsw.gov.au.

In addition, the NSW Department of Industry offers several programs to drive innovation and collaboration in NSW to support emerging industry growth, including:

- ▶ [Jobs for NSW](#) which provides financial support to startups and emerging and fast-growth small to medium enterprises
- ▶ [Boosting Business Innovation Program](#) which gives small businesses access to research organisations to build strong local business communities and stimulate economic growth in metropolitan and regional areas
- ▶ [TechVouchers](#) which connects NSW small to medium enterprises to experts, working in partnership on innovative joint research projects, and providing access to high tech instruments and facilities.

Further detail on these programs and how to get involved can be found here:

www.industry.nsw.gov.au/business-and-industry-in-nsw.

End Notes

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investigation (0-10 years).

Access Prioritisation Plan: Strategic plan using the Movement and Place Framework that identifies initiatives to prioritise access to interchanges, corridors and key places.

Greater Sydney Parking Guideline: Development and implementation of policy, in collaboration with local government, to ensure parking will be provided in a way that is consistent with the level of access by alternative modes of transport, including addressing the future provision of commuter car parks.

Regional Parking Guidelines: Development of a strategy as to how parking in regional NSW should be delivered in order to get to the best use of existing and future transport assets, increase amenity in places as well as supports freight and commercial businesses.

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Regional Place Plans to deliver an integrated transport network to improve access to/from within key places or centres by all modes across regional NSW.
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