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TRANSPORT TECHNOLOGY SECTOR

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Contents

1. Introduction

Transport for NSW (**TfNSW**) is committed to embracing the use of technology, smart analytics and innovation to create new solutions that improve transport services and networks, and enhance customer experience. In doing so, it recognises the importance of working in partnerships across Government, with communities and the private sector.

As the lead NSW Government agency responsible for the planning, development and delivery of passenger and freight transport across NSW, TfNSW has prepared this submission, with input from the Department of Customer Service, taking into consideration NSW policies for Artificial Intelligence and its ethical use, and the NSW Data Strategy.

TfNSW has relayed its commitment in driving innovation within the transport technology sector, most recently through its new *Future Transport Technology Roadmap 2021 - 2024* (the **Roadmap**) released on 30 March 2021, which sets out the research, development and delivery program for transport technology priorities and transport customers over the next three years.

The Roadmap is TfNSW's ambitious, portfolio-wide strategy for customer-facing technologies to deliver customer-centric and more efficient passenger and freight movement. It demonstrates TfNSW's strong track record of the successful delivery of technology projects and identifies how technology, when used in the transport sector and delivered in collaboration with local and international partnerships, can create better opportunities, enhance customer experience and unlock economic opportunity.

The Roadmap highlights six priority programs that TfNSW will deliver upon its ambitious strategy, including:

- leveraging Mobility as Service to deliver seamless and personalised journeys across all modes, including through real time public transport journey information and improvements to first and last mile transport services;
- NSW being a world-leading adopter of connected and automated vehicles (**CAVs**);
- rapid transition to zero emissions buses (**ZEBs**) and electric vehicles (**EVs**) to help NSW to reach net zero emissions by 2050;
- technology to transform mobility in regional NSW;
- more efficient freight through technology;
- using sensors and intelligent systems to create smart transport networks, including in relation to access and safety.

TfNSW's six priority programs are complemented by a strong research and development program to identify customer and community needs, co-design solutions, and create trials and proofs of concepts that provide valuable insights, which also inform further scaling of wider solutions.

Attributable to TfNSW's success in leading the development and delivery of programs are its partnerships with businesses of all scales – from start-ups to multinationals, councils, communities and research partners. As part of this, TfNSW works with many local partners to develop solutions and enable skill, job and business development opportunities in metropolitan and regional NSW.

NSW is delivering a $72 billion services and infrastructure program over the next four years in Australia's largest infrastructure pipeline, with more than 120 major projects underway. In line with the NSW State Infrastructure Strategy and Smart Infrastructure Policy, TfNSW is embedding technology and data-driven solutions, like sensors, Intelligent Transport Systems, real-time data analytics and smart motorways, in all new and upgraded infrastructure to improve community outcomes and provide the best return on infrastructure investments.

In light of this progress, it is also important that, as technology develops and service models evolve, policy and legislation remain fit for purpose, outcomes and safety focused, technology-neutral and responsive to customer needs. To this end, TfNSW is continuing to review and update regulatory and policy frameworks that govern the transport technology sector to create the best environment to facilitate growth and innovation for the future of transport.

For the emergence of some technology, adjustments to policy and regulation will be required to ensure policy outcomes, such as the increased use of open and shared data across governments, necessary to facilitate new innovations may be achieved. TfNSW will work closely with stakeholders and other jurisdictions, where required, to ensure that legislative frameworks are fit for purpose. Using the emergence of CAV technologies as an example, TfNSW is already collaborating with other states and national organisations on CAV trials and the development of a national regulatory framework to support the introduction of CAVs onto Australian roads.

TfNSW has a bold vision for utilising research and development to deliver transport service innovations in the transport technology sector. Its current plans and next steps are outlined in this submission, including information on important local partnerships that are delivering local transport and economic benefits and leveraging Australian talent and expertise.

2. Mobility as a Service (MaaS)

MaaS is an integrated digital solution that provides multiple mobility services from different operators, such as public transport, point to point transport and other privately operated mobility services, on a single platform which empowers customers to plan, book and pay for these services through the platform with convenience.

MaaS enables customers to experience seamless and connected choices for how they travel across multi-modal end-to-end journeys. MaaS offers personalised notifications and travel alerts so customers can tailor information to suit their needs and be advised of travel disruptions that will affect their journey. MaaS also offers customers a choice of connected payment systems to best suit their needs.

In recognition of these benefits, TfNSW is expanding its MaaS platform by developing Opal Connect as the single payment account for travel on all modes of transport, expanding digital ticketing to regional areas and other frictionless forms of payment across NSW, and establishing more partnerships with on-demand and rideshare mobility service providers to increase customer choice. This commitment by TfNSW is also set out in its Roadmap.

Transforming customer experience through MaaS

TfNSW is focussed on delivering world-leading MaaS choices through enabling technology. As a key provider of transport services across the NSW community, TfNSW has made great strides in developing a MaaS platform to better support its customers. Currently, TfNSW provides an award winning Opal Connect platform which offers trip planning, booking and payment options to customers for end-to-end journeys on a range of modes of public and privately operated transport.

Opal Connect helps customers link trips involving public transport, rideshare, taxis and other modes together on a single platform. It also allows commuters to use Opal Connect in commuter carparks, which enables commuters to park at participating Park&Ride commuter car parks and either park for free when connecting to public transport such as trains, buses and ferries, or to pay for parking through the Opal platform. The Park&Ride program helps commuters link conveniently by car to public transport rather than having to drive for the whole of their journey, and makes more parking spaces available for their use.

The Opal Connect platform also extends the convenience of Opal fares to the new On Demand transport service, which is a flexible and demand responsive public transport service, designed to improve connections to transport hubs and other popular destinations, like shopping centres or hospitals. On Demand services can pick customers up from home or an easily accessible location, and take them where they need to go. On Demand transport offers the convenience of point to point services like taxis and rideshare, with shared rides with other customers helping to keep the fares lower, while providing another mode of transport for the customer to access. The On Demand service links with Opal Connect to offer travel credits in order to reward customers who transfer to other public transport services, such as trains, buses or ferries.

In offering commuters more options to connect journeys and in recognition of its innovative approach to journey management, the Opal Connect platform won iTnews' 2020 Benchmark Awards for Best Mass Market Project and Best Australian IT Project.

The Ponds On Demand service operated by Busways using Via technology

As part of its service offering, TfNSW also provides transportnsw.info and Opal Travel app customer information capability, which use sophisticated algorithms to offer personalised information and bookings, across a range of modes. This includes trip planning for taxis, rideshare, walking and more direct, moderate and easier routes for cycling, to help customers make informed choices.

For example, TfNSW's automated shuttle service trial in Armidale integrated its service information onto the transportnsw.info trip planner, while the Busbot On Demand automated shuttle, which is currently being trialled in Coffs Harbour, integrated its bookings with the local service operator.

TfNSW has also integrated with Uber to launch an Uber and Transit feature so customers can select the best combination of UberX rideshare and public transport to reach their destination. Sydney was among the first cities in the world to launch this integration, alongside Chicago, enabling the sharing of real-time public transport data with Uber's services to provide better first-and last-mile connections to public transport.

TfNSW is now also trialling use of the Opal digital card to help customers gain credit on their Opal account when they transfer to public transport from Uber rideshare, Ingogo taxi or a Lime bike service. The Opal digital card is a mobile version of the adult Opal card, conveniently stored in the digital wallet of a customer's phones. It allows customers to simply tap on and tap off with their mobile device to pay for public transport, similar to using a contactless-enabled phone or watch.

From the middle of 2021, up to 10,000 Opal digital card users will be able to pay for an Uber, a fixed fare Ingogo taxi trip or a Lime bike journey using their Opal card. If they subsequently take public transport within 60 minutes, they will also receive a credit of up to $3 on their Opal account as a reward for connecting to public transport for part of their journey. Passengers on the My Fast Ferry service from Manly will also save 10 per cent on their ferry fare during peak times and 25 per cent when travelling off peak when paying using the Opal digital card.

Maas platforms, like Opal Connect, rely upon data from existing and new forms of transport. TfNSW's Open Data MaaS Data Specification enables sharing of planned and real-time service information between transport providers and TfNSW for a range of services to enable the operation of Opal products and MaaS to customers. For example, TfNSW's Car Park API data interface shares data on real-time car park occupancy for a growing number of Opal Park&Ride and Sydney Metro commuter car parks with app developers, enabling developers to develop products which provide up to date information to customers through a mobile phone.

TfNSW also helps public transport customers who drive to their station or bus stop by sharing real time car park availability data for Park&Ride commuter car parks, so users can see the approximate number of available spaces and predicted occupancy patterns based on historical data.

Local research and development partnerships

Partnerships are critical in delivering a comprehensive MaaS offering, which relies on the integration of a full range of public and privately operated mobility services, in order to provide customers with a platform on which multiple journey services and payment methods are available. In light of this, TfNSW is focussing on building upon more MaaS partnerships with providers of mobility services, affiliated car parking and bike storage services, payment system providers and data users like apps developers. These partnerships also provide local opportunities with skills, jobs and business development opportunities contributing to NSW's current and future economic activity.

TfNSW already has a large number of these partnerships in action. In 2018, TfNSW launched its Research Hub to foster collaboration and information sharing with the tertiary sector, industry and other government agencies.

Through the Research Hub, TfNSW structures engagement with the research sector on how the sector can assist with current transport challenges and opportunities, as well as support development of local skills. Recent research projects include an examination of MaaS business models and emerging business models in the digital economy.

Specifically, the research on MaaS business models was fostered through a collaboration between TfNSW, the iMove Cooperative Research Centre and the University of South Australia, which examined expected MaaS outcomes under different policy and regulatory scenarios. It also examined commercial opportunities in the public and private sector and recommended pragmatic actions for TfNSW to better enable and regulate MaaS.

To further stimulate successful local partnerships, TfNSW holds regular innovation challenges to rapidly deliver solutions with developers, and has established open data sharing standards. Innovation challenges are centred around specific business needs or problem areas that TfNSW seeks to improve, as well as considering where open data can be shared with developers to design and deliver products and solutions that improve a customer's transport experience.

The MaaS Innovation Challenge in 2019 enabled individuals, start-ups, scale ups and more major vendors to develop innovative customer solutions, and for TfNSW to work closely with them to explore a range of potential solutions at little cost. This challenge provided TfNSW with valuable insights related to customer behaviour, mobility service options and other matters. Importantly, these insights reinforced the value of a MaaS solution built on TfNSW's growing core of integrated mobility services, customer information and Opal payment platforms.

Additionally, TfNSW is working on trialling a number of partnerships with local councils to expand and improve its understanding of the use of kerb space by different modes, including

for parking, car sharing, and for bus, taxi and loading zones. Most journeys start and end at a kerb, and there is increasing competition for access to this space. These partnerships with local councils and TfNSW will enable both parties to share data on kerb usage to better understand who uses the kerb and which usage should be prioritised. It also enables TfNSW to consider future usage of kerbsides so they may be managed more dynamically to adjust for changes in demand. This responsive, demand driven approach would also support the most efficient use of kerbside space when it is needed.

3. Real time public transport journey management

Real time information is critical to ensuring that customers are able to plan and use public transport more efficiently. Disruptions, service interruptions, COVID-safe travel and points of congestion can all be better managed through real time information, which provides customers with more personalised and relevant information to their preferred or regular service.

In light of this, TfNSW is enabling a real-time view of transport and mobility services. With growing availability of real time, and near to real time, data, customers have more options to personalise their journeys, and to make informed decisions about when and how to travel. For example, as part of TfNSW's priority focus on transforming mobility in regional NSW, TfNSW will deliver real-time information and digital ticketing for all public transport services.

TfNSW's use of smart sensors and intelligent systems powered by artificial intelligence (**AI**) and machine learning will result in rich real-time customer information, service management, dynamic prioritisation and incident management.

TfNSW has also learnt that the powerful combination of real time data and intelligent analytics, such as using AI and machine learning, is highly successful for key uses. TfNSW is trialling additional uses for AI, machine learning and edge computing to generate real-time data and predictive analytics, so detailed insights can be used on road and rail networks to improve safety, manage congestion and predict performance, including for public transport services and customers.

Personalised customer journeys

Personalised customer journeys give customers the power to define and receive the information about services that interest them in real time.

Where customers opt in, TfNSW is using intelligent systems, such as AI, to anticipate the needs of these customers and to send personalised information that is relevant to their transport choice before and during travel. For example, customers can receive information about service alerts, trip planning and COVID-safe capacity that is relevant to their usual service mode and time of travel. Information may be delivered through multiple channels, including the Opal Travel app and transportnsw.info website.

As TfNSW expands the coverage of Opal and related technologies into regional areas, insights from this data are also transforming mobility in regional NSW, with real-time information and digital ticketing for all public transport services. Customers in a growing number of regional areas are starting to benefit from digital information, booking, and ticketing systems. TfNSW is also considering how to deliver better digital connectivity at transport hubs and on board major rail services for supporting access to real-time service information.

TfNSW is pursuing further initiatives to enable customers to plan and book public transport through real-time information. For example, the Transport Connected Bus program, which is being rolled out in regional NSW, provides real-time tracking and service information for regional bus services, so customers can track the location of their bus, its estimated arrival time and how full the service is. For customers, this improves trip planning and connections, as they can see the bus location on its route, spend less time waiting at the stop and more time at their destination.

TfNSW is also expanding its Transport Connected Bus Program, as part of its 16 Regional Cities Services Improvement Program, to improve public transport services and provide integrated, multi-modal and end-to-end journeys in regional areas. The location and capacity information from the Transport Connected Bus program provides real-time information for customers, bus operators and planners to better manage service operation and planning for future services.

TfNSW will also extend current trials of contactless RFID bag tags for school students, enabling children to board regional school bus services more quickly. This trial also provides real-time location to customers, making it easier for parents to know when to meet their child's school bus, while also sharing patronage data with regional bus operators and transport planners to make it easier for them to plan for and review provision of services.

Planning and booking public transport through real-time information

TfNSW's two main customer information channels – transportnsw.info and the Opal Travel app – have been significantly upgraded to help more customers easily plan and book services on a wider range of transport modes and across more locations, including through more personalised and real-time information.

Transportnsw.info now offers more help for regional customers, with information on regional bus and school bus services, and digital bookings for NSW TrainLink trains and coaches. This information connects journeys between trains and other modes and includes trip planning for point-to-point, walking and cycling trips, to help customers make informed choices.

Transportnsw.info also provides real-time passenger capacity information for all modes of transport, a feature that won the 2019 global Real Time Passenger Implementation Award in London and the 2020 ITS Australian Excellence in Transport Data Award. In a world first, estimated and predicted passenger capacity was added for all public transport modes to help customers travel on services with adequate capacity.

The Opal Travel app also streamlines trip planning, with a departure board for next services and in-trip tracking. The app offers personalised notifications and alerts across all modes of transport for trackwork, delays or incidents.

In another world first, TfNSW introduced personalised COVID Safe travel notifications from the Opal Travel app to inform customers if physical distancing is possible, based on predicted capacity on their regular train, metro, bus or ferry service. The app sends personalised proactive notifications on whether the transport service is COVID safe, and won the 2021 Web Excellence Award for Excellence for Apps and Mobile.

In continuing with TfNSW's record of world firsts during the height of the pandemic, the Travel Insights data tool was rapidly developed in response to businesses and employers wanting access to more data during the COVID-19 pandemic to assist with workforce planning and information for staff. Travel Insights is a publicly available interactive transport data visualisation tool that gives people the unprecedented ability to view and filter multi-modal Opal data to assist with understanding the latest travel trends. Users have the power to view data by public transport mode, day of the week or key commercial centres in greater Sydney and regional NSW.

Public transport priority for improved travel times and reliability

Road and rail networks can be optimised by prioritising services that move the most people (or goods) most effectively. Mass public transport is significantly more efficient for carrying the maximum number of people per lane, per hour and helps alleviate congestion by reducing the number of private car journeys needed.

TfNSW provides priority for road-based bus and light rail services with both infrastructure (for example, bus lanes) and technology solutions (for example, traffic signal priority). TfNSW also uses technologies to prioritise passenger rail services during commuter periods, allowing freight rail access and priority at other times.

The Public Transport Information and Priority System (PTIPS) is TfNSW's primary mechanism for providing priority for road-based public transport (buses and light rail) at signalised intersections. It is an intelligent transport system used to track, predict and prioritise public

transport movements through intersections. PTIPS uses machine learning to analyse and predict movements and prioritise high-capacity public transport to improve customers' travel times and reliability. PTIPS won the Overall Best Smart City Project at the 2017 Smart City Awards.

TfNSW will expand the use of the Sydney Coordinated Adaptive Traffic System (**SCATS**) and PTIPS to provide further priority for buses and light rail at signalised intersections, and to ensure that the SCATS system and PTIPS are prepared for the operation of CAVs. TfNSW is planning a major program to upgrade PTIPS traffic management software, which will enable greater prioritisation of buses and will reduce delays, permitting for more reliable customer journeys where customers can 'turn-up-and-go'.

PTIPS has proven valuable in creating such benefits, with, for example, the Rapid Bus Transitway, doubling the average bus speed from 27 km/h to 56 km/h and greatly improving journey times and scheduled compliance. On average, PTIPS is able to bring a late running bus back onto schedule within eight stops, congestion permitting.

As part of this expansion, TfNSW will also trial Bluetooth sensors with AI analytics on the road network to improve data collection which currently counts the volume of traffic at a number of locations. The trials will enable more useful information to be gathered on the volumes of end-to-end journeys, providing valuable insights on where the traffic flows through the network. This type of information could be used to better inform road network operation and planning for future public transport journey management.

In addition, TfNSW's Research Hub previously worked on developing a research project on optimising intersections for public transport priority by minimising vehicle stop-time. The research focussed on defining the optimum approach speed for light rail vehicles entering the intersection, using advanced algorithms and high level modelling to assess the expected benefit for light rail customers and any impacts on other traffic using the intersection.

The modelling indicated that a combination of speed adjustment to the light rail vehicle and optimisation of traffic signal timing could result in reduced delay for light rail customers, as well as reduced delay to other users of the intersection. While these results would need to be verified by field trials integrated with SCATS and PTIPS, they indicate that such work can be utilised to derive meaningful outcomes relating to transport management systems.

Real time rail network and service management

Sydney Trains uses near real-time Opal journey data to identify congestion points on the rail network based on where customers are experiencing delays in their end-to-end journey. The Customer Journey Tool is used by the Rail Operations Centre to help resolve incidents quickly and minimise flow-on impacts across the network. TfNSW plans to extend this functionality to other public transport modes to better reflects customers' end-to-end journeys. This will enable TfNSW to gain a more holistic view of customers' travel experience and for improvements to be planned at a network level, rather than for each transport mode separately.

Sydney Trains also provides real time passenger loading information for its Waratah train sets, and has developed a real time carriage load prediction model for non-Waratah train sets, to provide actual or predicted capacity information directly to customers.

Sydney Trains is also currently working with analytics providers, Ipsotek and Unleash, on a CCTV solution that will measure the numbers, distribution and flow of customers within, and approaching, stations in near real time, to improve safety and convenience. Bluetooth, Wi-Fi and other sensors are also being evaluated for this same purpose with local company, Behavioural Analytics, to assess the ability of non-CCTV technologies to deliver insights accurately and in near real time.

Automatic Train Protection (ATP) technology is being installed on train fleets across the electrified rail network, providing safer and more reliable services. With electronic

transponders installed in the rail corridor and on the Sydney Trains and NSW TrainLink intercity train fleet, ATP provides critical speed monitoring and signal information to the driver through indications, messages and audible alarms if the train is exceeding track speed. This helps drivers ensure trains operate within the permitted track speed and supports safer customer journeys.

NSW's $5.3 billion More Trains, More Services program is designed to deliver benefits for rail customers through digital systems, infrastructure upgrades and more new trains. It will modernise the rail network, creating high capacity, turn up and go services so customers can benefit from more frequent services, with less wait times and crowding, and better reliability.

As part of the More Trains, More Services program, the Digital Systems Program replaces trackside signalling with the latest train control technology, and implements Automatic Train Operation to help drivers reduce journey times. It also introduces a traffic management system to help train services to recover quickly from disruption.

Live Traffic NSW

Information on the Live Traffic NSW website and app is provided by TfNSW's Transport Management Centre (**TMC**), which manages the NSW State road network. Live Traffic NSW is a comprehensive source of information on planned and unplanned road disruption for all state and local roads in NSW, and supports customers in making safe and informed travel decisions, including for road-based public transport services across NSW.

TfNSW has recently added coverage of local road data in a trial with the Central NSW Joint Organisation group of councils. This has expanded to other councils on the North and Far North Coast, which was particularly valuable during recent flood events, when Live Traffic saw over three million visits in 11 days from 17 to 28 March 2021.

Live Traffic NSW customer channels now also include NSW Rural Fire Service data and soon, flood sensor data from Manly Hydraulic Laboratory, which provide improved information on the location and severity of fire and flood events. In collaboration with Service NSW, the State Emergency Service and the Digital Restart Fund, TfNSW is producing new incident data to allow app developers to more easily publish disaster information in useful formats.

The Live Traffic team has also engaged with partners in Google, Waze and TomTom to deliver a highly detailed data feed for mapping providers that will increase the accuracy and timeliness of data on third party systems.

Users of Live Traffic NSW who live in border towns, travel interstate or operate interstate freight also benefit from interstate data and visibility of incidents in surrounding states. TfNSW has combined data feeds from Victoria, Queensland, South Australia and the ACT to provide one source of road and traffic information for more than 80 per cent of Australia's population.

During COVID-19 lockdowns, this allowed users to see road closures on both sides of state borders, and will also cover road network impacts in neighbouring states during times of fire and flood, providing critical safety guidance for residents, visitors and cross border passenger service operators.

This provides public transport and privately operated mobility service providers with a wealth of real time information to proactively plan their journeys, maintain reliability, avoid incidents and communicate with their customers.

Optimising TfNSW networks and informing customers via smart systems

TfNSW has invested in major systems that optimise the operation of the road and rail networks. The multimodal Intelligent Congestion Management Program (**ICMP**) is an adaptive intelligent transport system that delivers real-time road status data for traffic, public transport, private motorways, emergency services, field crews and traffic alerts to the TMC.

ICMP consumes real-time data to quickly detect traffic patterns, share live customer information with passenger and freight road users and applies machine learning to automatically generate congestion alerts. This technology allows the TMC to make informed management decisions much faster, resulting in more reliable journeys with minimised congestion, including for road-based public transport.

ICMP is complemented by SCATS, which can synchronise traffic signals to optimise traffic flow across a whole city, region or corridor, including optimisation for public transport journeys. Using in-ground sensors and links to pedestrian push buttons, SCATS gathers real time data on vehicles and pedestrians accessing each intersection, and makes intelligent signalling decisions to adjust traffic light phasing to optimise for all traffic, as needed to meet network objectives. SCATS provides major time and cost savings, with a 25 per cent reduction in vehicle stops, 28 per cent reduction in travel times, 15 per cent reduction in emissions and 12 per cent less fuel consumed.

SCATS Cornerstone is a new spatial data and integration platform that ensures consistent intersection data for future Intelligent Transport Systems (**ITS**) technologies, providing better visibility of the transport network and adaptive traffic management using Cooperative-ITS connected vehicle technology and real-time spatial data analysis. Both ICMP and SCATS work with PTIPS to optimise road based public transport journeys, using high quality real-time analytics.

Real-time digital twin

Real-time data, including public transport data from intelligent sensors, is already aggregated and shared through the TfNSW Open Data Hub and the NSW Data Analytics Centre, and is being used by TfNSW network managers. This data can also be transformed by developers into solutions like apps for use by customers and service operators.

The Department of Customer Service is leading the development of a real time Spatial Digital Twin, with a digital 3D model of cities and communities to facilitate better planning, design and modelling for future needs, and as a platform for further transport innovation.

This spatial visualisation platform integrates information on property boundaries with transport and other information, and will be a valuable data visualisation platform that enables integration of static and real time live data feeds for transport assets, services, travel patterns and network performance. TfNSW plans to integrate real-time data into a Transport Digital Twin that will interface with the NSW Spatial Digital Twin for use by whole of government and as a platform for transport innovation.

Local research and development partnerships

TfNSW is working with CSIRO's Data61 team in Sydney to develop ways to integrate real-time transport data into a transport digital twin for the pilot area in Western Sydney.

This work includes the integration of real time traffic information and the use of AI to predict traffic congestion, where AI integrates machine learning with traffic simulations to continuously train the model to make short-term transport network predictions.

This work is contributing to the delivery of the next generation congestion management system for the NSW Transport Management Centre, with the system enhancing the capability to predict two hours into the future, which could lead to significant improvements in the efficiency of managing traffic flow.

4. First and last mile transport services

The first and last trips, or legs, in a customer's door-to-door journey are often made by walking or cycling, and often involve connections to a public transport service. Increasingly, first and last mile services such as rideshare, On Demand and bikeshare enable customers to choose the services that best suit their needs at different times.

To help customers connect more seamlessly, TfNSW is integrating more first and last mile services into its information, booking and payment systems, so customers can easily find a range of options and are supported in their connections. As with the focus on MaaS solutions, TfNSW is using innovative technologies to reduce friction with first and last mile connections, by offering new mobility and information services, payment and pricing options to help them connect with the greatest convenience.

For example, TfNSW has integrated with Uber to launch an Uber and Transit feature so customers can select information and book the best combination of UberX rideshare and public transport to reach their destination. Sydney and Chicago launched the first integration of such real-time public transport data with Uber's services to provide better first and last mile connections to public transport.

While Sydney residents can now access public transport information via the Uber app, world-leading technology is also being trialled to streamline fare payments for first and last mile services. From mid-2021, customers using Opal's digital ticketing can gain credit on their account when they transfer to public transport from Uber, a fixed fare Ingogo taxi trip or a Lime bike journey using their Opal digital card. If they catch public transport within 60 minutes, they will be rewarded with a credit to their Opal account of up to $3.

Also as part of the trial, My Fast Ferry customers will save between 10 and 25 per cent on their ferry fare as a reward for connecting with another public transport trip. TfNSW has also partnered with Mastercard, Commonwealth Bank of Australia and EML Payments Limited to deliver this 12-month Opal digital card trial.

Managing demand for first and last mile trips

As well as adding network capacity with major investments in infrastructure and services, TfNSW helps customers make optimal travel choices to suit their needs. Travel demand management programs enable TfNSW to spread customer demand more efficiently across the day by encouraging customers to use alternative modes of travel or reducing their need to make trips, which results in less pressure on the network during peak periods.

To help manage those changes to demand, TfNSW's COVIDSafe Travel Choices team works with businesses and their staff to encourage changes in travel behaviour patterns to suit their needs and balance demand for travel more sustainably across the network.

Information and technology solutions help to facilitate these choices, with more convenient connections offered for walking, cycling and first and last mile service connections to public transport. For example, the transportnsw.info and Opal Travel app capability uses sophisticated algorithms to offer personalised information and bookings across a range of first and last mile service modes. This includes trip planning for taxis, rideshare, walking and more direct, moderate and easier routes for cycling, to help customers make informed choices.

On Demand services of intelligent systems

TfNSW's On Demand public transport program has produced some of the fastest growing and most successful first and last mile services globally. Its large scale rollout of 23 pilots and five permanent services across regional and metropolitan, NSW has attracted attention around the world.

On Demand services use intelligent systems that navigate and manage demand through powerful algorithms. For example, through The Ponds service powered by Via Technology and operated by Cooee Busways, customers requesting rides through the On Demand app are offered the earliest On Demand ride available, as well as a comparable fixed route bus service if available. This technology ensures customers can choose the best first and last mile service at any given time.

Some first and last mile On Demand services connect to low frequency public transport, which require custom configuration for each algorithm to ensure customers receive a smooth transfer. The Coast Connect Woy Woy service used a feature that integrated real time train data so that if there were delays on the connecting train, On Demand customers would be notified and pick up times adjusted to optimise the journey.

The Ponds On Demand buses connecting customers to the station

Last mile freight

The last mile of journeys is also a key segment for freight deliveries. As part of its priority commitment to enable more efficient freight through technology, TfNSW will trial the use of automated and sustainable last mile freight vehicles. Electric and hydrogen-fuelled vehicles support cleaner and quieter freight operations, so TfNSW will also trial small EVs for last-mile urban deliveries, supporting successful places, which may enable flexible delivery hours. Trials will identify improved freight and environmental outcomes.

Local research and development partnerships

TfNSW has worked with a range of local partners to deliver On Demand first and last mile services in trials and as part of contracted services. This includes transport operators like Busways, Transit Systems, Keolis Downer, CDC Hillsbus and technology providers including Via, Liftango, BRIDJ and SWAT.

TfNSW has also developed partnerships with developers of automated vehicle technology and mobility service providers to explore future use of CAVs in providing first and last mile service connections. These include CAV suppliers Easymile, Conigital, Navya and HMI Technologies.

5. Using data to improve access and safety for travellers, including for women

TfNSW has a major focus on improving safe access to transport and to places for all customers. Generating and sharing data from digital technologies is critical to the success of these programs, providing the insights that power decisions and actions which improve access and safety.

Data helps TfNSW understand customers' needs, preferences and travel habits, so new services can be designed to better meet their needs. Data can also be used by AI systems to interpret threatening behaviours and to trigger action to keep customers safe on the network.

The data generated, shared and analysed by smart sensors and intelligent systems underpins the value of all new digital technologies that are being applied to transport, mobility and place making. When combined with smart analytics powered by AI and machine learning, vast volumes of complex data can be analysed more quickly and powerfully to provide real time situational awareness for network operators. Among other things, this information can be used to manage difficult situations and to support the provision of customer information relating to the network.

Continued investment in transport technologies and the collection, enrichment and use of data will yield benefits for customers, communities and the economy and enable long term economic opportunities for NSW.

Understanding customers' preferences

TfNSW is investing in technology and data analytics to build deeper insights about its customers' end-to-end journeys and the diverse needs of different NSW communities. Customer groups have different experiences, expectations and requirements from those in metropolitan, outer metropolitan and regional areas, as well as people with disability, and freight customers. TfNSW aims to offer value for all key customer segments and have clear insights of their needs, across regional and metropolitan communities and across all modes – whether they are driving, walking, cycling, using public transport or moving freight.

When developing new technologies, TfNSW engages with customers and uses human-centred design to make sure the vast needs of various customers are addressed. Through voice-of-the-customer data and regular customer satisfaction surveys, TfNSW also tracks the value that customers put on considerations like access, safety, convenient information and payments. These customer technologies and insights help improve services by providing planners and network managers with data on transport use and insights about customers' preferences.

TfNSW has an open data policy that shares transport data, through the Open Data Hub and Developer Portal and via Data.NSW, with other agencies and private developers who build consumer apps and other solutions to help customers. To date, over nine billion data requests have been made through TfNSW's Open Data Hub to inform customer information channels, and over 28 partner products have been developed with open data. For example, the TripGo app allows users to compare public and private transport options and provides information on estimated costs, fastest modes and routes based on real-time TfNSW data, with door-to-door directions.

Improved safety for women

All members of the community should have the right and confidence to travel, work and socialise at day or night without being harassed or victimised.

Research into women's safety reveals that girls and women do not always feel safe at night. To this end, TfNSW is collaborating with other government agencies, local councils and industry to work on solutions to make cities safer for women.

For example, the Women's Safety After Dark initiative is focused on making women feel, and be, safer when travelling on the transport network. This initiative led the University of Wollongong to develop an AI algorithm to detect threatening behaviours on the transport network. Surveillance cameras have been trained to accurately detect threatening behaviours in real time that might predict violence and assault. Where threatening behaviours are identified, the system is able to send an alert to security operators to raise an alarm and request support to the location.

A live trial of this initiative is underway at Wollongong Station, where the camera and AI will be tested in a range of simulations, to consider enabling this technology to be rolled out in other settings and across other locations in future.

Improved access for people with disability and mobility impairments

TfNSW has also delivered valuable customer technologies to help specific customer groups in planning and booking travel across NSW. For example, TfNSW has made it easier for customers with disability and mobility impairments to access trip planning services and plan for more accessible journeys through transportnsw.info and transport accessibility apps. TfNSW has also developed a voice command service via the Transport Bot virtual assistant powered by AI that can answer many common questions through Facebook Messenger, Amazon Alexa and Google Assistant. This delivers real-time service information, route maps, and information on mobility aids and travelling with assistance animals.

To further help people with disability, TfNSW is introducing a smartcard to replace the paper docket system for the Taxi Transport Subsidy Scheme and delivering a new centralised booking service for wheelchair accessible taxis with an associated app for taxi drivers to receive bookings. The booking service already accepts phone and online bookings and will soon offer more options with voice activated bookings, digital assistants and other apps to assist customers to save preferences and track their taxi.

Improved access to kerb space to meet changing local needs

Most journeys by road start and end at kerbs, which are important points of access for customers into communities and destinations, yet they can be subject to the needs of competing users for access to kerb space.

To address this, TfNSW is developing a multi-modal Digital Smart Kerb Pilot with councils in Sydney's Western Parkland City. TfNSW is partnering with councils to gather data on the allocation of kerb space for different uses (such as parking, bus, taxi and loading zones) and is using intelligent sensors to gather real-time data on actual kerb usage, to understand where and how kerbs might be used more effectively.

The pilot is enabling the sharing of open data between TfNSW and council road authorities with industry and apps developers, and will support the diverse needs of local communities for different passenger, freight and place making uses.

Supporting the '30 Minute City'

TfNSW is committed to delivering on the '30 Minute City' vision for Greater Sydney, where people can access jobs and services in their nearest metropolitan city and strategic centre within 30 minutes by public transport, seven days a week.

To help deliver these outcomes, TfNSW has partnered with local data strategy and analytics specialist, Smash Delta, to co-design and develop an innovative strategy and analytics platform to drive improved public transport outcomes. The new 30 Minute City platform is able

to analyse and assess public transport services at a hyper-granular level, to inform improved planning and operation of the public transport network, and show performance and progress in meeting the 30 Minute vision.

The 30 Minute City platform is now adopted as the transport performance methodology by the Greater Sydney Commission and is regularly updated for new transport services as a platform for a data enabled future.

Public transport accessibility

To deliver effective public transport services, TfNSW needs to understand how well the population is served by the public transport system and measure the level of access to the nearest public transport service, such as a bus stop, ferry wharf, light rail station and train station. TfNSW measures this connectivity using the Public Transport Accessibility Level (**PTAL**).

PTAL accesses data on the location and service frequency at stations and bus stops to calculate accessibility to public transport. It helps improve services where areas with poor accessibility are identified, and informs local planning and parking policies. It can also identify aged populations (over 65 years) in regional areas to plan for provision of community and/or On Demand transport services.

Alignment with NSW Data Strategy

The NSW Data Reform Program, endorsed in late 2020, builds on ongoing collaborative efforts which supported the whole of government response to COVID-19 to achieve alignment across NSW Departments on the use and sharing of data. Phase 1 of this program involved establishing a whole of government NSW Data Leadership Group of Chief Cluster Data Officers to oversee the program.

The NSW Data Strategy forms Phase 2 of the NSW Data Reform Program and is aimed at delivering better outcomes for the community by putting data at the heart of decision-making. The NSW Data Strategy will set out NSW Government's vision for better sharing and use of data in a considered, consistent and safe way, and will include principles and sector-wide actions that will inform cluster data roadmaps.

The Data Strategy complements the Beyond Digital Strategy and aligns with other key NSW Government strategies that rely on data and effective data governance for their successful implementation, including the AI Strategy, Smart Places Strategy, the NSW Customer Strategy, the Internet of Things Policy and the State Infrastructure Strategy.

Phase 3 of the NSW Data Reform, the statutory review of the *Data Sharing (Government Sector) Act 2015*, will determine whether the policy objectives of that Act remain valid, whether the terms of that Act remain appropriate for securing those objectives and assess further legislative opportunities to enhance whole-of-sector data capability.

6. Ethical considerations and regulations in development of connected and automated vehicles

The NSW Government has demonstrated strong leadership in the regulation and trialling of CAVs since 2017, including through its release of the Connected and Automated Vehicles Plan in 2019.

As a priority, TfNSW will continue to be a world-leading adopter of CAVs by undertaking trials to show how autonomous ridesharing services can integrate with MaaS, using the new vehicle testing Future Mobility Test Centre at Cudal to test integration of vehicle sensors with infrastructure, and applying policies needed for mass adoption of CAVs.

It will also further consider a program of initiatives to become 'CAV ready', not just to be ready to receive technology when it's available, but to accelerate the research, development and deployment of CAV technologies in NSW and Australia. Focussing on CAV readiness will help harness the benefits of the technology for the community and people of NSW.

As part of the creation of any regulatory framework for CAVs, TfNSW will assess all necessary considerations in developing this framework, including in relation to safety, privacy and cyber security.

Ethical considerations and regulations in the development of connected and automated vehicles

From a policy and regulatory perspective, TfNSW has created a clear legislative and safety assurance framework in NSW that enables it to test and trial a wide range of CAV uses under stringent safety controls. This safety assurance framework continues to be improved to support further trials and proposed initiatives, and TfNSW is working closely with the Australian Government and other jurisdictions to align and inform the national regulatory approach. This will ensure that NSW is on the front-foot with emerging technologies, while balancing all necessary ethical and regulatory considerations in the adoption of such new technology.

For example, the Smart Shuttle CAV trial at Sydney Olympic Park was successfully integrated with the SCATS traffic management system and demonstrated that such vehicles can communicate with signal technologies to maintain safe operation. The trial team also worked closely with TfNSW's cyber security advisors to ensure any potential for risks were addressed.

TfNSW addresses cyber security in its technology projects and acts on potential cyber security risks at all project stages. TfNSW follows NSW's updated Cyber Security Strategy and works with the new office of NSW Cyber Security to carefully address these issues.

Strict privacy of customers' personal and private information is a core value for TfNSW and its preservation is embedded in all technology projects. In all CAV trials, TfNSW works closely with in-house privacy advisors and the NSW's Information and Privacy Commission to develop Privacy Impact Assessments in order to address any concerns to ensure compliance with the *Privacy and Personal Information Protection Act 1998*.

The NSW Government issued the Artificial Intelligence Ethics Policy, which sets out five principles that are designed to ensure best practice use of AI. NSW government agencies must comply with the Policy when developing and using AI solutions, including in the development of CAV trials.

The Policy provides that AI must be:

- The most appropriate solution for a service delivery or policy problem;
- Used in such a way as to mitigate as much potential bias as possible;

- Used safely, securely, and in line with existing privacy and information access requirements;
- A solution that is open and transparent so that NSW citizens have access to efficient review mechanisms;
- A solution where the decisions are always subject to human review and intervention.

NSW has also established its Artificial Intelligence Strategy, which recognises the value of AI as a useful tool to assist in decisions and service delivery, but notes that any AI-informed decisions must remain the responsibility of the agency using the technology and that citizens should be able to understand how their data is being used, and for what purpose.

It is also important that CAVs deliver benefits and access for all users, and provide an inclusive service that assists more members of society with improved access. TfNSW is working to ensure that CAVs and the services they operate, provide accessible services which are open to people with disability and mobility impairments.

Case study: CAV shuttle services for vulnerable users

TfNSW trialled the automated Busbot shuttle at the Marian Grove Retirement Village in Coffs Harbour to test their operation in a more complex environment and the ability of CAVs to address various mobility needs. The trial was valuable for understanding the mobility needs of an older community and connecting an automated vehicle with an On-Demand service that residents could book via an app.

In particular, the trial tested community acceptance of driverless connected vehicles as a feasible transport option and was met with positive support among village residents and management. Phase 2 of the trial saw 2,500 passengers ride on 1,600 trips over 22 weeks, resulting in a clear positive change in residents' perceptions on what they thought of driverless transport before and after riding the vehicle, particularly in terms of safety and convenience.

> *'We can see the potential for vehicles like this in the future serving villages like ours, particularly the bigger ones. We recognised it has increased accessibility in the village with the elderly. Sometimes bad weather, health issues or just a bad day would have prevented residents from attending events, but we found having the BusBot in the village increases participation. BusBot was certainly viewed as a positive interaction to the village.'*
>
> Michael Darragh, CEO of Sawtell Catholic Care of the Aged

Busbot at Marian Grove Retirement Village, Coffs Harbour

Transforming mobility through connected and automated vehicles

The emergence of electric, connected and automated vehicles will be the most significant technology transformation in many decades, and will benefit passenger and freight transport and customer mobility. CAVs offer many benefits, including improved mobility and network efficiency, freight productivity, congestion mitigation and improved road safety. NSW has been actively exploring these vehicle technologies with new shared service models.

TfNSW's Smart Innovation Centre has been trialling new vehicle technologies and shared mobility solutions, including highly automated and connected Smart Shuttles at Sydney Olympic Park, integrated with traffic lights and digital bus stops to provide a regular turn-up-and-go shuttle service.

Two regional trials of highly automated shuttles in Armidale and Coffs Harbour have informed the use of automated vehicles on NSW roads, with the Armidale trial also integrating with trip planner and the Coffs Harbour trial operating with on-demand bookings capability. These trials have provided insights into the safety case for adopting automated vehicle technologies, and customers' use and attitudes towards them.

As an additional investigation of CAVs and the network's readiness for their introduction, the 2018 Sydney Orbital Automated Vehicle Initiative conducted on-road trials of partially automated vehicles with seven major car manufacturers to analyse interactions between vehicles and road network infrastructure.

The on-road trials took place on 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 partially automated cars were tested under different conditions and at different times of the day to assess the interaction between these vehicles and the existing road infrastructure, with the study helping to inform standards and requirements for new and upgraded road infrastructure.

Likewise, the Future Mobility Test Centre at Cudal in Central Western NSW will test automated safety features and connectivity with road infrastructure. These actions help us prepare for the safe adoption of automated vehicles and the development of new intellectual property in NSW.

The Future Mobility testing facility at Cudal in NSW's Central West

Local research and development partnerships

As with many other areas of technology development, TfNSW values the benefits of successful partnerships with industry, researchers and communities to deliver successful outcomes for customers and communities.

As a result, TfNSW has developed partnerships with developers of automated vehicle technology and mobility service providers, including CAV suppliers Easymile, Conigital, Navya, HMI Technologies, Motional and NVidia, as well as mobility service provides, VIA and Liftango. These partnerships have added to the understanding of the opportunities and challenges with being prepared for the emergence of CAVs and their future use.

Through this work, we have learnt there are challenges trialling and scaling the use of automated vehicles, where industry leaders are not yet based in Australia and travel is now restricted by COVID-19. TfNSW is acting to reduce these barriers and build local capability through strategic partnerships, thought leadership, data sharing, co-investment, supportive policy, digital and physical infrastructure, testing facilities and community engagement. TfNSW is also collaborating with other states and national organisations on trials and the development of a national regulatory framework.

In addition, TfNSW is the lead government partner for the Australian Driverless Vehicle Initiative (ADVI), which has established in NSW. ADVI is the peak industry advisory body that services the wide ecosystem of automated vehicle activities across Australia and New Zealand. This relationship both supports NSW's role as a leader in this technology and the development of partnerships that enable locally based industry and research skills and jobs in NSW.

TfNSW is also active in iMOVE, Australia's leading applied research centre in the transportation and mobility sector. This partnership helps businesses and TfNSW tackle transport-related challenges and has jointly funded a number of CAV projects with research and industry partners through iMOVE to achieve research outcomes. TfNSW also has a strategic research partnership with the Australian Centre for Field Robotics at the University of Sydney, which also supports local research and development of new autonomous and intelligent robots and systems technology.

Another important focus of TfNSW's work on CAVs is to support the development of local industry through research, trials, connections with international leaders and by seeking future investment. Transport technologies are recognised as important contributors to local skills, jobs and business development opportunities in metropolitan and regional NSW, and NSW is taking action to be a leader in this field.

These local partnerships align with NSW's economic development and innovation strategies, including:

- *20-Year Economic Vision for Regional NSW*, which recognises the opportunities in digital disruption and entrepreneurship in regional areas;
- *NSW Innovation Strategy*, which aims to boost innovation, stimulate economic activity and drive shared prosperity, including support for the knowledge economy and entrepreneurs;
- *Jobs for the Future*, to nurture growth in start-ups and digital innovation, and to skill up for the knowledge economy; and the
- *Trade and Investment Action Plan*, which includes strengthening NSW's economy by leveraging the transport technology sector.

Future considerations for connected and automated vehicles

TfNSW is continuing its priority focus on being a world-leading adopter of CAVs and developing a future work program by exploring trials and uses that address key transport outcomes for TfNSW and its customers. These include considering use of CAV technologies for purposes such as improving road safety, managing congestion, reducing household and business transport costs and improving connectivity of places.

Automated Driver Assist safety features such as automatic emergency braking, lane keeping and speed management technologies provide important road safety benefits that will significantly reduce the number and severity of road crashes that are due to human error.

Fewer crashes mean less impact on traffic flow and CAV's connectivity with ITS systems are expected to mitigate congestion by sharing information on safety hazards and unplanned incidents. Ultimately, the operating model for CAVs will determine the way these vehicles affect congestion. TfNSW is continuing to explore new uses for CAVs that support accessibility, add services in areas where there is less transport availability, reduce private vehicle dependence and improve safety.

TfNSW will also explore using CAVs in services to provide first and last mile connections for seamless end-to-end journeys, as well as combining the use of CAVs with other digital solutions to further bolster its MaaS offering. This includes exploring opportunities for further locations to establish trials of automated vehicles following the completion of successful trials like the ARDi automated shuttle trial in Armidale and the Smart Shuttle in Sydney Olympic Park.

Following successful operation of the BusBot automated shuttle trial in Coffs Harbour with an on-board supervisor, TfNSW is now progressing with the next stage where the shuttle will now operate without a supervisor on-board. This next phase will see the public shuttle service operate at the Coffs Harbour Botanic Garden in true driverless mode, following previous testing and safety assessments.

In addition, TfNSW is continuing development of an autonomous ute trial in Dubbo to assess the benefits and challenges of introducing CAVs in regional areas and under Australian conditions, including detection and avoidance of kangaroos on regional roads. The ute is expected to be tested initially at the Future Mobility Testing Facility in Cudal, followed by on-road trials in and around the Dubbo area.

A key feature of TfNSW's safety assurance approach is the testing and assurance capability that is centred on the Future Mobility testing facility at Cudal. TfNSW will use this facility to support ANCAP testing to provide valuable safety advice to customers on new automated driver assist technologies embedded in new vehicles. Importantly, this facility is also providing local NSW capability to test and assure future vehicle technologies, particularly in a regional environment. This will be a critical facility for the future safety and assurance of CAV and related technologies.

7. Local research and development opportunities

Partnerships

An important key to success when co-designing, developing and delivering effective technology solutions are the valuable ongoing partnerships with industries and businesses at all scales, from start-ups and scale-ups to multinationals, as well as with councils, communities, research partners and other jurisdictions. In addition to all of the local research and development partnerships referred to in this submission, this section outlines further pathways for opportunities and existing partnerships in which TfNSW is a part.

These valuable partnerships enable TfNSW and its partners to all benefit by leveraging the collective talent which deliver the best outcomes for NSW customers and communities. Successful partnerships also help NSW to address key challenges and opportunities around resilience and sustainability objectives, and help reinforce NSW as a global leader in transport technology development, with the economic opportunities for local communities and businesses.

TfNSW welcomes partnerships at all scales and is working with many of the best technology companies in the world, including Microsoft, Cisco, NVIDIA, Amazon Web Services and Google, to utilise innovative world leading technology that will reduce congestion and create connected and safer journeys for the community.

TfNSW is also leveraging the brightest minds and ideas by partnering with Australian based start-ups including AnyTrip (network visualisation tool) and Q-CTRL (quantum computing research and development project) to help solve problems and optimise the network.

To facilitate further partnerships in a range of different activities, TfNSW offers businesses, researchers, data developers and other groups a number of partnership pathways to make contact and become involved in TfNSW's technology program:

- Partnership Portal – a first point of contact that enables all prospective partners to express interest in areas of technology, create new partnerships, provide feedback on TfNSW's Technology Roadmap 2021-2024 and register for updates;
- Transport Digital Accelerator – working with partners to fast track better customer experiences through focused customer centred design-thinking programs and creating new connections between businesses, government agencies, researchers, entrepreneurs and start-ups;
- Lighthouse and Innovation Projects – working with partners to create new projects to showcase cutting-edge technologies;
- Smart Innovation Centre – working with partners on connected, automated and electric vehicles, and newer transport services;
- Research Hub – working with universities, the wider research sector, industry and government agencies to develop new research insights and solutions that address TfNSW priorities; and
- Open Data Hub – providing access to open data that helps developers and other data consumers to create apps and other digital solutions which bring customers value.

Opening economic opportunities

Building smart technologies into infrastructure and services opens up further economic opportunities by making freight more productive, creating jobs for the future and providing valuable business development opportunities. Under its COVID-19 Recovery Plan, NSW is

investing in major road, rail and freight infrastructure, with the added value of embedded technologies, such as sensors, Intelligent Transport Systems, real-time data analytics and smart motorways.

Case study: Bus commitment brings jobs and manufacturing opportunities

NSW's economic scale and strong commitment to adopting smart technologies are providing clear signals and confidence to the market to invest locally and create business development opportunities in metropolitan and regional NSW.

Following NSW's commitment to transition its fleet of around 8,000 buses to zero emission buses, two NSW bus suppliers and other Australian manufacturers are investing locally in jobs and business development.

NEXPORT and investment group, TrueGreen, have partnered to establish a $700 million facility in NSW's Southern Highlands for local production of electric vehicles, including buses. The advanced manufacturing facility in Moss Vale is expected to generate more than 2,000 new jobs over the next five years.

Custom Denning is also gearing up to supply Australian designed and built electric buses, including battery electric and hydrogen fuel cell electric buses, and has commenced a trial of the first NSW-built electric bus.

Meanwhile, Australian bus manufacturer, BusTech Group, has a vision to enable the next generation of connected transit with a focus on zero emissions buses and is also looking to establish a NSW-based manufacturing facility.

NSW will benefit from a local electric bus manufacturing facility

Future mobility technologies provide economic opportunities for NSW businesses to develop and commercialise new components and systems. For example, the expected increase in electric vehicle uptake is estimated to have major direct economic benefits including, based on a PwC report, a $2.9 billion increase in Australian real gross domestic product and the creation

of 13,400 jobs by 2030, while saving consumers $1,700 each year in ownership costs.[1]

Greater investment in transport technologies aligns with NSW's strategies for future jobs, trade and investment. For example, NSW aims to be one of the top 10 start-up ecosystems in the world and greater use of technologies will help nurture growth in start-ups and digital innovation, and to skill the workforce for the knowledge economy.

As identified in the Global NSW strategy, NSW is making significant investments in improving digital connectivity and has identified key enablers, including advanced manufacturing, workforce development and technology, to be globally competitive in harnessing innovation.

The scale of economic opportunity in these areas is significant. Global NSW notes that advanced manufacturing, including the rise of automation and robotics, represents a dramatic industry transformation with the potential to bring significant benefits including the on-shoring of production and localised production.

Global NSW also notes that technology advancements, including automation and AI, can boost productivity and income growth, attract global capital and create new higher-paying jobs. It is estimated that embracing automation in certain circumstances could add $1.1 trillion to $4 trillion to the Australian economy over the next 15 years.[2]

Tech Central technology hub

To help deliver on these future skills, jobs and business opportunities, the NSW Government is committed to creating the biggest technology hub of its kind in Australia in Sydney. Tech Central will provide affordable space for local start-ups and scale-ups, supported by excellent transport to Greater Sydney, rural and regional NSW and into international markets.

The NSW Government has committed over $48 million to kick-start Tech Central to deliver up to 25,000 square metres of affordable space for start-ups and scale-ups over the next five years around Central Station. The NSW Government's commitment will create the biggest technology hub of its kind in Australia, expand Sydney CBD's commercial core to the south and, in partnership with TfNSW, enhance Central Station's status as one of the key transport hubs in NSW.

Future Mobility Test Centre in regional NSW

It is important that the economic opportunities that flow from advanced transport technologies also benefit regional communities and businesses.

As part of TfNSW's priority to be a world leading adopter of CAV technologies, the Future Mobility Test Centre at Cudal in NSW's Central West has been established to be a regional facility for advanced testing of CAV technology integration with on-road sensors, infrastructure and other vehicles.

The Future Mobility Test Centre also has the potential to be a world class proving ground used to undertake robust testing of both products and vehicles, and support ongoing research and evaluations of CAV technologies.

The Test Centre enables strong partnerships to be built between Australian regulators and advisory bodies like ANCAP, Austroads and the National Transport Commission, and with vehicle OEMs, technology suppliers, universities and industry representatives, occurring in a central regional location and attracting local skills development and employment opportunities

1 PwC (2018), Recharging the economy: The economic impact of accelerating electric vehicle adoption.

2 Australia's automation opportunity: Reigniting productivity and inclusive income growth, McKinsey & Company March 2019.

8. Appendix – Alignment with NSW strategic directions

TfNSW's Future Transport Technology Roadmap priorities and program align with, and support, many other important NSW strategic policies and directions. These include:

- NSW Premier's Priorities – which focus on well-connected communities with quality local environments, and 'Government made easy', using technology and data to better integrate and improve the quality of government services;
- COVID-19 Recovery Plan – reflecting changes in transport demand and freight logistics, and that digital technology is vital infrastructure;
- Future State Intergenerational Report – including workforce 'virtualisation' as an enabler of regions; better customer services and infrastructure using technology and data; and future transport with new modes, more efficient networks and improved regional connectivity;
- Greater Sydney Region Plan: A Metropolis of Three Cities – including infrastructure to adapt to technological changes, like demand responsive transport, electric vehicle charging, and car parks and drop-off bays adapted for autonomous vehicles;
- 20-Year Economic Vision for Regional NSW – including digital disruption and leveraging opportunities with entrepreneurship in regional areas;
- State Infrastructure Strategy – including digital connectivity and technology, linking transport infrastructure, services and technologies, improved connectivity and treating data as an asset; and innovative service delivery models for innovative consumer-centric services;
- Smart Places Strategy and the Smart Infrastructure Policy – embedding technology and data-driven solutions in new and upgraded infrastructure, to improve communities and provide the best return on government's infrastructure commitments;
- Net Zero Plan – to reach net-zero emissions by 2050, with support for electric and hydrogen-powered vehicles – and the NSW Decarbonisation Innovation Study with electrified and efficient mobility, digitally connected automated networks, shared mobility services and low-emissions freight;
- NSW Innovation Strategy – to boost innovation, stimulate economic activity and drive shared prosperity, including support for the knowledge economy and entrepreneurs;
- Beyond Digital – including focus on MyServiceNSW accounts and linking services under 'Tell us Once', cyber security and data centre reform, supporting the Data Analytics Centre and Digital Twin, the Digital Restart Fund and TfNSW's Digital Accelerator;
- Digital Government Strategy and Cyber Security Strategy – identifying digital priorities and a risk-based approach for safeguarding citizen data and critical government services;
- AI Strategy and Ethics Policy – presenting Government's focus on ethical use of AI with five principles to ensure optimum service delivery outcomes, privacy, transparency and fairness;
- Data Strategy – putting data at the heart of decision-making through a collaborative, coordinated, consistent and safe approach to using and sharing data;
- Jobs for the Future to nurture growth in start-ups and digital innovation, and to skill up for the knowledge economy, and the Trade and Investment Action Plan, strengthening NSW's economy by leveraging the transport technology sector;
- Global NSW – NSW's approach to trade, investment and economic development to competitively position NSW in the global economy and cement Sydney and NSW's regional leadership as Australia's global hub.