

SCENARIOS FOR LAND TRANSPORT IN 2040

Prepared for the National Transport
Commission

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September 2016

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1 APPROACH TO CREATING SCENARIOS

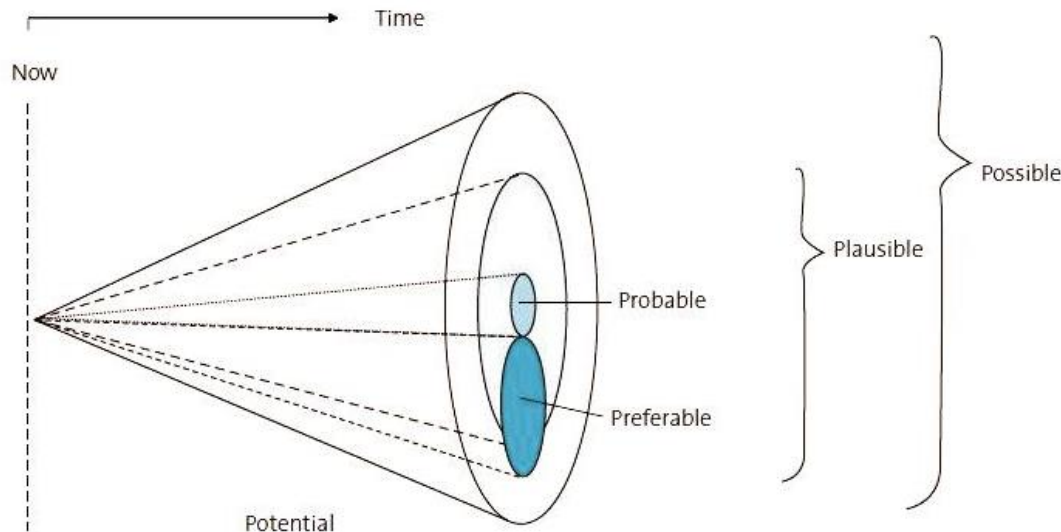
This report presents four qualitative scenarios about what land transport could look like in 2040. They have been prepared for the National Transport Commission to inform their work on the trends, influences and changes in society that will impact Australia's transport system into the future.

The scenarios are narratives that have been developed with stakeholders about a wide range of *plausible* futures. Their purpose is to prompt conversation and engagement on where we might be headed as well as where we are now. The scenarios are alternative visions of what *could* happen. They are not about what we think *should* occur, nor are they predictions of what is most *likely* to occur.

While it can be tempting to just focus on probable and preferable futures, plausible futures can help prompt new insights by taking a wider view. The five types of futures described by Voros¹ can be helpful to illustrate the difference and are included below. They are:

1. *Potential futures*: alternative futures in general, including those we cannot even begin to imagine;
2. *Possible futures*: all the kinds of futures we can possibly imagine;
3. *Plausible futures*: futures which could happen according to our current knowledge;
4. *Probable futures*: futures which are considered likely to happen;
5. *Preferable futures*: what we want to happen based on subjective value judgments.

FIGURE 1: FIVE TYPES OF FUTURES (VOROS 2003)



Judgment of what is possible, plausible, probable, or even preferable, will differ between people and over time. This is what makes discussions about scenarios so engaging and important. It is these discussions which can generate rich insights into the future, and inform decisions in the present.

Containing large elements of the unknown, thinking about the future can seem daunting. Having a framework helps to ensure that the scenarios are logical, relevant and credible. In addition to logic, scenario development also requires a degree of imagination and intuition. The framework developed for crafting the scenarios combines several approaches and a mix of inductive and deductive reasoning. The primary features are 'archetypal stories' and 'factors of change'. To build the scenarios out further, the framework also includes a geographical approach. It required the archetypal stories

¹ Voros, J., 2003. A generic foresight process framework. *Foresight*, 5 (3), 10 - 21.

and factors for each scenario to be considered through the lens of Australia's geographical and urban diversity. This is explained further below.

1.1 ARCHETYPAL STORIES ABOUT THE FUTURE

The framework drew upon archetypal stories to provide a starting point for four alternative futures. This approach helped to ensure that each narrative is diverse as well as internally consistent. Archetypes have been widely used and have a standard 'storyline'. The descriptions below of how these stories normally flow are adapted from AAS (2015) and Townsend (2014)².

Growth: Stories of this type are generally about continuation and growth of current trends. This includes growth in domains such as economics, science, technology and cultural complexity. Other factors that might grow or expand are population, the size of urban settlements or agricultural areas, or the amount of resources used. Growth could also be in terms of advancements in health or even democratic engagement. This scenario is about the (sometimes exponential) continuation of present trends and behaviours. Radical changes in behavior or resource usage would be considered under other scenarios.

Restraint: Stories of this type focus on encountering and responding to resource-based limits to growth. It typically involves exercising discipline to address undesirable outcomes - generally slowing growth to 'live within our means' whether this is environmentally focused or not. In addition to sustainability, restraint can also apply to taking collective responsibility for matters such as economic equity and poverty reduction. It is more than 'doing without' and could mean anticipating and preparing for future limits. Undesirable 'restraint', where the strong beliefs of one part of the population are imposed on or used to exclude other parts of society can turn into a collapse scenario. Scenarios involving fundamental changes to society's behaviour or values usually fall under 'transformation', although the boundaries aren't always clear.

Collapse: Stories of this type are about the loss of many valued aspects of society. It is a future where conditions deteriorate from present levels and critical systems can fail. A collapse scenario might emerge because good intentions didn't work out (for example, resource depletion while pursuing economic growth or resource protection leading to economic decline). Collapse might also result from direct destruction or from shocks and emergencies such as a severe global financial crisis or pandemic. The deciding factor in how bad a collapse scenario can get is whether society is prepared a society for the shock and whether it results in destroying a people's health and wellbeing.

Transformation: Stories of this type are about fundamental changes from the current state of society for the better (as opposed to undesirable changes which are considered under collapse). It is caused by a disruption to current patterns, values or behaviour, with the development of new ones. Transformations might also result from significant technological changes and/or major changes in culture, attitudes, policies, and practices. It can include growth. The difference from a typical growth scenario is that present trends are discontinued and growth emerges from a totally new regime based on innovation and new behaviour. Transformation occurs due to radical changes to core features of today's world.

1.2 LOCATIONS

Australia is a big place with significant differences between its urban, rural and remote communities in terms of transport options. Therefore, in addition to the archetypal stories, likely scenarios for different locations were considered. In the same way as with the archetypal stories, 'factors of change' were used to develop the narrative. The locations were:

- Major city (nationally important and/or a state capital – with differences between inner and outer suburbs)
- Large rural centre (a focal point of regional commerce, identity, and activity, urban centre population 25,000-99,999)

² AAS, 2015. Australia 2050: Structuring conversations about our future. Australian Academy of Science (AAS), Canberra; and Townsend, A., 2014. Re-programming mobility: The Digital Transformation of Transportation in the United States, Rudin Center for Transportation Policy & Management, New York University.

- Remote town and districts (significant distance from larger urban centres, less access to services than bigger centres, population of less than 5,000).

1.3 IDENTIFYING FACTORS OF CHANGE

In consultation with the National Transport Commission, a shortlist of ten factors of change was created. It isn't an exhaustive list. Rather, it was based on an assessment of what could be *most important* and *most influential* for the future of land transport in Australia. These were drawn from an analysis of the literature on emerging trends. The list included:

1. Automation
2. Shared mobility
3. Consumer demand for convenience and new services
4. Peer to peer economy
5. Data availability
6. Consumer trust
7. Pricing transparency
8. Demographic shifts
9. Energy availability and cost
10. Sustainability response

From this longer list of ten factors, we worked with stakeholders to create a shorter list of four priority 'factors of change'. They are outlined in Table 1 below. The four factors were chosen by participants during a workshop hosted by the National Transport Commission and facilitated by the Australian Futures Project. Recognising that the status would vary in each different scenario, a simple classification of either 'high', 'medium' or 'low' for each factor was also developed.

TABLE 1. FACTORS OF CHANGE

Factor of change	High	Low
Consumer demand for convenience and new services	Consumers place a high value on convenience and new services – everything is tailored to their needs and there are few barriers	Consumers place a higher value on stability of systems and familiar faces. Minimum user requirements are acceptable
Automation	Availability and uptake of automated transport options is high	Availability and uptake of automated transport options is low because of factors such as technology not reaching full capability or low user trust
Shared mobility	Willingness to share (rather than personally own) and availability of shared vehicles, public transport and other mobility devices is high. Indicators of this could be: <ul style="list-style-type: none"> • Data on the peer to peer economy. E.g. high level of peer to peer trading in private assets • Willingness to use and availability of mass transit services 	Willingness to share (rather than personally own) and availability of shared vehicles, public transport and other mobility devices is low. Indicators of this could be: <ul style="list-style-type: none"> • Data on the peer to peer economy. E.g. low level of peer to peer trading in private assets • Low use of mass transit services

Data availability and sharing	Private and/or aggregated data is highly available and shared between organisations (whether due to lax privacy rules or due to robust and highly trusted systems for data protection and sharing)	Private and aggregated data is difficult to access, held by organisations (whether due to strict privacy rules or other factors such as a loss of consumer trust resulting in a refusal to share valuable data)
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Table 2 shows the ‘setting’ that was chosen by stakeholders for each scenario. Using these factors of change, plus the chosen setting, descriptions for each scenario were developed in more detail. Potential indicators, consequences, behaviours, and values were also described. These descriptions were then further explored in a second workshop with stakeholders. The discussion and ideas this generated were incorporated into the final narratives.

TABLE 2. SETTINGS FOR EACH SCENARIO

Factor of change	GROWTH	RESTRAINT	COLLAPSE	TRANSFORMATION
Consumer demand for convenience and new services	High	Medium	Low	High
Automation	High	Medium	Low	High
Shared mobility	Low	Medium	Low	Extremely High
Data availability and sharing	High	Medium-to-Low	Not Available	High

Key points from each scenario have been captured in Figure 2 below. The full narratives are outlined in Section 2. Each narrative has been given a title to reflect the story line. They are:

1. Long live the free market (growth)
2. Slow and steady wins the race (restraint)
3. Going offline (collapse)
4. A new way of thinking (transformation)

FIGURE 2. HIGHLIGHTS FROM THE FOUR SCENARIOS

LONG LIVE THE FREE MARKET

- High consumer demand for new services and convenience
High levels of automation, privately owned, low sharing
Secure, interoperable data underpins functionality
- Congestion is high – but AV users don't really care
 - Vehicles are turned over more often
 - Fully automated rail is common
 - Regional renaissance near rail hubs and freeways
 - Fairness decreases for some as mobility costs and time rise

A NEW WAY OF THINKING

- Consumers want on-demand mobility, whenever needed
Shared automation the norm, private ownership low
Highly secure, linked data systems underpin everything
- Travel times reliable, and travel time reclaimed
 - Deaths and injuries almost unheard of
 - Fully automated rail for people and freight
 - Regional centres revive, knowledge economy
 - Cheap mobility available to all – focus of market

GOING OFFLINE

- High consumer demand for stability and familiarity
Little to no automation, privately owned, low sharing
Data systems unsecure, not trusted - disconnected
- Congestion is high and worst in urban areas
 - Older vehicles preferred – reliability over gadgets
 - Rail remains core of mass transit
 - Rural – agrarian economy centres grow
 - Fairness decreases as cost of mobility goes up

SLOW & STEADY WINS THE RACE

- Consumers want convenience and stability to be balanced
Automation in certain places, and sharing more common
Data systems have evolved, but not linked everywhere
- Congestion is high and worst in urban areas
 - Safety has improved, but drivers still needed
 - Rail more popular and driverless
 - Rural decline to larger centres
 - Fairness decreases as transport cost/time goes up

2 SCENARIO NARRATIVES

2.1 LONG LIVE THE FREE MARKET

In this scenario, there is a continuation of current trends, with an emphasis on strong economic growth, technological innovation and individualism. Consumer demand dominates and technology and businesses deliver. Changes in transport patterns and consumer habits result. Population growth continues in urban communities and large rural centres, while population decline continues in many remote towns. The amount of space and resources used for the transport task also grows. Overall, there is an increase in the number of vehicles on the road as well the growth of specialised services for commercial purposes. Many public transport services have been replaced by privately owned automated vehicles and consumers prefer it that way. While the uptake of automated transport is high, ride sharing uptake has been low. Meanwhile the market in personal information grows as data is seen as a tradeable commodity.

Automated and expensive

From the big cities to the regional centres, the streets are busy and the highways are crowded. The majority of people still privately own their own vehicles. These cars are highly automated and customised to meet individual needs. For most daily travel, including trips to school or work, commuters are transported in their tailor made cars, using the journey time to work, sleep, or eat, depending on whatever is convenient to them. All this automated luxury does not come cheaply. Owning a car is an expensive exercise. It isn't the running of the vehicle that costs a lot. The switch to electric vehicles has meant power comes cheap from home-generated solar sources. Rather, the biggest expense comes from the cost of vehicle sensors, software, and ongoing payments for security updates and new versions of the operating system.

Rail reliance

Despite the reliance on cars, rail is still important. In fact, services by rail have increased as a result of road congestion in the cities. Metro passenger rail remains the key means of commuting to work in the CBD. Automation has occurred on trains as well, with driverless rail systems now common. The problem of trains interacting with cars at level crossings is a thing of the past. Safe and reliable, rail is also a key method of transport between regional centres and capital cities. And it remains a reliable option for those who do not wish to use an automated vehicle, or who cannot afford one, such as students and those who are less well off.

Real time traffic management

The transport network is entirely connected. Navigation systems, smart phones, sensors and operating systems all communicate with each other constantly. Navigation software is part of every vehicle. They are linked in with traffic management systems that use real-time data analytics and algorithms to map and route both freight and passenger flows. This means that the journey to a destination can take a different route on any given day. It also means the idea of a designated 'highway' or transport corridor isn't what it once was. Every road can become a highway depending on how the traffic gets directed. There are some no-go zones that are excluded from this practice, but most are included in the search for faster ways to move. On arrival to the destination, car parking may still be required. The difference is that the car drops off the occupants and then parks itself. Vehicles are permitted to circle the block with no occupants until it is notified that a park has become available or return home to transport other members of the household. With the vehicle synced to an online calendar it knows when to return for passenger pick-up.

Data driven services

It is a society that embraces individualism, economic growth, and technological innovation. Data is seen as a tradeable commodity. It is also highly available because individuals are willing to disclose their personal information for the sake of personalised services. The concept of privacy is outdated, particularly for younger generations. There has been a surge in the number of companies who source and blend data for the purposes of personalising and value adding to transport services. Third party aggregators easily outnumber physical service providers.

Crowded roads and early starts

The economy is growing but worsening congestion is impacting on productivity. It is normal to leave in the early hours of the morning to try to avoid the worst of it and traffic 'spreads' to accommodate increased demand. Flexible work hours help with some employees in the knowledge economy able to start early and leave late or work in their vehicle. Some complete their work week in four days, or work at night time and catch a few hours of sleep during their early morning commute. Time of day charging adds an extra incentive to avoid the peak. The introduction of premium express lanes for those willing to pay extra has been popular. All of this has helped, but for some people it is still quicker to walk or ride their bike or small mobility device than travel by car.

Give me room

Given the investment required in owning a vehicle, some people have chosen to opt for alternatives, including car and ride sharing. This trend is highest in the inner suburbs where shared mobility services are available on-demand. Even then, car sharing is preferred over having to share a ride. Cubicles and individual pods are a growing trend. Few people have chosen to keep their non-automated vehicles. For the most part these old cars aren't a problem, except when something goes wrong. When a crash occurs, it usually involves a non-automated car. Automated vehicles very rarely crash into a pedestrian or another vehicle.

Unequal progress

Trade is booming and goods and services are in high demand. Jobs and growth are benefiting the majority, but fairness and equity are decreasing. In wealthier inner city areas, there are an abundance of transport services available 24 hours a day and people earn enough to be able to afford them - or they can walk, cycle or catch a train or taxi. They can buy transport plans that give them bundled unlimited services on a month by month basis. Unfortunately, not every area has this access. There are some suburbs on the outer fringe with lower income and less densely populated that have become increasingly transport disadvantaged. They don't have driverless trains, vehicles, or even on-demand mini buses. For those residents, their only option is to walk or cycle out to a better serviced suburb for the nearest rail connection. Regular buses don't operate anymore and timetables no longer exist. They have to hope an on-demand min-pod service is scheduled to be in that area to pick them up.

Non-essential 'discretionary' travel has become too expensive for some people. The days when government was a big player in providing road transport services are long passed. The private sector is the main provider of infrastructure and services for both public and private travel. Many local governments have had to step in with automated community transport. It has gone some way to helping address transport disadvantage for unemployed youth, a growing number of elderly, lower income and disabled members of society. Despite these efforts, transport disadvantage remains entrenched in some groups and locations.

Catching up in the outback

For rural and remote areas, the uptake of automation has occurred to the extent that physical and cyber infrastructure allows for it. The challenge has been that geo-mapping and road certification efforts have focused on more densely populated areas. The majority of roads in remote Australia remain unsealed. Low traffic volumes and accessibility has meant limits on private investment. There are also ongoing issues with internet connectivity. Where high-speed internet is available, automation and the 'internet of things' requires several terabytes (not gigabytes) in data allowance per

month. Where automation is available, it has proven to be a big advantage, with certain vehicle features helping to overcome road fatalities from speeding and fatigue.

The limited reach of automation isn't a reflection of a lack of interest. Uptake is likely to be rapid once infrastructure issues are resolved. There is hope that new models entering the market will have better unsealed and off-road capabilities. And mapping is now nearing completion due to citizen led efforts. The real benefits have been accruing to larger regional centres. Population growth is being triggered by a flight from congested cities as well as the lure of opportunities created by cyber capabilities and automation. More reliable driverless rail services between cities and large towns have also been a factor in regional growth. The pull is working in the other direction as well. People are not just moving from cities to these larger centres, but from other rural and remote areas as well.

Blurred lines

Convergence is occurring across a range of areas due to the pervasiveness of technology. Transport and retail are merging due to data-driven personalised online shopping experiences that are promoted to passengers. Targeted advertising features on the smart screens that are integrated into every vehicle, public and private. Travellers are not only a captive audience for retailers; they are further incentivised by travel discounts for in-vehicle purchases. Technology is leading while regulations lag behind. With the infiltration of data, the internet of things, and automation into every aspect of daily life, there has also been a blurring of the lines between corporations and people. It has become more difficult for insurance companies and enforcement to determine who is in control and therefore who or what to regulate.

Meanwhile, it is getting more difficult for government to respond to anti-competitive behaviour. Vertical integration in the provision of mobility has meant more of a focus on competition and corporation law. National standards are in place but they are loosely defined. Consumers and crowd based rating systems have a major influence on the success or otherwise of transport providers. Ratings reflect the risk, convenience and other service factors of the provider. Automated private and commercial vehicles self-report on many issues such as speed and weight so the compliance approach has shifted. Effort has moved from the roadside to the back office as fraud detection requires monitoring software and virtual communications. Many automated vehicles also report potentially illegal or dangerous behaviour they detect around them directly to the police.

Express delivery

Growth has occurred in the freight market as it has transformed into an end-to-end intermodal service. Despite developments such as 3D printing, high rates of goods consumption continue. This has meant increases in overall volumes and value - although consolidation has reduced the number of players. A small number of technology companies now dominate the industry. They own the supply chain from vehicle operating systems through to the diagnostics and even delivery systems. Small to medium enterprises need to focus on niche areas or work within the digital marketplace of larger operators on a for-hire basis.

Platoons of heavy automated vehicles haul freight on road, while high speed automated freight trains carry bulk and other goods on dedicated lines. Dedicated lanes on the highways and purpose built rail lines mean that time-critical freight can get across the country in record time. Automated freight vehicles usually have someone on board but their role is mainly customer service and systems monitoring. The typical 'truckie' is trained in ICT systems and customer service and manages all aspects of the consignment. Same day parcel deliveries are common, although a disproportionate amount of time is spent on the last mile, getting deliveries through traffic to the front door. This has increased delivery costs and affected timing. Most companies have opted for late night drop-off services and automated pick-up hubs for consumers. The story is similar for tradespeople, who have had to adjust as well. Working non-standard hours has become essential as consumers demand more 24/7 services.

Greg, 53, Financial Advisor, lives in the inner-suburbs

When I tell my kids that I used to catch a bus to school they look at me like I'm from another planet. "Why didn't your car take you?" they ask. The idea of waiting for a scheduled service or sharing the trip with other kids is so foreign to them they can't see how I might have actually enjoyed it - the banter, the homework sharing, and the companionship. You see, my kids are never lonely. They've got friendship via their smart phones any minute of the day. But they like to be alone. They'll share their data and details with anyone online, but not their personal space.

We are all pretty relaxed about online privacy these days – our data is just one piece amongst billions. I'm not sure what it is about sharing tangible goods and services that makes it different but it is. The kids will occasionally tolerate a lift from one of the buses with individualised pods to get themselves to sports training, but you'd think I'd asked them to donate a kidney the way they carry on.

I won't admit it out loud but there are some benefits to being constantly connected and online. I never need to go to the mall or grocery store anymore. It has given me much more time on weekends. Whatever I want – food, clothes, technology – is available at all hours and the recommendations that pop up on my smart screen are usually right on the money. It is all individualised to what I want, when I want. I try not to take it for granted but I have to admit I've gotten pretty spoiled with everything on demand and tailored to my every need.

The fact that delivery can be any time, day or night, also means no more trips to the post office to pick up parcels that I've missed. I kept one of those old paper parcel pick-up notices that used to get delivered to the mail box as a memento of the 'olden days' for when I have grandkids. I haven't seen one of those bits of paper for years. The best thing is when you get shopping discounts just for making purchases while you are in your vehicle. You just have to keep your eye out for the good offers amongst all the rest.

Things really have changed a lot over the last few years. With all we've seen, who knows where to next? What I can tell you is that now we have self-driving vehicles, I plan to make the most of it. I'll have my own automated vehicle chauffeuring me around until I'm 100.

2.2 SLOW AND STEADY WINS THE RACE

This scenario is similar to business as usual but with constrained growth. Government regulators and consumers have responded to limits in both infrastructure and automation as well as consumer concerns about automation and data availability. Additionally, automation technology has only recently reached the capability of fully driverless operations. To avoid growing congestion, government has implemented restrictions on the volume and use of all vehicles, both automated and non-automated. To manage the risks of having both automated and non-automated vehicles on the road, transition and road sharing rules have been implemented. Community transport provided by government and community organisations supplements commercial mobility-as-a-service providers for those with transport disadvantage. Citizens are also provided with a minimum travel budget to ensure greater equity. The public expects governments to protect them – including their private data. People are willing to do without all the advances of automation and data analytics in order to protect their privacy, ensure healthy competition, and maintain road safety. Tight budgets for the private and public sector remain a constraint on spending, and individual consumers and infrastructure owners seek to maximize the value of their time and assets.

Drivers required

The people who wrote dramatic predictions about the future of transport two decades ago must be wondering what world they've woken up to today. Despite all the forecasts, automation technology has only recently reached the capability of fully driverless operations, and is generally only available in specific locations. Crash avoidance and other driver's aids have been in place for a long time, but full automation is rare. It is largely limited to interstate highways, farms, factories, and scheduled bus and tram routes. Automation is also common for rail where trains operate on closed networks. Overall, non-automated vehicles still make up a large proportion of the fleet. There was a time when humanity looked to have opened Pandora's Box, but this definitely isn't a driverless world.

Calling for caution

With the technological capability in existence, it can seem strange that this is the path that was chosen. On reflection, the reasons are obvious. Most are due to consumer attitudes and values. Concerns about technology, automation and data security were responded to by government and a raft of new regulations have been introduced that helped put the brakes on the pace of change. Aiding this was the sheer amount of infrastructure needing to be upgraded and the presence of many older non-automated vehicles on the road. Budgets have been tight and spending has had to be targeted. Investment decisions need time for agreement to be reached on where to direct limited capital, and how to satisfy the many different stakeholders. It isn't that citizens aren't willing to pay taxes. With an ageing population, there are just not as many working aged people to be taxed. The result is that new infrastructure investment has been limited, except for high capacity passenger rail.

Road works

When the first automated vehicles arrived on the market, people were very uncomfortable about the thought of letting go of control. There were also hotspots of chaos, especially in inner urban areas. It took a few crashes and law suits before new road sharing rules were introduced. Early teething problems added to a sense that incremental change was wiser than radical reform. There were also uncertainties around the timeframe in which technological development would occur. A way for automated and non-automated vehicles to co-exist now seems to have been found. Traffic congestion has improved. Voter support remains strong for restrictions that have helped this to occur, such as limiting the volume and use of single occupancy vehicles on major transport arteries. Consumers have also proven willing to pay for access to premium services and lanes that minimise their travel time.

Locational differences

The highest rates of adoption have been in inner city areas. Some people had expected outer suburbs and rural areas to adopt automation more quickly than the inner city areas. The logic was that these areas had advantages such as less traffic to navigate and bigger distances to travel. Fatigue avoidance would also have been a big benefit. The problem was that not everyone could afford their own automated vehicle and the upgrading of roads to a high enough quality came at a cost. It resulted in a slower uptake outside the city centre.

With limits to geo-mapping and many roads not suitable for automation, locational differences still persist, particularly in rural and remote areas. Measures are being taken to improve transport access in a range of locations and this is largely supporter by voters. It is consistent with a widely shared belief in the importance of fairness and equity. Transport is seen a right and expected to be affordable for all, even if this means paying taxes and providing subsidies.

In urban areas, public transport has also been partly automated, the use of which has remained high. There are still first and last mile challenges but public transport remains the backbone of the transport system and is largely provided by government.

Parcel pick-up

Predictions of drones delivering parcels to the front door have not eventuated. Freight delivery has not been automated. Instead, there are a growing number of distribution centres and hubs for customer convenience. Freight vehicles are automated to a moderate degree, although functions are limited and restricted to highways. All freight modes have seen increases in the volume of tonnage moved, and interstate routes are frequently at capacity at certain points. Integrated, intermodal freight services and companies have become more common.

All aboard

There has been a move towards greater sharing of vehicles and rides. It hasn't been a huge shift but significant enough to create a whole new market within the transport sector. This is particularly the case in the inner suburbs and the city where car sharing is quick and easy to access. For those city dwellers it is the new normal. In the outer suburbs and rural areas, consumers have been much slower to adopt shared mobility services, even if it could save them money.

Most people still much prefer car ownership over services provided by someone else, but uptake is growing. The preference is for low multiple occupancy ride sharing, particularly for the work commute. Some government and businesses are leading by example with the use of ridesharing and car sharing services. Accompanying this trend has been a medium uptake of peer-to-peer trading of assets, building off a low base.

For some families, shared services have replaced the need for a second car, but many rural and outer urban families still own multiple vehicles. The services just aren't as abundant or and as easy to access. Informal non-commercial sharing of transport in regional and rural areas has always been relatively strong and remains so. And driver's newer vehicles with safer technology are starting to help prevent most avoidable crashes and reduce fatalities and serious injuries.

Keeping secure

There has been a rapid evolution of data security measures. Government responded quickly to citizen concerns about data security with the introduction of strict privacy laws. Attention has also been paid to key elements like interoperability and stability. The laws allow for some sharing of private individual and aggregated data, but place limitations on what can be transferred between organisations. There are experts who will assert this has created a trade-off, delaying advances in automation and data analytics. However, public polling shows that most votes prefer data security over embracing all the inventions coming out of Silicon Valley.

Safety first

There are very strong national standards on transport safety. The importance of corporate and competition rules has also increased. As consolidation across the transport supply chain occurred, forward thinking regulators created new rules to stop anti-competitiveness and protect consumer rights. This has included regulating new entrants into the transport market such as technology companies. Liability for any inadvertent consequences of using automated technology was complicated, but has now been resolved. Uptake of automation is improving safety outcomes. Greater certainty around standards and regulations is also encouraging investment and making it easier for local start-ups to get a foothold in the mobility services space.

Megan, 28, Founder of the Community Transport Action Group, lives in the outer suburbs

Looking back on the past three years, I'm really proud of what we've achieved with our community action group. When we started, our area only got limited attention from government and little in the way of funding. As an outer ring suburb, we were easy to ignore. The roads here weren't good enough for automated vehicles and community transport was infrequent and unfrequented. While the minimum travel budget has been a great help for many people, there were still black spots in terms of infrastructure and access out here.

Since we began our campaign, we've been able to introduce daily automated travel services for the community. The mini-buses are new models with comfortable seating and plenty of room for people with wheelchairs and prams. It has scheduled departure times but the route changes depending on where people need to go. They just book in advance using a simple phone app and the most mutually beneficial path for all commuters gets mapped. It is a great complement to the mainstream public transport services and provides a connection to the railway stations as well as shopping malls and doctors. We can even help people get to the post office to pick up their parcels.

It was a big effort initially, with a lot of fundraising required. The bus was leased with money donated entirely from everyday citizens. Given how well we are doing, government has started granting us additional funds to keep the service going. Who knows? Maybe we could even form a social enterprise eventually! Our other big initiative was to start documenting poor road conditions and posting photos on our website. It really put a spotlight on the need for better roads and led to a total upgrade of several streets by the local council. These roads are now of a standard that suits automation but also makes the journey much smoother for all forms of travel.

Our next project will be to educate citizens on the importance of cyber security. Government has done a great job limiting cybercrime but there are always those that are vulnerable to scams and hacks. Our target is the growing population of 60-80 year olds. They spend a lot of time online communicating with their families and friends but don't have much idea how to protect themselves from modern cyber-criminals. We have already created 15 minute seminars that can be taught while people are travelling on our bus.

2.3 GOING OFFLINE

In this scenario, the promise of tomorrow's technology solving our problems has not eventuated. Disappointment has followed. Over time, consumer confidence in technology has been lost, with adverse events eroding the features of privacy, safety and security required for a transformation of the transport system. Cyberterrorism and cybercrime has destroyed trust in data and consumers are refusing to purchase location-specific services or equipment (or turning off the 'smart' features of their phones and cars). The driverless function in automated vehicles never reached adoption. Governments are under pressure to prohibit the technology around the world. Jobs losses due to automation have resulted in community and political reluctance to adopt new business models that might see further unemployment. Australian industries have experienced shocks to their supply chains due to the redundancy of many internet based systems, which are now seen as insecure. Data sharing is limited. The cyber-infrastructure required for intelligent transport systems has not eventuated. Personalised on-demand services and smart apps are a thing of the past. There has been a resurgence in local industries as people relearn the skills and occupations of the past.

Faith lost

Rural and remote communities were certain they would get better transport services and access. There was a widespread belief that 'tomorrow's technology' would solve all society's ills. Transport problems would be solved and the tyranny of distance would be overcome. Fuelling this were commitments to relocate jobs and statements that prosperity would finally return. The failure of this eventuality undermined faith in promises as well as in the people making them. A spate of high profile incidents eroded it further. Vehicle crashes revealed flaws in product safety standards for many new services and technologies. Wide scale product recalls and legal battles ensued. The worst were the attacks by cybercriminals. Though few in number and isolated, they could reach in to people's homes and vehicles with anonymity and were reported widely in the media. Freight shipments and public transport were also targeted. It became apparent that operating systems were not secure. Nervousness about the safety of transport grew. Highly publicised breaches of privacy didn't help. High expectations led to deep disappointment. The backlash was significant and Australia was not alone. Trust in technology fell internationally.

Switching off

Faith in the future was lost. Eventually individuals took matters into their own hands. All over the country, people soon started turning off the 'smart' features of their phones, cars, and household devices. They began limiting their use of the internet wherever personal information was involved. With the perception that no organisation could provide online security, they began to protect themselves by switching offline. The internet is still in use, but not for sensitive purposes like banking. Connectivity has been scaled right back.

While automation in vehicles never quite reached the stage of driverless function, governments are under massive pressure to prohibit any further introduction of the technology in the future. In the outer suburbs and rural and regional areas, almost every driveway features an old petrol model vehicle. There are a few electric vehicles in the mix too, with fuel price volatility making them popular. The common feature for both is that neither has any connection to the internet. In the inner city, people are still nervous about being in large numbers in constrained spaces and there is only the one driverless train on a closed, dedicated, metro rail line. Footpaths and roadsides are as busy as ever, as people return to walking and cycling to get around.

Informal economies

Fairness has decreased as disparities in income and access to services grow. What were once well serviced areas have lost mobility access. The burden on families for caring for their young and elderly has also grown. Barter systems and volunteering have re-emerged between friends and within communities as behaviours evolve to fill the gaps that technology left behind. Informal arrangements and hitchhiking still occur, particularly in rural areas, but the concept of ride sharing never really took hold. Lack of trust in the wider system led to lack of trust in each other too. The willingness

to share, rather than personally own, vehicles and other mobility devices is unsurprisingly low. Distrust of outsiders and tribalism has become more dominant. People are looking to who and what they know to create stability and security.

In the eye of the beholder

Automation, whether in a car or a factory, has been conflated in people's minds as the thing that destroys jobs and takes over lives. Consumers don't want innovation. They prefer certainty and stability over convenience and new services. Voter angst has led to political reluctance to promote new technology or business models that could disrupt current employment patterns. Changes to the job market will likely arise regardless. Structural adjustment is occurring as Australian industries recover from the shocks to their supply chains and the redundancy of the many systems that relied on secure internet connectivity. People have had to relearn skills they relied upon in ages past as personalised on-demand services and smart apps are phased out. Uncertainty on this magnitude has played out in the private sector in the form of less investment in research and development, plus a greater focus on cost cutting and narrowing of core markets.

In truth, safety records and road tolls haven't changed much at all. But it is a question of perception as much as reality. Transformation of the transport system would require trust in the privacy, safety and security of the network – both physical and virtual. The quality of road and rail would need to be maintained at a higher standard. The investment in the cyber-infrastructure required for an intelligent transport system would be significant. Instantaneous sharing of massive volumes of data would be needed. In a society where technology is often seen as the enemy, it is hard to imagine these conditions arising anytime soon.

Falling revenues

The ramifications for government, particularly budgets, are significant. Automated user charging technology no longer works. At the same time, the cost of transport is rising rapidly. Income isn't being reported and internet based tax monitoring systems no longer work. The informal economy is also undercutting a significant proportion of government income. People are upset because they don't understand why travel has become so expensive. The size of the overall fleet is expanding so at least some revenue is coming from a growing number of driver's licence, vehicle registration, and parking fees. This is undercut slightly by the use of small, low energy, two wheel vehicles to evade charges. They are a new source of congestion. Budget constraints have meant that it is impossible to keep every sealed road maintained. Voters are seeing the decline around them and the call for government to do something grows louder. This is despite the fact that citizen trust in both public and private sector organisations to deliver transport services and infrastructure remains low.

A silver lining

It is not all bad news. While some things have declined, not everything is going backwards. New jobs are arising as more staff are required for secure paper based tasks like record keeping, warehousing, and postage services. Many roles have experienced a revival. Jobs in freight are growing due to a surge in deliveries based on a preference for physical rather than virtual goods and experiences. Archivists and librarians are back in vogue as the move away from 'cloud' based storage services continues. New opportunities are emerging as handmade, antique and local items become more highly regarded. Cottage industries using old skills are flourishing. Older drivers have found employment mentoring and teaching driving and mechanical skills in 'manual' cars. There is a yearning for 'authentic' experiences in the form of local music, art, markets, and storytelling. Face-to-face communication is experiencing a revival, competing with the globalised, 24/7 news and entertainment cycle. The current shift goes deeper than economics, travel, or daily decision making. Ideological and political changes are afoot as society evolves to its changing circumstances.

The sheep is back

Ironically, the promise of a rural renewal is also coming about, albeit in a very different way than was originally envisaged. Australia's role in food and fibre production is producing an economic boom that will likely offset much of the damage to the ICT and services sectors. In the short-term, the transition is complex as it requires the retraining and relocation of workers back to rural and regional areas and a rethink of investment in road and rail freight routes. For now, there remains a mismatch between where people live and where the jobs are. This is playing out in the outer-suburbs every day, where rising congestion is having the greatest impact on the long commute to city based jobs. Rail has remained functional and provides relatively reliable, cost effective transport, but many people are in areas without access to this option. Progress is coming but it is not always linear.

Douglas, 76, Pensioner/ Carpentry Instructor, lives in a small rural town

There were a few years there where things got really tough. Government was almost bankrupt and pension payments were put on hold for months at a time. It wasn't until my grandson asked me to teach him how to be a carpenter that I realised I might have a chance to make things better. His Dad never learnt the practical stuff but I've been handy with a hammer ever since I was young.

It started with just him but word got out to his friends. They started arriving at my door, not just from the local community but from nearby towns. A few began turning up on foot from the railway centre after making the journey by train. Others arrived in their noisy old model clunkers or even hitched a ride here. They wanted me to teach them to do woodwork as well.

Soon, I had lessons scheduled most days of the week. The kids learn quick so they only require a couple, but they like coming back once they've got the hang of it to learn about some of the finer techniques. They are all setting up businesses creating craft, household furnishings and even wooden toys. I've had to bring my buddy Ron on as my assistant. He was a builder before he retired so he's much better at answering the really technical questions and building the larger scale stuff.

It is great to get paid – all off the books of course - but the companionship has been good too. It is nice to be able to recognise some of the young folk in the neighbourhood by name. It's like the old days when you knew who you lived next door to. It feels like there is more of a community coming alive again with all the local food, art and craft markets being held so often. The work won't last forever but it came at just the right time. Without it I wouldn't have been able to pay the bills.

2.4 A NEW WAY OF THINKING

In this scenario, fundamental changes have occurred that have changed society for the better. Current patterns of high consumption have been replaced by a move to a more sustainable and collaborative economy. Technological innovations have significantly improved quality of life and are seen as for the greater good. Travel time has been reclaimed as productive time and the tyranny of distance is overcome for many Australian communities. Major shifts in culture and attitudes have occurred. Public good is defined differently and there is an obligation for everyone to contribute to the public good, including private companies. De-personalised data is freely exchanged as part of an open source knowledge economy, where value is created through the provision of services. Opportunities are endless as rural Australia is reconnected with urban areas and people can choose where they want to live based on the lifestyle they value. Automation has created new efficiencies where reclaimed time is put towards helping others and making the world a better place. The knowledge economy has created abundant opportunities for everyone. Socioeconomic equality is at an all-time high and the resource intensity of transport has reduced significantly, putting Australia on a path to ecologically sustainable growth.

A new direction

Looking out over the orderly freeway today, breathing in the clean air and quiet, it can be easy to forget that this was once the place of traffic jams and air pollution. With the smooth flow of electric vehicles, dedicated e-bike and freight lanes, and the almost empty on-ramps, it might be hard to imagine how many fundamental changes had to occur for society to arrive at this point. A new vision was required, not just for transport but for technology, the economy, and the environment. It took conscious effort. It wasn't that this was necessarily a coordinated movement. In many ways it happened spontaneously. Good intentions and technological capabilities collided, leading to changes arising in many far flung places simultaneously. Transformation was being catalysed from both the bottom up and the top down.

Everyone shares

Full automation and driverless capability for both road and rail was achieved early and reliably. Clean, safe, convenient and cheap public transit and on-demand shared transport services are the backbone of the urban transport system. They are even common in regional towns. Technological innovations have significantly improved quality of life. This is demonstrated most strongly in the reclaiming of travel time as productive time due to the widespread uptake of automated transport options. Not having to drive means so much else can be achieved while commuting. It has also meant workers now spend fewer hours in the office. They've been freed to spend more time at home, on hobbies, volunteering, and with family and friends. There has been a renewed collective energy for helping others and making the world a better place.

Distance conquered

Shared services and automation are present but less common in remote areas due to the challenges of distance, unsealed roads, and off-road driving. Vehicle sharing occurs to some degree but most residents of remote areas still require their own vehicle. Automation has still created benefits, removing many physically demanding tasks in industries such as agriculture. And the capability to navigate dirt roads is improving. Long distance travel has also unlocked opportunities as it has become easier. The tyranny of distance, so distinctively part of the Australian psyche, has been largely overcome. Specially modified vehicles and trains that are essentially a high-speed hotel on wheels make long distance trips quick and painless. Opportunities are endless as rural Australia is reconnected with urban areas and people can choose where they want to live based on the lifestyle they value. Some rural and remote communities have benefited from the arrival of technology companies keen to pilot new automation features in low traffic areas.

Collaborative consumption

The move to shared mobility was part of a major cultural shift towards a more sustainable and collaborative economy. Over time, new behaviours replaced old patterns of consumption. Consumers now prefer to buy experiences rather than products. There have also been changing attitudes around the ownership of vehicles. The idea of owning your own car is outdated. Transport has been reconceived as a service rather than a means of establishing identity. Consumers value access. This has meant that the willingness to share vehicles or other mobility devices is extremely high. Transport service providers also choose not to invest their capital into ownership. Vehicles are all leased and 'turned over' quickly via a small number of vehicle fleet operators. While vehicles are replaced more often, the total number on the road has decreased substantially, and cradle-to-cradle recycling and modular design has reduced the environmental and physical cost of manufacturing. Vehicle occupancy rates are higher than they once were. At the same time, the resource intensity of transport has reduced, as has associated greenhouse gas emissions. This has put Australia on a path to ecologically sustainable growth.

Virtual commons

The willingness to share has been extended to the virtual world. An open-source information management model now underpins the knowledge economy. De-personalised private and aggregated data is freely exchanged between individuals and organisations. This doesn't mean that there aren't jobs or revenue being created. Consumer demand for convenience and new services remains high. The difference is that value is created through meeting this need rather than the protection of intellectual property and the commodification of personal information. Innovation and disruption are welcomed and expected, with the recognition that the new knowledge economy has created abundant opportunities for everyone. Instead of experiencing job losses, the transport sector has become an even larger employer, with associated services a much larger part of the overall economy.

Package deals

Mobility is bought as an integrated service like a phone and data package. For the urban transport network, the distinction between modes of travel has decreased. Buses, trams, maxi-taxis and scheduled road public transport services have all merged into small-to-mid-sized pods. Larger pods still have a human conductor to greet guests and ensure they have an enjoyable journey. Consumers pay for bundled services, quality, and the speed of the journey. There are many ways to purchase these options - from per trip usage payments through to subscription services and monthly billing options. Pricing is transparent. Timetables have been replaced by real-time information apps and on-demand services. Taking cues from the traditional approach of the airlines, passenger movements are managed in real time through sophisticated booking systems.

Beyond the suburbs

In rural areas, the modes on offer are more distinct and not as frequent, but there has been a huge improvement in levels of mobility services compared to decades past. Rail has had a renaissance, particularly in rural and remote areas. The restored rail network has reconnected towns all across the country. Automation has enabled passenger and commercial services that are reliable, affordable and in high demand. Community transport has become automated, helping patients to access health services in distant centres. Domestic tourism has increased as people are willing to travel further inland. Harking back to the past, 'self-drive tourism' has also become popular, with visitors enjoying the opportunity to drive an old manual vehicle on designated off-road areas. Jobs have also grown due to the knowledge economy, for which distance is no barrier.

Protecting the greater good

The public good is now defined differently. Experience has shown that protecting environmental and social capital also delivers financial capital. There is an obligation and expectation that everyone will contribute to the public good, including private companies. Not everyone is on board with this, but crowd based ratings systems quickly regulate any errant

behaviour. Regulators spend a greater proportion of their time playing the role of facilitator and educator for new operators. Australian-specific standards are aligned with international frameworks with limited reworking. They ensure travel remains safe and reliable. With crash avoidance technology, road accidents are rare and fatalities are very low. Road trauma from speed and fatigue has been almost eliminated. With automation, vehicles have been pre-programmed to obey road rules. Breaches are rare and are self-reported by the vehicle. This has meant that much of the police force that was assigned to road safety has been reallocated to other important tasks such as cyber security. With transport systems so efficient, and the private sector delivering most services, the cost of providing transport and the need for government to subsidise it has reduced significantly. This revenue has been redirected to address inequities in mobility access to meet community service obligations and improve infrastructure.

Changing streetscapes

Urban form has changed dramatically. Huge pockets of unused land arose when most forms of car parking no longer became required. This space was reclaimed for greenspace and community gardens, performance spaces for local entertainment and housing. In the suburbs, space once dedicated to garages and driveways has been rezoned. Infilling has occurred to some degree. More greenspace has also resulted from urban consolidation. Less on-street parking has meant streets could be redesigned and managed more for people and less for vehicles, with greater communal space and dedicated cycling lanes. Social cohesion and capital has been increasing in tandem with the reclaimed space.

Vacant real estate left by the closure of many fuel stations have been taken over for other uses. Technology companies and 3D printing specialists are not just limited to the large cities. Their presence is felt in regional centres as well, allowing immediate filling of orders for spare-parts and other printable products. Smaller warehouses and distribution hubs have also cropped up along freight corridors as platooning pods are re-routed for maximum efficiency of the network. There is now the infrastructure for fully driverless high speed rail and road freight that operates like a continuous conveyer belt across multiple vehicle types. This is facilitated by interoperable data exchange and advanced analytics. The driver is now the brand ambassador and in charge of consignment security. Supply chains are vertically integrated. There is less inventory in storage and more 'just in time' deliveries and on-site 3D printing which lead to less double travel and double handling due to better systems and consolidation.

A fairer world

Socioeconomic equality is at an all-time high. Those that were previously unable to access transport services are no longer as disadvantaged. The young, elderly and people with disabilities that were previously unable to travel now have the world at their fingertips. And when they stay home and require products or assistance to be delivered, automation has significantly reduced the cost. Economic, environmental and social transformation has gone hand in hand.

Beth, 34, Distribution Centre Manager, lives in a large regional centre

When I was asked as a child what I wanted to be when I grow up, it wasn't a distribution centre manager. I didn't even know that type of role existed. But you know what? It has turned out to be my dream job. I have a Master's degree in Cyber Science and I need to call on what I've learnt every single day. Each package that passes through this centre is tracked from pick-up to delivery. The route it takes is guaranteed to be the most efficient path possible based on the data collected at that moment in time.

I'm in charge of a team of data specialists who crunch the numbers, as well as a fleet of artificially intelligent bots who move and store everything and anything in the warehouse. Both have a quirky sense of humour but they get the job done. My consignment specialists travel with the automated freight pods during the journey; trouble shooting any issues and providing a concierge service for my customers. The finance team deals with all manner of payment whether in old currency or new block chain protocols, and also manage subscriptions for companies who use our service regularly.

I dabble in external communications but I also have an online media and public relations specialist to lead that work. My overall responsibility is to make sure that all the operating systems, sensors, and smart apps are integrated and talking to each other. I monitor cyber security and the data analytics on our performance. I am always looking for

system improvements, whether it be for cross-country delivery times, better customer service or ways to reduce environmental impacts. We've got a whole unit dedicated to returning recyclable materials back to the manufacturers. We work six hour shifts and also spend time volunteering at the local community centre. My team is the fastest, smartest crew on the block, and we regularly outperform the competition in terms of speed, cost, and style.