



Autonomous Vehicles in Tempe: Opportunities and Risks



Executive Summary

This report outlines policy considerations and pilot projects that could further define what investments and ordinances may be necessary to ensure that autonomous vehicles are appropriately and safely integrated into Tempe's infrastructure and communities. The report aims to:

- Understand the role of AV in Tempe
- Identify opportunities and risks
- Identify potential investments
- Identify potential policies and pilot projects
- Provide the Mayor and Council with clear next steps

Autonomous vehicles present Tempe and others cities with both opportunities and risks. Opportunities to rethink how people, goods, and vehicles move around our city in ways that improve communities and enhance sustainability. Risks in terms uncertainties around vehicle and roadway safety, transparency and trust between local governments and industry, and implications for other infrastructure systems, including public transit use. This report reviews how AVs might impact Tempe's Strategic Priorities, including:



Safe and Secure Communities



AVs could reduce human error, reduce the number of cars on the road and support Tempe's Vision Zero.



Uncertainty and lack of transparency about vehicle and roadway safety continues to reduce public trust in AVs.



Strong Community Connections



AVs could be used to connect people to public transit and, with shuttles, be used to enhance pedestrian zones in certain areas.



AVs could reduce public transit ridership and increase car trips.



Quality of Life



Partnerships with operators, such as Lyft and Waymo, can help ensure access to AVs in ways that enhance mobility for those who need it.



Like current rideshare options, AVs might not be affordable to populations who could benefit most.



Sustainable Growth and Development



AVs are deployed as fleet autonomous shared and electric, reducing trips, air pollution and carbon emissions.



AVs result in more car trips.



Long-term Financial Stability and Vitality



Tempe uses its role as an innovator to provide leadership in how to forge public-private partnerships with AV industry.



AVs drastically reduce several sources of revenue including parking and gas tax.

The report recommends the Mayor and Council:

1. Supplemental Budget Request to Create Smart Mobility Playbook
2. Support autonomous vehicle and smart mobility partnerships and pilot projects
3. Continue to invest in Transportation Master Plan and national best practices in transportation planning
4. Advocate for smart mobility at regional and state-levels
5. Continue to follow NLC recommendations

About this report

In April of 2018, the City established a Technology and Innovation Steering Committee (TISC). The committee is made up of Directors and Deputy Directors from each department and includes both the COO and CFO from the City Manager's Office. The purpose of the committee is to ensure that our investment in technology and I.T. resources is collaborative, reflects a common vision of service delivery, and is operationally sustainable. The overarching objective of the committee is to advance the strategic priorities of the City through sustainable and innovative practices.

One of the key subcommittees of TISC is the Innovation subcommittee. The role of the Innovation subcommittee is to engage with our public and private partners on highly visible new technology and "smart city" initiatives that will influence Tempe's future as a leader in innovation. Currently the subcommittee is focused on Autonomous Vehicles. The Autonomous Vehicles (AVs) subcommittee was established in February 2018, just weeks prior to the Uber fatality. The purpose of the subcommittee is to understand the current and possible future use of AVs in Tempe. The subcommittee is comprised of representatives from key city departments, commissioners from the City of Tempe Transportation Commission, ASU and Maricopa Association of Governments (MAG). The subcommittee is partnering with Arizona State University's Center for Smart Cities and Regions, led by Dr. Thad Miller, to help facilitate conversation with AV companies, smart city experts and the public. Dr. Miller led a class of students in the Fall of 2017 from the School for the Future of Innovation in Society. The students explored the potential future of AVs in Tempe and how AVs could support or provide challenges to achieving the Council's strategic priorities, such as 20 minute city, increased mobility through traffic reduction, increased access for people with disabilities or increased safety through a reduction of fatal and serious car crashes. The subcommittee has spent the last few months meeting with experts, other cities, and AV companies in order to produce a white paper for Council.

- Jennifer Bolosan, IT Solutions Architect, City of Tempe
- Nigel Brooks, Commissioner, Tempe Transportation Commission
- Brenda Buren, Assistant Police Chief, City of Tempe
- Keith Burke, Deputy Community Services Director, Recreation, City of Tempe
- Don Cassano, Community Relations Manager at Arizona Department of Transportation
- Stephanie Deitrick, Enterprise GIS Manager, City of Tempe
- Julian Dresang, Traffic Engineer, City of Tempe
- Ryan Guzy, Chair, Tempe Transportation Commission
- Kim Hale, Commander, City of Tempe
- Christopher Hansen, Risk Manager, City of Tempe
- Bob Hazlett, Senior Engineer Project Manager at Maricopa Association of Governments
- Wydale Holmes, Strategic Management Analyst, City of Tempe
- Paul Hubbel, Commissioner, Tempe Transportation Commission
- David Humble, Assistant Police Chief, City of Tempe
- Rosa Inchausti, Strategic Management & Diversity Director, City of Tempe
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- Braden Kay, Sustainability Director, City of Tempe
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- Shelly Seyler, Deputy Public Works Director, Transit/Traffic Engineering, City of Tempe
- Lori Singleton, Interim CEO / President at Arizona Forward
- Teresa Voss, Assistant City Attorney, City of Tempe
- Chad Weaver, Community Development Director, City of Tempe
- Mark Wittenburg, Deputy Internal Services Director, IT, City of Tempe
- Marge Zylla, Government Relations Officer, City of Tempe

Goals for Report

This white paper outlines policy considerations and pilot projects that could further define what investments and ordinances may be necessary to ensure that AVs are appropriately and safely integrated into the city. The report aims to:

- Understand the role of AVs in Tempe
- Identify opportunities and risks
- Identify potential investments
- Identify potential policies
- Provide the Mayor and Council with clear next steps

Tempe City Council Priority Performance Measures

This report ensures that Tempe examines the incorporation of AVs into our city in a manner that supports and enhances the city. Specific attention is paid to how AVs can support the following Mayor and Council-adopted performance measures:

- 1.08 – High Severity Traffic Crashes: Achieve a reduction in the number of fatal and serious injury crashes to zero.
- 3.13 – Disability Social Inclusion: Achieve a score of 100 on the self-assessment tool for “Disability Social Inclusion” in accordance with the Tempe Disability Inclusion Plan (T-DIP) and the National Council on Disability.
- 3.26 – 20 Minute City: Achieve a multimodal transportation system (20-minute city) where residents can walk, bicycle, or use public transit to meet all basic daily, non-work needs.
- 3.27 – Traffic Delay Reduction: Achieve travel times at or below XX minutes per mile during rush hour traffic periods along major streets (arterial corridors).
- 3.29 – Transportation System: Achieve ratings of “Very Satisfied” or “Satisfied” with the “Overall Satisfaction with Transit System in Tempe” greater than or equal to 80% as measured by the City of Tempe Transit Survey.
- 4.19 – Carbon Neutrality: Achieve the City Council goal of carbon neutrality in municipal operation by 2050 with a strategy of 100% renewable energy by 2035.

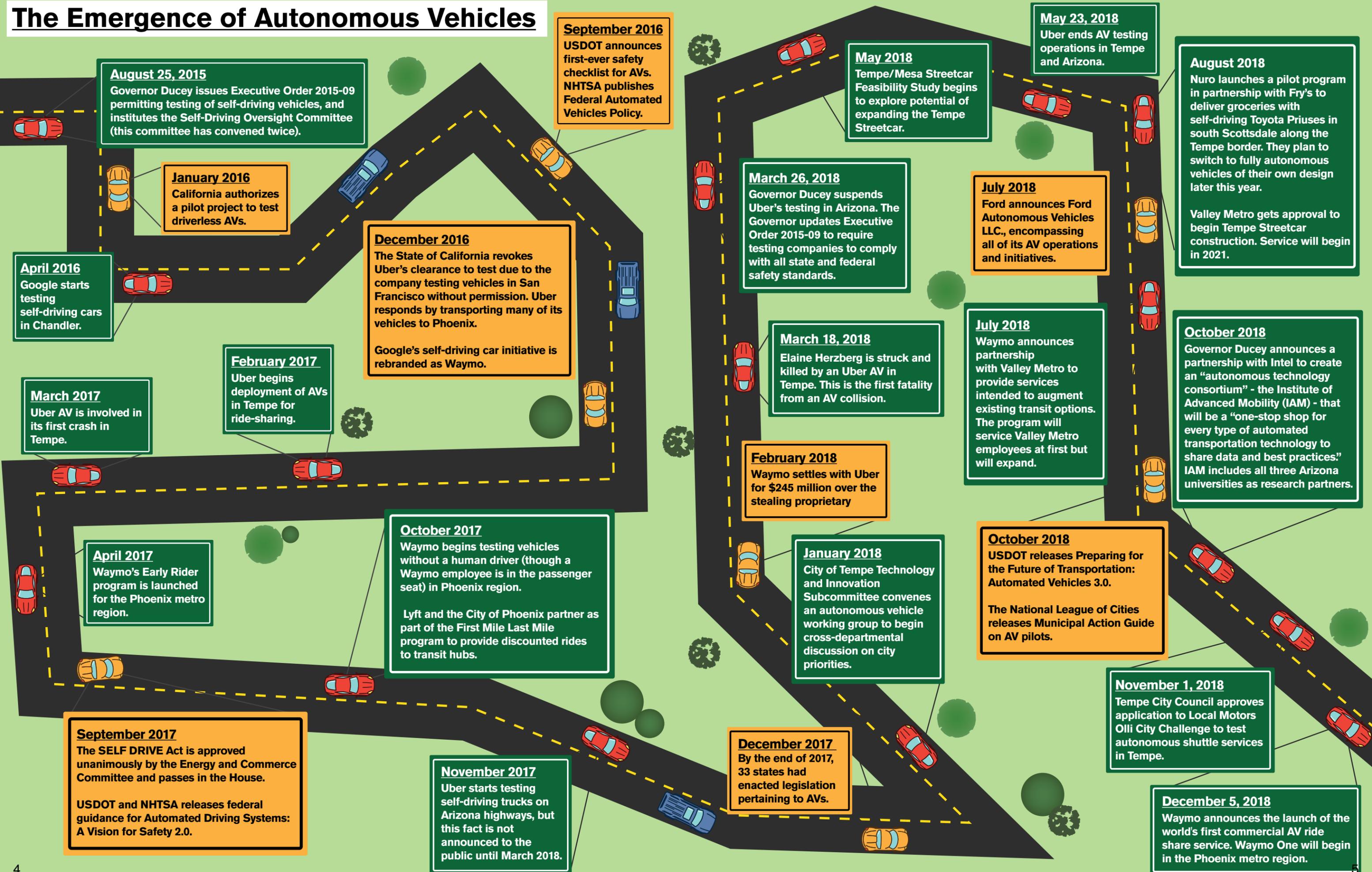
Authors

This report is a reflection of discussions in the TISC. The research and writing of the report was led by Dr. Thad Miller and Dr. Devon McAslan from the ASU Center for Smart Cities and Regions and Dr. Braden Kay and Rosa Inchausti from the City of Tempe.

Acknowledgements

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The Emergence of Autonomous Vehicles



August 25, 2015
Governor Ducey issues Executive Order 2015-09 permitting testing of self-driving vehicles, and institutes the Self-Driving Oversight Committee (this committee has convened twice).

January 2016
California authorizes a pilot project to test driverless AVs.

April 2016
Google starts testing self-driving cars in Chandler.

March 2017
Uber AV is involved in its first crash in Tempe.

February 2017
Uber begins deployment of AVs in Tempe for ride-sharing.

April 2017
Waymo's Early Rider program is launched for the Phoenix metro region.

September 2017
The SELF DRIVE Act is approved unanimously by the Energy and Commerce Committee and passes in the House.

USDOT and NHTSA releases federal guidance for Automated Driving Systems: A Vision for Safety 2.0.

December 2016
The State of California revokes Uber's clearance to test due to the company testing vehicles in San Francisco without permission. Uber responds by transporting many of its vehicles to Phoenix.

Google's self-driving car initiative is rebranded as Waymo.

October 2017
Waymo begins testing vehicles without a human driver (though a Waymo employee is in the passenger seat) in Phoenix region.

Lyft and the City of Phoenix partner as part of the First Mile Last Mile program to provide discounted rides to transit hubs.

November 2017
Uber starts testing self-driving trucks on Arizona highways, but this fact is not announced to the public until March 2018.

September 2016
USDOT announces first-ever safety checklist for AVs. NHTSA publishes Federal Automated Vehicles Policy.

February 2018
Waymo settles with Uber for \$245 million over the stealing proprietary

January 2018
City of Tempe Technology and Innovation Subcommittee convenes an autonomous vehicle working group to begin cross-departmental discussion on city priorities.

December 2017
By the end of 2017, 33 states had enacted legislation pertaining to AVs.

March 18, 2018
Elaine Herzberg is struck and killed by an Uber AV in Tempe. This is the first fatality from an AV collision.

March 26, 2018
Governor Ducey suspends Uber's testing in Arizona. The Governor updates Executive Order 2015-09 to require testing companies to comply with all state and federal safety standards.

May 2018
Tempe/Mesa Streetcar Feasibility Study begins to explore potential of expanding the Tempe Streetcar.

July 2018
Ford announces Ford Autonomous Vehicles LLC., encompassing all of its AV operations and initiatives.

July 2018
Waymo announces partnership with Valley Metro to provide services intended to augment existing transit options. The program will service Valley Metro employees at first but will expand.

October 2018
USDOT releases Preparing for the Future of Transportation: Automated Vehicles 3.0.

The National League of Cities releases Municipal Action Guide on AV pilots.

November 1, 2018
Tempe City Council approves application to Local Motors Olli City Challenge to test autonomous shuttle services in Tempe.

December 5, 2018
Waymo announces the launch of the world's first commercial AV ride share service. Waymo One will begin in the Phoenix metro region.

May 23, 2018
Uber ends AV testing operations in Tempe and Arizona.

August 2018
Nuro launches a pilot program in partnership with Fry's to deliver groceries with self-driving Toyota Priuses in south Scottsdale along the Tempe border. They plan to switch to fully autonomous vehicles of their own design later this year.

Valley Metro gets approval to begin Tempe Streetcar construction. Service will begin in 2021.

October 2018
Governor Ducey announces a partnership with Intel to create an "autonomous technology consortium" - the Institute of Advanced Mobility (IAM) - that will be a "one-stop shop for every type of automated transportation technology to share data and best practices." IAM includes all three Arizona universities as research partners.

What is an autonomous vehicle?

Autonomous Vehicles (AVs) — often referred to as connected, self-driving, or driverless cars — are vehicles that are capable of navigating through physical environments with limited to no human controls. AVs utilize a variety of sensing technologies — such as cameras, LIDAR (light detection and ranging), GPS (global positioning satellites), and radar — in combination with onboard control systems to build three dimensional maps of the world they traverse. AVs can be linked to external sensors embedded in the infrastructure or in other vehicles, allowing them to transmit the data they collect and to receive data about the transportation system beyond their own sensing range.

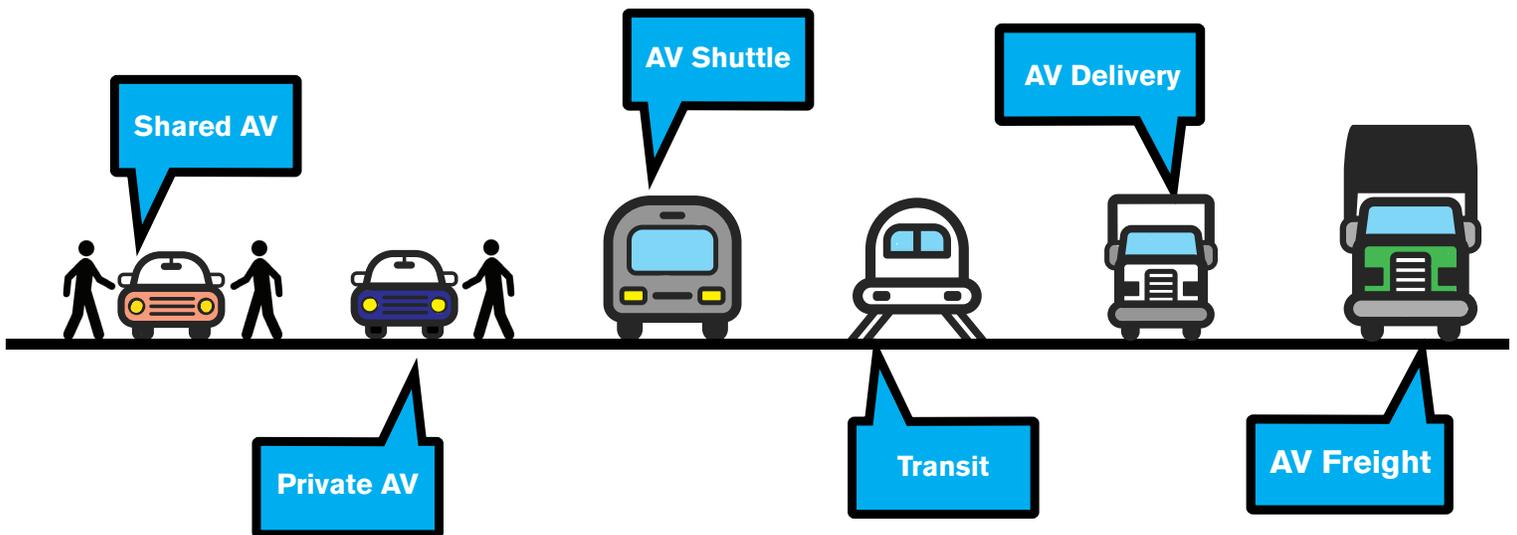
A six-level classification of automation has been developed by the Society of Automotive Engineers (SAE). This scale ranges from manual or level 0 (the automated system offers warning and suggestions but does not participate in operation of the vehicle) to fully autonomous or level 5 (no human intervention is required at all). The levels in between are considered “semi-autonomous.” One of the key socio-technical challenges with autonomous vehicles lies in this range, as the driver must remain alert and prepared to quickly take over for the automated systems in certain situations. The frequency of these instances, referred to as “disengagements,” has received increasing attention as a metric of AV performance.

0	1	2	3	4	5
No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
The driver constantly performs all aspects of the dynamic driving task. No systems intervene - only those that warn the driver	The system can take over either steering or acceleration / deceleration. The driver must continuously carry out the other.	The system takes over both steering and acceleration / deceleration in a defined use case.	The system takes over both steering and acceleration / deceleration in a defined use case. It is capable or recognizing its limits and notifying the driver.	The system is capable of handling the entire driving task in defined use case.	The system can take over the entire dynamic driving task in all use cases.
The driver must constantly monitor the drive.	The driver must constantly monitor the drive. They must resume full control immediately.	The driver must constantly monitor the drive. They must resume full control immediately.	The driver does not need to monitor the drive, but be ready to resume full control within a given time frame if the system so requests.	The driver would not be required at all during these cases - neither for monitoring or as a backup.	The drive is no longer required at all.
Old news	Current fleet	On the road Tesla autopilot	For sale. Audi A8	In testing Waymo	The ultimate goal

What's around the corner?

Technological projections should be taken with a “grain of salt” as there remains a lot of uncertainty and a lack of transparency around AV performance. However, autonomous vehicle technology has progressed rapidly in the last five years. In the last decade, the costs associated with AV technology have drastically reduced, primarily the various sensors, such as LIDAR. Presently, the technologies required to make a car self-driving cost anywhere from \$50,000 to \$200,000 per vehicle. By 2020, these costs are expected to drop to about \$10,000 and to only \$5,000 by 2035. The current high cost of these makes private autonomous vehicle ownership prohibitive, but many companies see this as an opportunity to capitalize on ride-sharing as the primary model for AV adoption. Existing

ride share-companies, Uber and Lyft, are both developing their own self-driving technology, while new companies, such as Waymo and Local Motors here in the Phoenix area, and many others in other cities across the US, are developing ride-sharing services. Waymo expects to begin their commercial ride-share service in December, building on the last two years of their early-rider program. As these ride-sharing services mature and begin to offer full Level 5 autonomous travel within the next five to ten years, the costs associated with AVs will continue to drop and potentially allow for private AV adoption at a large scale, most likely within the 10-15 year time frame.



The Role of Cities

New federal guidelines for AVs focus on getting the technology to market and on vehicle safety standards. Federal developments show less concern with the logistics of their testing and deployment and their potential impact on local infrastructure and communities. Local governments across the US have begun to rapidly develop cross-cutting working groups, policies, initiatives and pilots to explore what AVs mean for their city and residents.

Throughout the nation, cities and states are creatively exploring how best to harness AVs for the public good and, just as importantly, are coming together to share their experiences of what works. Early initiatives emphasize vehicle and roadway safety, congestion, integration with public transportation systems, improved mobility for numerous demographics (e.g. elderly, youth, and disabled persons), equity, labor market impacts, and sustainability.



Tempe Strategic Priorities	Department of New Urban Mechanics (Boston, MA)	Autonomous Transportation Open Standards Lab (Sacramento, CA)	Smart Autonomous Vehicles Initiative (Portland, OR)	Department of Mobility and Infrastructure (Pittsburgh, PA)
 Safe and Secure Communities	✓	✓	✓	✓
 Strong Community Connections			✓	
 Quality of Life	✓			✓
 Sustainable Growth and Development			✓	
 Financial Stability and Vitality	✓	✓	✓	✓



-  **Policy Initiative**
-  **Street Pilot**
-  **Both**

Pittsburgh: Department of Mobility and Infrastructure

The City of Pittsburgh has emerged as a leader in the field of Smart Cities. The Department of Mobility and Infrastructure (DOMI) mission is to guide the development of AVs and related emerging technologies to ensure they further the city’s goals of zero deaths or serious injuries, 20-minute city design, active travel for short trips, reduced financial burden of transportation, and safe streets for vulnerable users. Having emerged from a disappointing partnership with Uber, Pittsburgh’s Mayor Peduto has reaffirmed its commitment to a “social compact with shared and autonomous mobility providers [that] ensures that these services do good for communities while these businesses do well in cities.”

Portland: Smart Autonomous Vehicles Initiative

Portland believes it can show how to “do AV smart” by working with transportation providers and the public to implement testing and piloting of this technology, while advancing public safety, protection of the environment, and transportation access for everyone. Portland’s Connected and Automated Vehicles Policy, adopted in June 2018, prioritizes implementation of fleets of automated vehicles that are electric and shared (FAVES). The policy also emphasizes integration with other smart technologies, safety, and minimizing or improving the environmental impact of Portland’s transportation system.

Sacramento: Autonomous Transportation Open Standards Lab (SACATOS)

Launched in April of 2017, ATOS Lab is “a platform to ask and answer how to best to scale for the benefit of the public.” ATOS is comprised of government agencies and AV companies working together under a research agenda and data-sharing agreement. ATOS levels the playing field between developers, creating a more diverse development ecosystem.

ATOS research aims to create new workforce opportunities, interoperable standards, evidence-based policy, and performance validation. ATOS will also produce an open source playbook to help other cities optimize their collaboration with public agencies and industry partners.

Boston: Office of New Urban Mechanics

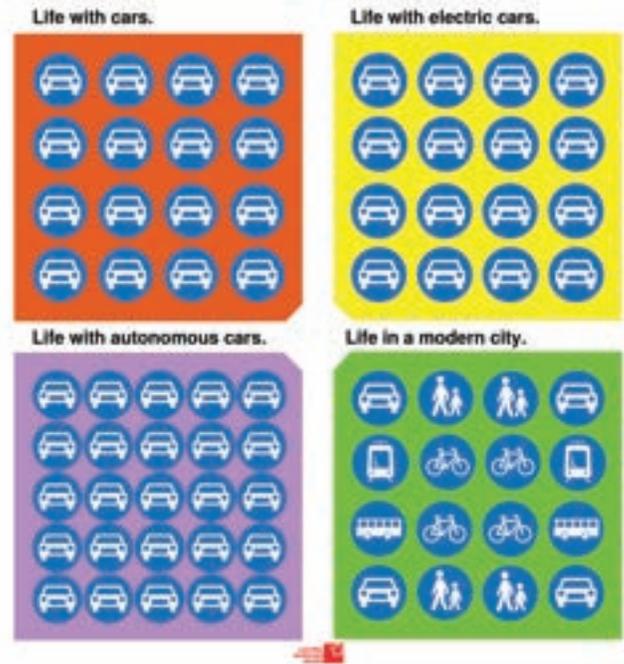
Boston’s “graduated” approach to autonomous vehicles has been focused on safety from the start. Testers must meet successive performance milestones in order to expand their pilot. Even inclement weather limits the testers’ freedom in early phases. Boston’s pilot with NuTonomy is the only company to have achieved a level of trust that allows them to use the entire city.

The Office of New Urban Mechanics is guided by its commitment to a vision of zero roadway deaths that extends to pedestrians and other vulnerable roadway users, expanded mobility for those who cannot drive, and reliable, equitable transit that arrives quickly and on time. While some cities have taken a hands-off approach to attract testers, Boston, with support from its universities and affiliated research centers, has maintained active oversight of all testing on its streets.

Autonomous Vehicles in Tempe: Risks and Opportunities

The City of Tempe has been at the forefront of the deployment of AVs and a site for innovation. AVs present significant opportunities and risks for the Tempe community. AVs do offer an opportunity to re-think how people and things move around our community. As such, AVs could be a catalyst for community connectivity, economic development, and sustainability. Yet, as the fatal collision involving an Uber self-driving car in March 2018 highlighted, this new technology carries new risks and uncertain public expectations.

Autonomous vehicles present a number of opportunities and risks in cities, particularly in cities such as Tempe. Below, some of the opportunities and risks are shown in relationship to the City of Tempe Strategic Priorities. Many of the benefits of AVs will only be realized if a shared autonomous future comes about, where fleet owned vehicles are the dominant use of AVs as opposed to privately owned AVs simply replacing existing private automobiles. This is highlighted in the image below which stresses the point that an AV is still a car, and unless we rethink how we get around the city completely, AVs provide little benefit over human driven cars, aside from their potential for improved safety.



AV Industry in Tempe



Nuro (and Toyota)

In partnership with Fry's Food and Drugs, Nuro is piloting an automated vehicle delivery service in the 85257 zip code in Scottsdale, AZ. Customers will be able to shop online with a phone or computer and Nuro's vehicle will deliver the purchased items later that day for a small delivery fee of about \$6. Currently, the pilot uses Toyota Priuses, but will be switching over to a special vehicle, the Nuro-designed R1, later this year.



Intel

Governor Ducey has announced the creation of the Institute of Automated Mobility - an autonomous technology research and development consortium - and Intel is first founding partner from the private-sector. Intel has been developing its Mobileye technology in Arizona since 2016 and has been cooperating with ASU since 2017.



Local Motors

Arizona-based Local Motors has designed an autonomous shuttle called the Olli and is now fielding proposals for pilots involving the vehicles. Tempe has submitted a proposal in November 2018.



General Motors

GM operates an IT Innovation Center in Chandler and the Cruise Automation facility in Scottsdale. In 2016, GM acquired Cruise and started testing autonomous vehicles in Chandler. Recently, Cruise Automation has received massive financial backing totaling about \$5 billion from Honda and Softbank, making it poised to expand its operations significantly.



Waymo

Google driverless car project has been on the road in the Phoenix area since 2016. Its rideshare program, which has been servicing only a select few early riders, will go to a fee based system. Waymo has partnered with Valley Metro to launch a first-last mile pilot program. Waymo has announced that it will launch its commercial AV rideshare program in December 2018 under a new company name.

Safe and Secure Communities

“Ensuring a safe and secure community through a commitment to public safety and justice.” This strategic priority relates to public safety, addressing issues such as emergency response, crime, and traffic safety.



Traffic Safety



AVs may have lower crash rates, prevent speeding and red light running. Implemented well, AVs could help achieve Vision Zero.



Thumbs-down: Could make people feel less safe as human drivers, as passengers, or as vulnerable road users such as pedestrians and bicyclists.

Emergency Response



AVs could be used as emergency response vehicles and take the fastest routes, reducing response times, and allowing personnel to focus on services and care.



AVs might not drive fast enough to improve times, or on certain roads, and AVs without connected infrastructure or smart signals will be less helpful for emergency response.

Cybersecurity



Guidelines for the safe collection, storage and use of data will increase trust in AV companies, as well as transparency.



Unwillingness to have data collected, or uncertainty about the collection and use of data by private companies could make people not want to use AVs.

Liability and Public Safety



AVs can reduce the number of accidents on Tempe streets, thus improving safety and changing ownership models will enable greater ride-sharing in the future. The city can take a leading role early on to develop guidelines for accident liability (perhaps partnering with State Farm) that can eventually be written into new laws and regulations.



Existing insurance liability does not apply well to AVs and new rules, regulations and laws will need to be written. If the city takes a back seat, these rules could negate many benefits of AVs.

Strong Community Connections

“Developing and maintaining a strong community connection by emphasizing the importance of open government, customer service and communication with community members.” This strategic priority addresses governance in Tempe, which is leading by example in the area of autonomous vehicles, through its Tempe Innovation Steering Committee on Autonomous Vehicles (TISC) and working with regional partners, such as Maricopa Association of Governments (MAG).



“The issue that we are dealing with the most is how we can help assist autonomous vehicles to function...” -- City of Tempe staff, interview

AV Governance



If the city builds partnerships and helps get the public familiar with AV technology, there will be higher use and more people will potentially benefit.



A lack of trust in the technology and other aspects of AVs and a lack of engagement will make people less likely to adopt AV technology in any significant way.

Data governance and sharing



Early steps to work with AV companies to require a certain level of data-sharing or mutual data-sharing, could dramatically improve a wide range of city services.



A lack of partnership-building with AV companies to leverage data-sharing agreements will only benefit private companies.

Public transportation



AVs can benefit existing public transit systems if they focus on the first/last mile and help get people to and from transit stops.



A failure to continue to improve public transit service will make AVs a more appealing option for those who can afford it and reduce transit ridership.



Quality of Life

“Enhancing the quality of life for all Tempe residents and workers through investment in neighborhoods, parks, the arts, human services, and city amenities, with an emphasis on equity and diversity.” This strategic priority addresses issues relating to education, age-friendly communities, accessibility, parks and the arts.



“...How it [automated vehicles] are developed in a way that is perhaps a bit more equitable than other emerging technologies tend to be.”

-- City of Tempe staff, interview

Accessibility for youth, elderly, disabled



AVs could enhance the mobility of youth, elderly and disabled populations to get them to work, school, shopping, public services and medical appointments, and many other destinations.



Regulations requiring occupants to have a driver's license reduces the ability of AVs to benefit populations that currently do not have driver's licenses and could benefit from AV mobility since they themselves do not drive.

Equity – access to new mobility options



Partnerships with operators, such as Lyft and Waymo, can help ensure access to AVs in ways that enhance mobility for those who need it.



The risk is that as with many new technologies they are available only to high income individuals and households, and not lower income groups, who could benefit the greatest from low cost and reliable mobility that AVs could provide.

20-minute neighborhoods



Could help make 20-minute neighborhoods a reality, particularly if there is an emphasis on using AVs as neighborhood shuttles or as a first/last mile solution to get people to existing public transit.



AVs could make driving cheaper and easier which disincentivizes changes in the urban environment to make neighborhoods more walkable, bikeable and transit oriented.

Congestion



AVs could make roadways more efficient reducing congestion.



More people in cars and a shift of users from public transit to AVs could put more cars on the roads, possibly negating potential gains in the efficiency of AVs.

Public perception



City and industry partnerships could work closely with local communities to discuss and understand hopes, concerns, and expectations to shape how AVs are deployed and utilized in Tempe.



With little public engagement, local communities' concerns are not heard. Tempe communities may not support public or private development of AV use.

Sustainable Growth and Development

“Implementing sustainable growth and development strategies, including improving Tempe’s public transit system to meet future needs, by actively seeking innovative technologies and leading the way in creating a more sustainable community.” This strategic priority addresses numerous environmental concerns including energy use, water, transportation, and urban development patterns.



“What if it was a combination [of bus, light rail and ride-share] with autonomous vehicles using a fixed route to get to and from space that are constant needs... but then can also go the extra mile to your house.” -- City of Tempe staff, interview

Emissions and climate impact



If all AVs are electric vehicles, then there will be a reduction in GHG emissions.



If AVs are not electric, GHG emissions will stay the same.

Compact urban development



AVs can enable the redevelopment of centrally located areas that are currently dedicated to parking lots and garages if less parking is needed in the future, particularly through a ride-sharing future.



Willingness to drive further distances in an AV and cheap land on the outskirts of the metropolitan area could reduce the market demand for new denser development in Tempe.



Long-term Financial Stability and Vitality

“Maintaining long-term financial stability and vitality by focusing on economic development, business retention, and generating employment to create a robust and diverse economic base.” This strategic priority addresses the economic base of the city, in terms of city revenue and spending and jobs.



Revenue impact



AVs could be incentivized to be electric and shared which will help lower GHG emissions, reduce parking requirements, and could help lower congestion. Alternative revenue sources such as road-pricing, per mile user fees, or vehicle occupancy fees offer a more fair pricing structure for the use of public infrastructure.



Existing revenues from public parking, traffic citations, gas-taxes, and others could be drastically be reduced.

Infrastructure needs



Many companies are building their self-driving technology to operate in existing roadways, which will make them less infrastructure dependent.



AV infrastructure needs could be expensive and require significant changes in roadway configurations and other types of infrastructure and not relying on a certain amount of infrastructure dependence could eliminate many of the potential benefits, such as with connected vehicles. Additionally, rapid changes in technology could make investments outdated by the time they are fully built-out by the city.

Labor market impacts



A shift in employment away from driving can make room for more a more customer service-oriented transportation model where instead of driving, employees can care for riders, answer questions and provide other customer service they otherwise could not.



AVs will remove many automobile related jobs from the economy, primarily drivers, requiring retraining programs for a large proportion of the population.

The Future of AVs in Tempe: Priorities and Pilots

As the previous section emphasized, AVs carry with them many opportunities and risks for Tempe. In order to manage and leverage AVs to meet near- and medium-term community needs and strategic priorities, now is the time for Tempe develop industry and community partnerships that lay the foundation for pilot initiatives, policy and infrastructure solutions that make AVs work for our community.

This section makes several recommendations for near-term actions regarding AVs in Tempe and identifies areas for further discussion and research. These recommendations are based on interviews, TISC discussions, and a series of expert and public forums on the Future of Transportation hosted by the City of Tempe and ASU.

Emerging Technology Strategy: A Smart Mobility Playbook

The City of Tempe has been very effective in developing and communicating its core goals and values. As this report has discussed, the challenge is how to make sense of emerging technologies, like AVs, and ensure that they are helping Tempe meet their goals and serve their values and communities. This report is a step in that direction, but further work is needed. We recommend that City Council direct city staff and administration to develop an Autonomous Vehicle, or, more broadly, a Smart Mobility Playbook (a broader version would include not just AVs, but also EVs, e-scooters, etc.). The audience for the Playbook would be city staff and administration, researchers, industry, and community members. It would clarify the problems, values and goals that Tempe is focused on and how AVs and other technologies might be able to support that. As such it would support better communication between Tempe and other sectors and facilitate more effective and impactful partnerships. While not a full smart mobility strategy, it would lay the groundwork for that and encourage the testing out of partnerships and pilots to develop and learn from new ideas. More specifically, the development of a Playbook would also encourage further analysis and discussion of the the following key issue areas:

- **Equity.** How can AVs and other emerging mobility technologies help move around people and things in ways that enhance community connections, quality of life and sustainability?
- **Infrastructure Zoning and Land Use.** There are a lot of options and uncertainties about what may or may not be needed or possible in terms of infrastructure, land use, zoning codes, and street design. Additional discussions, research, and regional and industry dialogues would help support further work on this issue.
- **Public Safety.** Develop a protocol for how industry can coordinate with Tempe public safety and emergency response for training and engagement. This could also explore regional coordination efforts. In addition, there may be an opportunity for the City of Tempe (perhaps in partnership with ASU) to become a national hub for public safety training and AVs.
- **Data Governance and Sharing.** AVs collect data about infrastructure conditions, safety and performance, and how people and things move around the city. How can we create data sharing platforms that ensure the safety and privacy of our communities while also accessing valuable data for transportation and infrastructure systems planning and maintenance?
- **Learning.** How can City of Tempe staff and administration, Tempe communities and local industry learn from pilot projects and from AV deployment?

An AV or Smart Mobility Playbook would provide guidance to both city staff and industry as they increasingly engage on AV deployment, pilot projects, and training.

Build Partnerships

From public safety concerns to the connection of AVs with public transportation, effective and open partnerships are critical to developing trust and to making AVs work for Tempe.

- **Industry partnerships.** Across the Phoenix region and US cities, the AV industry and city governments have created partnerships to deploy AVs to help solve specific urban problems (e.g., Boston and Nutonomy to explore safety and congestion; Valley Metro and Waymo to address first/last mile public transportation issues). Tempe should seek partnerships with AV and ride-share companies that have demonstrated their ability to act as open, collaborative, and trustworthy partners. These partnerships are key to making the recommended pilot projects proposed below work and to eventually develop policy solutions.

Beyond the AV industry, there are also local opportunities to partner to address insurance and liability issues with State Farm.

- **Regional partnerships.** AVs are being tested across the Valley, yet, to this point, there has been little regional coordination between Valley cities, with the Maricopa Association of Governments (MAG), or with Valley Metro. Regional partnerships could help test specific issues, support integration of effective solutions, and help facilitate industry partnerships.
- **State partnerships.** While the Arizona Governor's Office has been a first-mover on the acceptance of the AV industry and testing, there has been little coordination with local efforts. However, new opportunities are emerging. Governor Ducey recently launched the Institute for Automated Mobility (IAM), a public-private-university consortium to develop AV solutions. Tempe should reach out to determine an effective path for engagement in IAM.
- **ASU partnerships.** ASU has policy, social science, and engineering capacity on AVs and smart cities. The City of Tempe and ASU's Center for Smart Cities and Regions have been collaborating for over a year on AV policy and planning, which builds on other effective partnerships on sustainability. Tempe should continue and expand partnerships with ASU to help support policy developments, community engagement, and industry and regional partnerships.



Potential Pilot Projects

As noted earlier, a number of cities throughout the US are partnering with industry to conduct AV pilot projects that both test the technology and its ability to meet community needs. Tempe is in an excellent position to establish meaningful partnerships with industry to explore the ability of AVs to meet Tempe's strategic priorities. Over the course of the last year, the TISC AV subcommittee has discussed potential pilots. These pilots emerged from research and were discussed at public and expert forums. The potential pilots that Tempe might pursue included the following:

Use AVs to Support and Enhance Public Transportation

Neighborhood Circulator Shuttle. AVs are more than sedans and minivans; a number of companies are developing autonomous shuttles that can move people around campuses, to urban hubs, and to public transportation nodes. One example is the Olli developed by Local Motors. The City of Tempe has an application under review with Local Motors to deploy an Olli in the area between the Tempe Transportation Center and ASU. A neighborhood shuttle can better connect people to public transportation and also presents opportunities to reduce or eliminate single occupancy vehicles from certain areas, increasing pedestrian areas and utilizing the shuttle to move people around.

First/Last Mile. A perennial problem in public transportation systems is how to get people from their home to public transit and from public transit to their destination. Autonomous vehicles may offer an opportunity to fill this gap in our public transportation systems and services. Valley Metro and Waymo are currently in the early stages of a partnership that will address this issue. Tempe could explore a similar partnership to develop its own first/last mile solution.

Use AVs to Reduce Single Occupancy Vehicles

Incentivize deployment of fleet autonomous vehicles electric shared (FAVES). Through partnerships and incentives, the City of Tempe should work with industry to facilitate the deployment of AVs that are fleet, shared and electric. Shared AVs may help avoid the scenario of having single occupancy AVs (or just one rider) replace existing cars, which will not address congestion issues. FAVES also support the city's sustainability goals by promoting the use of electric vehicles.

Use AVs to Promote Equity and Access

On-demand or fixed route AVs to reach transit vulnerable communities. Transportation is the second largest expense for Tempe families. Many families are stretched thin by the costs of owning two or more cars, while others might need the mobility a first or second car provides but cannot afford it. This is particularly acute for elderly citizens and low income families. A pilot project in Tempe could use an autonomous shuttle to provide low cost mobility to middle and low income families. The pilot will test the ability of an autonomous shuttle (with on-demand and fixed routes) to reduce transportation expenditures, and provide quality, low cost mobility where it is absent. Access to low cost, reliable transportation could be transformative for families as increased mobility can help lower- and middle-income households live in neighborhoods with higher incomes, enables higher labor force participation, and provides access to better schools.

On-demand AV shuttle for paratransit. Autonomous shuttles could provide low cost, on-demand transportation for people with disabilities and personalized mobility needs. It could also be used to connect elderly citizens to doctor appointments and other needs.

Develop a Community Engagement Process for AVs

There is a mixture of concern and enthusiasm regarding AVs among the general public. The City of Tempe, perhaps partnering with both industry and ASU, should develop a series public engagement events to both educate people about AVs. This public engagement should also work with communities in order to understand their hopes and concerns around this emerging technology as well as how their needs might be met. This community engagement can lead to the development of new pilots that directly address Tempe residents' most pressing concerns and effectively demonstrate the safety and benefits of AV technology.

Next Steps

Mayor and Council have an opportunity to shape the future of transportation in the city and the region. Through meaningful partnerships, sound policy decisions and critical infrastructure investment, Tempe can use autonomous vehicle technologies and smart mobility solutions to support our high quality of life and vibrant economy. Mayor and Council should ensure strong and immediate steps are taken to embrace an innovative and successful approaches. Next steps include:

1. Supplemental Budget Request to Create Smart Mobility Playbook

- Funding for the guide.
- Commit to ASU Center for Smart Cities and Regions as a research partner to produce guide.
- Work with regional and national partners to ensure a high-quality guide.
- Ensure guide meets needs of public safety.

2. Support autonomous vehicle and smart mobility pilot projects.

- Developing public-private partnerships with the AV and smart mobility industry.
- Supporting research partnerships with ASU on responsible innovation, smart mobility, public safety, and public perception and engagement.
- Dedicating staff time and resources to develop and implement pilot projects.

3. Continue to invest in Transportation Master Plan and national best practices in transportation planning

- Identify opportunities within Proposition 400 extension.
- Support Transportation and Engineering Divisions in adopting street and infrastructure design guidelines in line with Council Priorities (based on Sustainability Commission recommendation).
- Identifying travel demand solutions with business community (based on the Urban Core Master Plan recommendation).

4. Continue to follow NLC recommendations

- Commit resources to regional AV coordination.
- Explore opportunity to participate in state-level conversations regarding AV state policies.
- Partner with ASU on public perception and engagement of AVs.





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