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Automated Vehicle Governance in California, Michigan, and Arizona –
**Trends in Social Equity and Environmental Benefits of Automated
Vehicles through Policy and Planning**

By

Jerel Francisco

Thesis

Submitted in partial satisfaction of the requirements for the degree of
Masters of Science

in

Transportation, Technology and Policy

In the

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Abstract

The possible emergence of automated vehicles on public road ways presents numerous challenges and opportunities for all levels of government in the US. Automated vehicle (AV) technology can achieve equitable outcomes if operated by mobility service providers with shared rides, greatly reducing the cost of travel and thereby increasing mobility for the mobility disadvantaged and reducing reliance on car-centric infrastructure. However, if AVs are personally owned, they could exacerbate existing inequities by reinforcing car-centric transportation and leaving behind vulnerable populations who could benefit from AV technology the most.

This thesis explores how to steer the adoption of AVs to an equitable and sustainable future by creating an AV justice framework informed by the unjust history of US transportation investments and policy. In examining the history of US transportation planning and policy, I will consider historic injustices pertaining to mobility, environmental and transportation justice. This examination will inform the development of the AV justice framework which will be applied to the planning and policy landscape of state and local governments in California, Arizona, and Michigan. Trends in each state indicate that local governments are the primary leaders in progressing towards achieving AV justice with the exception of California. At the state level, economic development priorities seem to dominate while sustainability and equity have taken a back seat when compared to progress at the local level.

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Chapter 1) Introduction

The current transportation system in the United States is at a crossroads. The Three Revolutions of vehicle sharing, electrification and automation create innovative on-road passenger transportation modes. New transportation technology such as ride-sharing services present more convenient ways to travel than ever before. Zero-emission vehicles can potentially improve air quality in congested urban areas and mitigate climate change, while vehicle automation can provide more efficient and safer ways to travel. This thesis will focus on this last piece, passenger vehicle automation, to explore how US policymakers at the state and local level can develop more socially equitable policies and plans for this nascent yet promising technology.

This thesis will consider past historic injustices within the US transportation system and the ways in which the system has historically unevenly distributed the benefits and burdens, leaving vulnerable groups disproportionately impacted by its negative externalities. This historic overview will create a contextual background for identifying what policy principles state and local governments should abide by, if public goals are to adopt AVs with social equity and environmental sustainability in mind. Specifically, I seek to identify how AV policies can potentially address past and present environmental, transportation and mobility injustices to inform a broader theory of AV justice. Each element of the AV justice framework will call upon potential injustices that AVs are poised to create system pertaining to **land-use, environmental sustainability, mobility, and government investment**. While this is not a complete list of areas which AVs may impact, I attempt to bring some resolution to decision makers and planners within an uncertain AV future. Once this AV justice framework is created I will use it to analyze federal, state and local government policy and planning landscapes to identify potential policy

intervention opportunities and recommendations to create a path towards the sustainable and equitable adoption of passenger automated vehicles.

To begin understanding what policy strategies are needed to achieve a sense of AV justice, the next Chapter (**Chapter 2**) will provide an overview of the historical context of transportation planning in the US, given the historic injustices of car-centric planning. **Chapter 3** will define AV technology and their impacts to society based on which ownership models are adopted. **Chapter 4** will provide an overview of the social (*mobility* and *government investment*) and environmental (*land-use* and *sustainability*) impacts which AVs pose to society to show how AV technology can create uncertainty to local and regional planning. Additionally, Chapter 4 will provide the AV justice framework informed by previous chapters which identify strategic AV policy recommendations based on environmental, mobility and transportation justice. In **Chapter 5**, I examine the Federal and State policy implications for AVs while considering how nascent the technology is. **Chapter 6** includes the methods of how the AV justice framework is applied to analyzing local and state AV documents and policies. **Chapter 7 – 9** will identify existing AV programs and policy trends in California, Arizona and Michigan to see how state and their local governments are working to address past, present and potential future transportation burdens created by AVs. Finally, **Chapter 10-12** I will apply the equity framework to identify how policies can and create pathways for local and state governments to address these issues.

Chapter 2) Historic Inequities of Transportation Policy

This following section will provide a historic overview of US transportation planning focusing on the impacts of federal highways investment within and around urban communities of color. I will address how race and class would define which communities would participate in highway planning process, leading to the unequal distribution of benefits and burdens of these car-centric investments. The purpose is to develop the historical background for the three justice elements.

2.1) Benefits of Highway Development

Transportation planning in the U.S. historically sought to decrease traffic congestion and increase connectivity between land-uses to create faster ways to transport goods and people. The Federal Interstate Highway Act of the Eisenhower administration provided federal funds to local and state agencies to create a nation-wide highway system connecting urban and rural communities. ¹ The propose of these federal highway funds was to plan and implement solutions around decongesting metropolitan areas based on principles of efficient movement and reduced travel times to meet a target “level of service.” This way of car-centric planning encouraged private vehicle ownership through road expansion thus reducing “paralyzing levels” of congestion experienced at the time. ² The benefits of creating a nation-wide interstate highway system would promise increased mobility for those who owned private automobiles to easily access opportunities though dispersed and sprawling land-uses. This would finally provide road connections for rural communities to access amenities and opportunities provided in denser urban areas. Overall, the provision of a new national highway network would create economic

¹ Raymond A Mohl, “The Interstates and the Cities: Highways, Housing, and the Freeway Revolt,” 2002, 78.

² Karel Martens, “Fairness in Traditional Transportation Planning,” in *Transportation Justice: Designing Fair Transportation Systems* (Routledge - Taylor and Francis Group, 2017).

and mobility benefits particularly to those living outside urban areas. The ability to travel seamlessly through previously congested cities was an appeal for many local and state officials receiving federal funding. In addition to this appeal, urban redevelopment agencies saw the opportunity to redevelop their downtown neighborhoods. Into the 1950s and 1960s, local redevelopment agencies sought to capitalize off of investment from the Federal Interstate Highway Act to increase access to urban centers through automobile travel. This meant that highways destroyed the physical and cultural identities of urban neighborhoods while displacing and segregating communities with the least amount of power in the highway planning process.³ The following section will address the social cost of highway development and how it has perpetuated Jim-Crow era segregation into the physical landscape of urban cities.⁴

2.2) Cost of Highway Development

While highway redevelopment would promise the benefits of high-levels of connectivity across the nation, it also came with non-monetary cost disproportionately impacting urban communities of color. These costs mainly impacted the urban communities that physically stood in the way of these concrete structures. Many communities of color were intentionally targeted for highway placement and were forcibly moved to make way for car-centric investments. Not only did highway placement serve to displace communities of color but they also acted as physical barriers. These structures physically reinstated Jim Crow-era segregation since they segregated

³ Robert Caro, *The Power Broker: Robert Moses and the Fall of New York*, 1974.

⁴ David Karas, "Highway to Inequity: The Disparate Impact of the Interstate Highway System on Poor and Minority Communities in American Cities" 7 (2015): 13.

communities of color from other parts of the cities and thus effectively isolated them.⁵ For highways to cut through cities to make way for automobile travel ultimately led to the destruction of the local cultural and social fabric of these communities.

One of the major challenges that urban communities faced in the highway planning process was being able to effectively engaging and informing state and local officials about the impacts of highways on the community. More specifically, government officials failed to engage with local communities to further understand the impacts of highway placement. Engagement by government officials with local communities varied between different cities, each telling their own story of highway history. For urban communities such as Vieux Carré in New Orleans and Greenwich Village in New York City, local highway advocacy efforts served to protect the interest of white elites with the power, resources and connections to influence the planning process and steer these structures away from the “historical” communities they beloved.⁶ These two cities both successfully prevented highway construction within the communities they desired. Opposite to this, communities of color such as Miami’s Black community of Overtown and Detroit’s racially mixed community of Rondo, were not as well connected or resourced to participate within the decision-making process for highways. These communities of color were rather seen as a form of urban blight, and highway planning officials saw the opportunity to erase them to make way for car-centric investments. The result led to the destruction of Overtown and Rondo which held concentrations of Black wealth and culture in South Florida and the Mid-West

⁵ David Karas, “Highway to Inequity: The Disparate Impact of the Interstate Highway System on Poor and Minority Communities in American Cities” 7 (2015): 13.

⁶ Eric Avila, *The Folklore of the Freeway: Race and Revolt in the Modernist City* (Minneapolis, UNITED STATES: University of Minnesota Press, 2014), <http://ebookcentral.proquest.com/lib/ucdavis/detail.action?docID=1693129>.

respectively. Other urban communities of color were also targeted such as Boston's Chinatown and South Stockton's Mexican and Asian communities.

The story of these four cities, as recounted by geographer Eric Avila, ultimately show the same racist intentions that highway planners exhibited to perpetuate institutional racism.⁷ Highway planners and decision makers saw these communities as what Robert Bullard would call the "path of least resistance" due to the high barriers of engagement experienced by these communities of color.⁸ The different levels of participation between well-resourced white communities and under-resourced communities of color ultimately tells a story of class privilege, but also indicates the barriers to engagement set by state and local governments.⁹ The barriers limited the opportunities of engagement for under-resourced communities of color to voice their concern within the state to prevent destructive highway development. Communities of color were purposely left out of government (local, state and federal) processes for the sake of "progress" through car-centric investments.

The high barriers of engagement prevented communities of color from advocating for their needs within the highway planning process thereby leading to transportation injustices. Preventing communities of color from engaging in the planning process has led to disproportionate mobility and environmental burdens. If AV policies are developed with similar barriers of engagement, it can potentially perpetuate past transportation injustices leading to additional mobility and environmental burdens on communities of color. The following sections will address what how

⁷ Avila.

⁸ Robert D. Bullard, "Environmental Justice in the 21st Century: Race Still Matters," *Clark Atlanta University* 49, no. 3/4 (2001): 151–71, <https://doi.org/10.2307/3132626>.

⁹ Eric Avila, *The Folklore of the Freeway: Race and Revolt in the Modernist City* (Minneapolis, UNITED STATES: University of Minnesota Press, 2014), <http://ebookcentral.proquest.com/lib/ucdavis/detail.action?docID=1693129>.

each justice element has originated with regards to the historical context of transportation planning.

2.3) Environmental Justice Origins - Impacts of Highway Development

Highways also had significant impacts on local air quality forcing those that live near highways to bear the disproportionate burden of mobile source emissions. These emissions degrade local air quality leading to detrimental public health impacts such as pulmonary and cardiovascular issues, and chronic asthma due to long term exposure to these emissions which often burdening communities of color the most.¹⁰ While these environmental injustices persisted in urban communities of color, the origins of the EJ movement evolved from questioning the process of how toxic waste sites were disproportionately placed in communities of color in the late 1970s.¹¹ The movement grew and expanded to include environmental disparities experienced by low-income and minority communities beyond locally unwanted land-uses (LULU). Around the 1990s the EJ movement began to include transportation, focusing on unequal access to transit service and the disproportionate burden of mobile source emissions from highway placement in communities of color.¹² Today many of these communities still face these environmental burdens resulting from inequitable transportation planning practices.¹³

¹⁰ Lara P. Clark, Dylan B. Millet, and Julian D. Marshall, “Changes in Transportation-Related Air Pollution Exposures by Race-Ethnicity and Socioeconomic Status: Outdoor Nitrogen Dioxide in the United States in 2000 and 2010,” *Environmental Health Perspectives* 125, no. 9 (September 22, 2017): 097012, <https://doi.org/10.1289/EHP959>.

¹¹ Devajyoti Deka, “Environmental Justice, Transport Justice, and Mobility Justice,” in *International Encyclopedia of Transportation*, ed. Roger Vickerman (Oxford: Elsevier, 2021), 305–10, <https://doi.org/10.1016/B978-0-08-102671-7.10728-6>.

¹² Deka, “Environmental Justice, Transport Justice, and Mobility Justice.”

¹³ Bullard, “Environmental Justice in the 21st Century.”

Environmental Justice (EJ) can be defined as the equitable distribution of environmental burdens and benefits of environmental benefits (clean air) and cost (air pollution). With regards to highway history, EJ focuses on reducing the environmental burdens associated with mobile source emissions. The history of transportation planning sought to place highways in low income and minority communities that lacked the power to voice their needs and opinions within this planning process meaning that highways development would followed the “path of least resistance.”¹⁴ Many of these communities impacted by highway planning had already been suffering from the generational impacts of “redlining,” an institutionalized racist practice in which communities of color were deemed high risk for home loans thus creating barriers to better housing opportunity.¹⁵ These same redlined communities of color faced highway displacement as well as the disproportionate burden of noise and air pollution. The need to address these environmental injustices is also iterated in Robert Bullard’s “Environmental Justice in the 21st Century: Race Still Matters.” While Bullard’s piece is focused on locally unwanted land-uses, the environmental justice principles he lays out still pertain to the transportation sector. Specifically, Bullard addresses the need to prevent environmental harm caused by the transportation sector due to the racially institutionalized practices which have intentionally placed highways in communities of color.

These mobile source emissions which tend to burden communities of color locally has resulted in environmental injustices. While environmental burdens are disproportionately placed on communities of color living near highway infrastructure, the primary benefit of increased mobility was only felt by those with access a personal vehicle. These injustices could be

¹⁴ Bullard.

¹⁵ Jacob W. Faber, “We Built This: Consequences of New Deal Era Intervention in America’s Racial Geography,” *American Sociological Review* 85, no. 5 (October 1, 2020): 739–75, <https://doi.org/10.1177/0003122420948464>.

exacerbated by AV technology if deployed with ICE technology rather than zero-emission vehicle (ZEV) technology within a car-centric built environment. The distribution of the benefits could remain similarly uneven if AV technology is deployed primarily in privately owned vehicles.

While our car-centric transportation policies created these environmental injustices, they have also led to transportation injustices. The following section will discuss how exclusive transportation planning processes have created transportation injustices from a homogenous transportation system dependent on personal vehicles.

2.4) Impacts of Highway Dependence – Transportation Justice

The negative impacts of federal highway investment have also contributed to an unsustainable land-use and transportation system. Highway expansion sought to resolve traffic congestion generated in US metropolitan areas post-WWII with very little engagement with communities impacted the most by these developments. Despite the short-term benefits of congestion relief, highway expansion ultimately exacerbated congestion in the long-term and unevenly distributed the benefits and burdens of highways. The following section explains how these transportation injustices occurred.

Transportation Justice (TJ) can be defined as the equitable distribution of a mobility system's benefits and burdens achieved through an inclusive participatory decision-making process. I argue that due to the unfair participatory processes within the highways planning and policy processes, decision makers and planners must embed an inclusive public participation process in the development and implementation of AV policies and plans to reduce disproportionate

impacts that vulnerable individuals and communities have historically experienced from the transportation sector.

Unlike the grassroots origins of EJ, TJ evolved from academia as a critique of the traditional transportation planning process. Building on the work of others, Karel Martens provided an articulation of the concept with his 2017 book *Transport Justice: Designing Fair Transportation Systems*.¹⁶ The critique focuses on how state-centric processes created distributive injustices in the benefits and costs associated with car-centric highway planning.¹⁷ State-centric actions can be defined as government (local, state and federal) controlled transportation planning and policy processes which uphold the standards for developing transportation projects and infrastructure. With the highway planning processes, the knowledge of state-centric actors (planning agencies and decision makers) was privileged the most over community or society-centric knowledge.¹⁸ These processes have historically excluded low income and communities of color within the planning and distribution of highway infrastructure. Planning for a built environment around vehicles only benefited those with access and the ability to drive a vehicle. Communities and individuals which depended on personal vehicles obtained government investment for these car-centric investments while other modes (transit, walking and biking) did not receive equal investment until the 1970s through the Intermodal Surface Transportation Efficiency Act.

¹⁶ Devajyoti Deka, “Environmental Justice, Transport Justice, and Mobility Justice,” in *International Encyclopedia of Transportation*, ed. Roger Vickerman (Oxford: Elsevier, January 1, 2021), <https://doi.org/10.1016/B978-0-08-102671-7.10728-6>.

¹⁷ Alex Karner et al., “From Transportation Equity to Transportation Justice: Within, Through and Beyond the State,” *Journal of Planning Literature* Volume 35, no. Issue 4 (2020): 440–59.

¹⁸ Karner et al., “From Transportation Equity to Transportation Justice: Within, Through and Beyond the State.”

To prevent perpetuating these past injustices within the adoption of AV technology, achieving transportation justice involves the inclusion of vulnerable communities in numerous domains of AV planning and policy development processes.

These state-centric investments and processes have ultimately led to the sprawling metropolitan regions in the US today. The highways which connected dispersed land-uses served to reinforce segregation by setting a physical boundary between communities of color and white communities.¹⁹ Examples of the intentional placement of highway infrastructure in low-income and communities of color can be seen across US cities, from New York City²⁰ to Oakland, California.²¹ These vulnerable communities were intentionally displaced at the cost of increased connectivity and reduced travel times to and from urban cores.²² The overwhelming focus on installing car-centric infrastructure to relieve congestion led to an unjust transportation planning process. State centric knowledge was highly privileged over needs and opinions of the targeted communities.²³

While suburban sprawl created transportation injustices, it is a common landscape seen around many US metropolitan areas today. AVs can potentially exacerbate the issues of sprawl especially if they are adopted as private vehicles, and if land-use policies do not encourage high-density development and other complementary local government land-use policies. While the legacy of highway planning has left us with sprawling landscapes, the process which created this

¹⁹ Elizabeth Roberto and Elizabeth Korver-Glenn, “The Spatial Structure and Local Experience of Residential Segregation,” *Spatial Demography* 9, no. 3 (October 1, 2021): 277–307, <https://doi.org/10.1007/s40980-021-00086-7>.

²⁰ Robert Caro, *The Power Broker - Robert Moses and the Follow of New York*, n.d., <https://www.robertcaro.com/the-books/the-power-broker/>.

²¹ Aaron Golub, Richard A. Marcantonio, and Thomas W. Sanchez, “Race, Space, and Struggles for Mobility: Transportation Impacts on African Americans in Oakland and the East Bay,” *Urban Geography* 34, no. 5 (August 2013): 699–728, <https://doi.org/10.1080/02723638.2013.778598>.

²² Martens, “Fairness in Traditional Transportation Planning.”

²³ Dianne S Schwager, “CONSEQUENCES OF THE DEVELOPMENT OF THE INTERSTATE HIGHWAY SYSTEM FOR TRANSIT,” n.d., 22.

car-centric environment constitutes mobility injustices since not everyone can use, access or afford a vehicle. The following section focuses on how these mobility injustices were created.

2.5) Mobility Impacts of Car-Centrism – Mobility Justice

Highway planning has created the car-centric environment which has enhanced the mobility of personal vehicle owners enabling them to travel greater distances within shorter time periods in a sprawling environment. However, for those who do not have access to a personal vehicle, their mobility is greatly limited leading to lower levels of accessibility. Those without a personal vehicle are forced to rely on alternative modes such as transit which do not provide the same level of mobility. I argue that these mobility injustices have all resulted from this car-centric built environment. While these injustices have persisted since highway expansion post-WWII, mobility justice is a relatively recent concept which developed out of academia.

Mobility Justice (MJ) can be defined as the equal freedom and ease of movement for all people across different systems.²⁴ While TJ and MJ were introduced around the same time, these concepts of justice represent different imbalances within the transportation system. Within the context of transportation, MJ seeks to identify exploitive systems which create disparities of mobility among transportation users. These systems can exclude and include groups from benefiting (or losing) from the transportation system.²⁵ MJ mainly pertains to addressing recent issues such as the climate, urbanization and refugee crisis.

Car-centric infrastructure dependence is an exploitive system which MJ can address.

Specifically, the injustice it seeks to address is the varying levels of mobility between vehicle

²⁴ Mimi Sheller, *Mobility Justice: The Politics of Movement in the Age of Extremes* (Vesro, n.d.).

²⁵ Deka, “Environmental Justice, Transport Justice, and Mobility Justice.”

owners and non-vehicle owners that leads to “mobility-haves” and “mobility-have-nots.”

Mobility-have-nots are individuals unable to use a personal vehicle and may have other barriers to independent mobility. For example, someone who is unable to drive due to the lack of vehicle access, cost of travel, or other limitations such as physical or mental disabilities will have their mobility greatly limited in a car-centric society. As a result, they must be dependent on other modes such as transit, walking or biking, which do not provide the same level of mobility and access when compared to private vehicles. The dependence on alternative modes can reduce an individual’s opportunity in several ways. If users of these alternative modes feel unsafe using and/or accessing these modes, it can prevent travel all together leading to low levels of access to activities such as healthcare, education, jobs and quality food, thereby leading to a lower-quality of life. Mobility-haves are individuals who have few barriers to mobility and include those who are able to drive and own a personal vehicle. These individuals receive the highest benefits of our car-centric transportation system since they are able to access the diversity of land-uses within a sprawling environment primarily bolstered through private vehicles.

AVs have the great potential to increase mobility for all, including for mobility disadvantaged people, since they eliminate the need for a driver. With effective planning strategies and policy actions AVs can potentially increase mobility for the mobility have nots.

2.6) Historic Inequities of Car-Centric Planning – Discussion

From the overview of US transportation planning and policy it’s clear that the highway planning process has led to the unequal distribution of the benefits and costs of a car-centric society.

Highway planning process presented high barriers of engagement for all communities. The communities able to overcome these barriers where mainly white elites with the resources,

connections and knowledge to protect their communities of interest.²⁶ Meanwhile, under resourced communities of color were unable to overcome these barriers of engagement resulting in the destruction of Black and Brown communities of culture and wealth. This exclusive process of transportation planning has produced transportation injustice since it has led to cascading environmental and mobility injustices.

With AVs, decision makers have the opportunity to address these past injustices through community engagement within the AV planning processes to ultimately guide AV technology to meet the needs of the community. Through an open policy engagement process with a diversity of stakeholders, policy makers and planners can identify mobility needs and utilize AVs to meet these mobility needs rather than historically imposing a specific transportation mode which excludes individuals who may be mobility disadvantaged. The greater question is, how can policies account for these past injustices while mitigating the negative impacts of AVs? The following chapter will provide an overview of AV technology, including defining what AVs are and how the technology has the potential to address past injustices while mitigating its future negative impacts.

Chapter 3) Defining AV Technology and Technology Impacts to Society

Before diving into the policy paths, it's important to understand the potential of AV technology. First I will define what an "AV" is and the state of the technology. Once this overview is given I will dive into the broader implications AVs will have for society.

²⁶ Avila, *The Folklore of the Freeway*.

According to the Society of Automotive Engineers (SAE) Levels of Driving Automation, there are six levels of driving automation. Each level progresses from 0 (no driving automation) to 5 (full driving automation). Based on these levels, an AV is capable of performing increasingly complex dynamic driving tasks (act of sustained driving) as the technology transitions from lower to higher levels of automation. An AV is given its automated driving level based on the number of automated features which are engaged at any given time. This means that a vehicle containing an ADS (automated driving system) is able to contribute more to the dynamic driving task as the level of driving automated increases, requiring less attention from the (human) driver in some instances. Vehicles with Level 1-3 are considered to be lower levels of driving automation. Within these levels, the automated driving system is engaged while the human driver continues to perform part of the dynamic driving task. These lower levels of automation are best utilized in ways which ease the burden of labor for driving and reduce safety risk with human drivers. In Levels 4-5, when the AV system is engaged, it performs the dynamic driving task (DDT) on an on-going basis. Level 3 automation still requires the drivers to be able to take over the dynamic driving task while Levels 4 and 5 do not require a human driver. A vehicle with Level 4-5 capabilities is referred to have “automated driving” features.²⁷

Across the nation, there are numerous companies testing, developing and piloting AV technology with varying levels of driving automation. Several companies such as General Motor’s Cruise and Google’s Waymo are currently offering automated ride-hailing services in cities such as San

²⁷ “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles” (Society of Automotive Engineers International, April 2021), https://www.sae.org/standards/content/j3016_202104/.

Francisco,²⁸ Santa Monica²⁹, and Phoenix³⁰ with Level-3 (includes a driver) and Level-4 (no driver needed) autonomy. The goal of many of these development companies is to eventually create Level-5 technology capable of full self-driving ultimately eliminating the burden of driving with an automated driving system across numerous industries including passenger transportation. It is predicted that it will take several years until Level-5 vehicles will begin operating on public roads. The year 2030 could be the earliest society could potentially see higher levels (3-5) of AVs being commercial operated however, it may take until 2045 to see 50% of all vehicles being AVs.³¹

As the automated vehicle industry grows, the technology will mature and benefits in the form of driver safety can be realized with assisted lane keeping, collision avoidance and eventually full self-driving (Level 5). Until then we will see a transitional phase of AVs with ADS, starting with partially automated vehicles (Levels 0-2) including but not limited to existing technology such as cruise control, assisted lane keeping and adaptive cruise control. However, AV research indicates that partial automated driving levels (2-3) can create dangerous driving environments, undermining potential safety benefits of AVs.³² Whether it be consumers assuming their vehicle is equipped with Level 2 capabilities instead of Level-5, or unsafe road interactions between

²⁸ Peterson, “Resolution Approving Cruise LLC’s Application for Phase I Driverless Autonomous Vehicle Passenger Service Deployment Program.”

²⁹ Waymo Team, “Waypoint - The Official Waymo Blog: Next Stop for Waymo One: Los Angeles,” Waypoint – The official Waymo blog, accessed November 3, 2022, <https://blog.waymo.com/2022/10/next-stop-for-waymo-one-los-angeles.html>.

³⁰ Rebecca Bellan, “Waymo Is Expanding Its Driverless Program in Phoenix,” TechCrunch, May 18, 2022, <https://techcrunch.com/2022/05/18/waymo-is-expanding-its-driverless-program-in-phoenix/>.

³¹ Todd Litman, “Autonomous Vehicle Implementation Predictions - Implications for Transport Planning,” November 2022, 48.

³² Mary L. Cummings and Ben Bauchwitz, “Safety Implications of Variability in Autonomous Driving Assist Alerting,” *IEEE Transactions on Intelligent Transportation Systems* 23, no. 8 (August 2022): 12039–49, <https://doi.org/10.1109/TITS.2021.3109555>.

automated and non-automated vehicles, policy is needed to guide the AV industry to reduce safety risk and maximize safety benefits.

Another technological opportunity to advance the efficiency and safety benefits of AVs is through connected automated vehicles or CAVs. CAVs are digitally connected vehicles which communicate with other vehicles and traffic infrastructure to enhance safety and efficiency benefits. Through the uses of on-board vehicle technology and road-side equipment, vehicles can communicate data such as speed, position and direction to allow both human and computer “drivers” to become aware of road hazards and dangers and avoid them.³³ In an ideal future, Level-5 AVs will also have connected vehicle technology along with complementary connected roadside infrastructure to creating safe road and driving conditions.

Once these safety benefits are realized, society can begin to benefit. Since the burden of driving will be reduced as AV technology matures, human drivers will be relieved of driving stress thereby making the task easier. The simplification of the driving task can increase mobility for existing drivers and more importantly increase mobility access for those who cannot drive such as elderly individuals, people with disabilities and people without a driver’s license (mobility disadvantaged). Travelers can also be expected to travel for longer distances too, considering that time previously spent driving can be spent doing other things such as working, eating, sleeping or other forms of on-board entertainment.³⁴

³³ University of Michigan, “MCity - Leading the Mobility Transformation,” Academic Research, Mcity - Fast Facts, 2022, <https://mcity.umich.edu/our-vision/fast-facts/>.

³⁴ Baiba Pudāne, Sander van Cranenburgh, and Caspar G. Chorus, “A Day in the Life with an Automated Vehicle: Empirical Analysis of Data from an Interactive Stated Activity-Travel Survey,” *Journal of Choice Modelling* 39 (June 1, 2021): 100286, <https://doi.org/10.1016/j.jocm.2021.100286>.

3.1) Ownership AV Models

While the safety and efficiency benefits of AVs can increase mobility for those who are unable to drive or access a vehicle, these same benefits come with associated cost. These costs pertain to the ownership models in which AVs are adopted. This following section will address the various models of ownership and how these different models create benefits and burdens to society.

A private ownership models of AVs consist of an individual purchasing, maintaining and operating a personal AV. This model represents the ownership models seen today with many individuals who have personal vehicles today in the US and also contributes to a car-centric transportation system.

Contrary to a private AV ownership model is a shared model. A shared ownership model provides more accessible ways an individual can access a vehicle without the burdens of owning an AV. One of these possibilities is through fleets of AVs where a mobility service provider provides mobility-as-a-service through a ride-hailing phone application. An individual with a smart phone can summon a shared AV to bring them to their destination. Contrary to private AV ownership, ride-sharing can occur within the trip meaning other individuals can board the same vehicle to utilize the service. While ride-sharing may be more inconvenient than a private AV trip, there are broader indirect benefits to society for sharing a AV.³⁵ These benefits include decrease reliance on road and parking infrastructure which can relinquish the need for this infrastructure. Other benefits can include increasing personal miles traveled while decreasing vehicle miles traveled.

³⁵ Litman, "Autonomous Vehicle Implementation Predictions - Implications for Transport Planning."

Chapter 4) AVs Impacts and Justice Framework

Just as past transportation planning and technology has led to present disparities, AVs can potentially create new disparities and perpetuate previous ones within our transportation system. As automated vehicle technologies mature, their social and environmental impacts will be felt at the local level through local AV deployments, pilots and testing. Local and state governments must be prepared to mitigate and prevent the potential negative externalities of automated vehicles while simultaneously supporting innovation and maturation of automated vehicle technologies for society to receive its benefits. The following section will provide an overview of the foreseeable impacts of passenger automated vehicles pertaining to **mobility, environmental and transportation** justice elements. These impacts along with past injustices will be used to create **policy principles** which seek to reconcile past injustices based on the three justice principles. This examination of how the history of US transportation planning within the domains of **land-use, environmental sustainability, mobility, and government investment**. Within each of these domains of transportation planning and policy, I will examine how AVs can exacerbate existing inequitable conditions. These principles will be used to create **policy paths** which provide policy and planning actions for local and state governments to reduce the negative impacts of AVs and achieve AV Justice.

4.1) Transportation Justice Principles

AVs have the potential to exacerbate historically racist transportation planning practices. However, with the proper policies government (state and local) action towards AVs can potentially address these systematic injustices to create a more equitable transportation system.

With regards to TJ, privileging state-centric knowledge in transportation planning processes and intentionally excluding impacted communities historically created an unequal distribution of the costs (environmental harm and limited mobility) and benefits (enhanced mobility and environmental quality) associated with highway investment. If AVs are deployed without these injustices in mind, they can potentially exacerbate these racially institutionalized practices by privileging state centered knowledge. To achieve a degree of TJ, government action towards AVs should seek to privilege local community knowledge in the planning processes for AVs to ensure that all communities receive the same benefits through an inclusive AV planning process.³⁶

Transportation Justice Principle

Ensure the knowledge of low-income communities of color is privileged and incorporated in the development of AV policies and planning documents.

4.1.1) Land-Use Policy Path -Transportation Justice

AVs will decrease the burden and stress of driving enabling travelers to move across greater distances with ease. Consumers may choose to live farther away from their jobs and urban centers due to the reduced housing cost. While these choices may be logistically and financially sound to individual consumers, the perceived trade-off of lower housing cost for traveling longer distances can potentially induce demand especially within a sprawling environment. The section below will focus on how land-use policies can be implemented through the TJ justice principle.

³⁶ Karner et al., “From Transportation Equity to Transportation Justice: Within, Through and Beyond the State.”

Policymakers and planners can abide by this principle through the implementation of road-user-charges (RUC) to encourage shared AVs and discourage single occupancy AVs.³⁷ A RUC places a price for using road-way space (e.g. \$/mile) which can be used to decrease congestion of single occupancy vehicles and encourage alternative forms of travel or shared vehicle trips. While this can mitigate increases in VMT it has equity implications for low-income communities who may be unable to pay.³⁸ In order to address the equity issues of a RUC, policy makers must engage with communities who may be financially burdened through these pricing schemes. By engaging with local communities, the RUC can progressively reduce the financial burden of traveling for mobility have nots (low-income travelers) while mitigating the increases in VMT for mobility haves. Additionally, through transparent and open public engagement processes decision makers can identify community needs and reinvest RUC revenue to these meet these needs such as alternative transportation modes including transit, bike lanes, and pedestrian infrastructure. By embedding an open public engagement process, decision makers can create solutions which both solve the negative externalities (increase in VMT and mobile emissions) while preventing financial burdens on mobility have nots.

Local governments must also prepare for the change in road space utilization if traffic is reduced from shared AVs. Shared AVs can reduce the need for existing road space such as parking and travel lanes creating opportunities for in-fill development. Potential alternative solutions to excess road space include reallocating the underutilized road space to existing local needs such as housing and alternative transportation such as bike lanes and widening sidewalks.³⁹ Local

³⁷ Rodier, Chai, and Kaddoura. "Simulating the Effects of Shared Automated Vehicles and Benefits to Low-Income Communities in Los Angeles."

³⁸ Rodier, Chai, and Kaddoura,

³⁹ "Principles for Autonomous Vehicle Policy," American Planning Association, accessed June 15, 2022, <https://www.planning.org/policy/principles/av/>.

governments must prepare for these impacts of these land use changes and become more flexible in changing existing land-use designations to ones that can enhance community well-being.

General AV policy guidelines could include that the operation of passenger AVs should encourage shared/pooled trips powered by electric vehicle technology. Through an open public engagement process, policy makers can develop a RUC which can be used to incentivize the shared use of AVs, and reduce potential increases in VMT. Additionally, by engaging local communities within the RUC development process, policy makers can understand how to design the RUC program to prevent creating regressive tax on low-income travelers

4.1.2) Government Investment Policy Path – Transportation Justice

US federal transportation investments have historically been focused on car-centric travel, creating past and present negative social and environmental impacts. These investments failed to incorporate an open public engagement process to help decision makers understand local needs and concerns of highway development in urban communities of color. Failure to listen to local communities and their concerns within these infrastructure investments has led to the transportation injustices which create disproportionate burdens in communities of color today. Similar to how local redevelopment agencies planned for federal highway investment in the past, local and state governments may begin to think about where AV investments can be made today. This section will address how connected automated vehicle (CAV) investments can support achieving transportation justice.

Based on the review of local and state AV planning documents both Arizona and Michigan are beginning to think about funding responsibilities and opportunities regarding CAV

infrastructure. CAV infrastructure may be needed due to the technology's potential benefits of creating a more efficient and safe transportation system. CAVs can communicate and transfer necessary information and data via CAV infrastructure to make other CAVs and potential road users aware of road hazards such as construction, traffic accidents or vulnerable road users at the local and regional scale. Despite the potential to maximize traffic efficiency and safety, local and state governments have several issues surrounding how, if and why public investments should be made for CAV infrastructure within a rapidly changing technology environment. Considering how nascent AV technology currently is and the potential for the technology to rapidly change, public investment in CAV infrastructure today could prove to be obsolete in the near future. The cost of CAV infrastructure could be significantly expensive for local and state governments, especially when considering current cost in federal transportation is in the billions.⁴⁰

The question that still remains unanswered for local and state governments pertains to who will pay from the infrastructure and how do these investments achieve maximum public benefit? Answering the “who (local, state or federal) will pay question” is so far unclear. McAslan et al. brings up this question with regard to how government investment in CAV infrastructure mainly provides direct benefits for AV manufactures and operators to pilot and demonstrate their technology. Meanwhile secondary benefits are created through implementation of the AV pilot as it provides mobility services for local communities. Does this still constitute as a public benefit if investments are oriented towards AV businesses first and community needs?

⁴⁰ Shane Epting, “Automated Vehicles and Transportation Justice,” *Philosophy & Technology* 32, no. 3 (September 2019): 389–403, <https://doi.org/10.1007/s13347-018-0307-5>.

For **government investment**, TJ can be achieved by including the community voices in the distribution of public funds of AV related pilots and infrastructure projects. This can ensure that both public dollars are efficiently spent by meeting community needs. A possible public process which can achieve this is through the participatory budgeting process.⁴¹ In applying this policy path to local AV documents, I will attempt to identify how community voices are being included within the planning process particularly from historically marginalized communities.

Below are the policy paths which apply the TJ principle **to government investment** and **land-use impacts**.

Table 1) Transportation Justice Policy Paths

AV Challenge	Policy Path
Greenfield Development	Equitable Road-User Charge
Underutilized Car Infrastructure	Repurpose land-use for alternative community land-use needs
Payment for AV Infrastructure	AV infrastructure investments do not overtake community needs

4.2) Environmental Justice Principle

According to the US Environmental Protection Agency, transportation emissions account for 27% of all greenhouse gas emission in the US in 2020.⁴² Research has shown that without effective policy interventions AVs can increase GHG emissions from the transportation sector due to several factors.⁴³ AVs are expected to increase VMT since they reduce the burden of

⁴¹ Alex Karner et al., “From Transportation Equity to Transportation Justice: Within, Through and Beyond the State,” *Journal of Planning Literature* Volume 35, no. Issue 4 (2020): 440–59.

⁴² EPA, “Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990-2020)” (U.S. Environmental Protection Agency, 2022), <https://www.epa.gov/ghgemissions/draft-inventory-us-greenhouse-gas-emissions-and-sinks-1990-2020>.

⁴³ Rodier, “Automated Vehicles Are Expected to Increase Driving and Emissions Without Policy Intervention,” 2020, <https://doi.org/10.7922/G2G73BZW>.

driving making it safer and easier to drive or travel. Early research into AV impacts to travel demand behavior indicate that vehicles with partial automation (Tesla Autopilot) and vehicles which simulate full self-driving can increase VMT.⁴⁴ One of the challenges for policymakers is that the increase in VMT can have cascading impacts such as increasing mobile source emissions (exhaust and non-exhaust), road quality degradation due to increased road usage, increased traffic congestion and sprawl. Similar to how highway investment creates induced demand leading to environmental and mobility injustices, AVs ability to increase VMT present similar past injustices without policy intervention.

If AVs are electric, they can reduce mobile source emissions and GHGs, improving health related air-quality issues and mitigating climate change respectively. Since many highways are located within communities of color, they would receive the benefit of reduced mobile emissions and noise pollution if AVs are electric, potentially undoing past environmental injustices of highway development. The combination of having electric and shared AVs would produce the most socially and environmentally desirable outcomes. Government policies and plans can account for these environmental injustices by ensuring that vulnerable communities are not disproportionately burdened with the environmental harms from the adoption of AVs. The EJ principle below seeks to address these potential inequities and achieve a sense of AV justice.

Environmental Justice Principle

Reduce environmental burdens of AV technology within low-income communities of color

⁴⁴ Scott Hardman, Jae Hyun Lee, and Gil Tal, “How Do Drivers Use Automation? Insights from a Survey of Partially Automated Vehicle Owners in the United States,” *Transportation Research Part A: Policy and Practice* 129 (November 1, 2019): 246–56, <https://doi.org/10.1016/j.tra.2019.08.008>.

4.2.1) Environmental Sustainability Policy Path

Research indicates that AVs should mitigate the increases in VMT and GHG emissions by supporting the deployment of **shared and electric usage of AVs**.⁴⁵ When AVs are pooled individual riders with different destinations can share an AV trip with a vehicle containing more than one passenger. Encouraging consumers to share AVs can reduce the number of vehicles on the road and thus avoid increases in VMT.

If AVs are electric, they can reduce mobile source emissions and GHGs, improving health related air-quality issues and mitigating climate change respectively. Since many highways are located within communities of color, these same communities would receive the benefit of reduced mobile emissions and noise pollution if AVs are electric, potentially undoing past environmental injustices of highway development. The combination of having electric and shared AVs would produce the most socially and environmentally desirable outcomes as seen in **Table 2** below. There are broader questions about market acceptance for individuals sharing rides with strangers which create policy intervention opportunities for decision makers and planners to encourage the desired behavior of AVs to prevent increases in VMT.⁴⁶ Possible ways to encourage individuals to use shared AVs can be through pricing mechanisms such as a road-user charge. By increasing the cost per mile of riding in a private or low occupancy AV, consumers may be more willing to pay less for a shared AV.⁴⁷

Below indicate policy solutions for reducing environmental impacts of AVs.

⁴⁵Caroline Rodier et al., “Automated Vehicles Are Expected to Increase Driving and Emissions Without Policy Intervention,” March 1, 2020, <https://doi.org/10.7922/G2G73BZW>.

⁴⁶ Rodier et al.

⁴⁷ Litman, “Autonomous Vehicle Implementation Predictions - Implications for Transport Planning.”

Table 2) Environmental Justice Policy Path

AV Challenge	Policy Path
Increase in vehicle-miles traveled	Operate shared Avs
Increase in mobile source emissions	Operate zero-emission AVs

4.3) Mobility Justice Principle

If policy goals are to address historic mobility injustices, AV technology must improve mobility for those who are considered to be mobility disadvantaged meaning that individual and community barriers to mobility must be taken down. However, private AVs can take ridership away from existing transit service causing a decline in service limiting mobility for its low-income users. Future transportation planning practices should not perpetuate car-centric planning but rather enhance and complement existing transportation investments such as transit, walking and biking. Support for these alternative modes through AVs can support a multi-modal transportation system and mitigate competition with other modes. This form of planning is not only more sustainable but can enhance the mobility for those who do not receive the benefits of car-centric planning.

Mobility Justice Principle

Enhance mobility and access for the mobility disadvantage

4.3.1) Mobility - Policy Path

Research indicates that AVs can potentially increase mobility and access for those who are mobility disadvantaged. Since mobility barriers can vary greatly across different individuals and

communities, vehicle design of AVs and infrastructure must seek to accommodate these varying needs. For example, people who are physically or mentally disabled may require human support in entering or exiting the vehicle to help with the first and last “15 feet”. In contrast, someone who is low-income may require subsidies to access AV passenger service. Low-income travelers tend to spend a higher percentage of their income for travel when compared to higher income earners.⁴⁸ As a result, they must rely on other cheaper modes relative to private car ownership which do not provide the same levels of mobility. Subsidizing AV services for low-income travelers, can reduce the financial burden of travel while potentially increasing their mobility.⁴⁹ To ensure that local mobility needs are being met through an AV service deployment, these various mobility barriers must be considered in the planning and policy development processes for AV adoption.

Another impact that AVs can have on mobility justice pertains to whether or not AVs are adopted as shared or private vehicles. If AVs are adopted in a manner that is only accessible to high income earners it can potentially lead higher levels of mobility for this group. Whereas lower income earners are unable to purchase an AV leading to lower levels of mobility. Similar to highway investment, private AVs risk increasing access only for those who can purchase, own and maintain the technology. However, if AVs are adopted in a manner that supports shared usage, it could increase mobility access for all since they can provide low-cost travel.⁵⁰

⁴⁸ Hana Creger, Joel Espino, and Alvaro S Sanchez, “Autonomous Vehicle Heaven or Hell? Creating a Transportation Revolution That Benefits All,” *Transportation Research Board*, January 2019, 71.

⁴⁹ Daniel Sperling, *Three Revolutions: Steering Automated, Shared and Electric Vehicles to a Better Future*, 1st ed. (Washington, DC : Island Press/Center for Resource Economics : Imprint: Island Press: Island Press, 2018).

⁵⁰ Lew Fulton, Jacob Mason, and Dominique Meroux, “Three Revolutions in Urban Transportation,” Research Report (University Of California Davis: Institute of Transportation Studies - UC Davis, May 2017), https://steps.ucdavis.edu/wp-content/uploads/2017/05/STEPS_ITDP-3R-Report-5-10-2017-2.pdf.

4.3.2) Government Investment – Mobility Justice

One final policy path which can progress AV technology to achieving mobility justice is through publicly funding local AV deployments to connect AV service to existing transportation modes which lean away from private vehicle ownership and support multi-modal transportation.

Possible policy investment opportunities can include partnerships between local/ regional transit agencies and AV passenger services to bolster a multi-modal transportation system via shared and electric AVs. These connections can increase transit ridership and reduce VMT and GHGs while reducing traffic congestion, improving air quality and enhancing mobility and access by enhancing the service of existing transit investments. This policy solution can also include providing incentives for public and private partnerships to improve first/last mile transit connections.

With the proper regulations a share and electric AV service which supports multi-modalism can address the diversity of barriers experienced by mobility have-nots (income, disabilities etc.),

The policy paths below can potentially address historic mobility injustices for the mobility disadvantaged.

Table 3) Mobility Justice Policy Paths

AV Challenge	Policy Path
Wide Array of Mobility Barriers	Inclusive service access and vehicle design
High Cost of AV technology	Subsidize AV service for mobility disadvantaged groups
Multi-Modal Plots	Investments in shared and electric AV pilots which enhance alternative modes including transit

Before diving into the Federal AV Policy context, it's important to note the common theme between all of the justice element policy paths. Sharing or pooling of AVs is the common path included within each path. The reason for this is due to the multitude of social and environmental benefits of reducing VMT through sharing AVs. Sharing AVs can also reduce reliance on the privatized ownership models of AVs reducing the cost of travel per mile for all travelers especially lower-income travelers.⁵¹ The reduce cost can all low-income travelers to access more affordable transportation options reducing the financial barriers to mobility improving their well-being. Due to time importance of shared AVs, the framework analysis (Chapter 10 and 11) will also include specific sections which identify how local and state governments are attempting to adopt AVs as shared vehicles.

Chapter 5) Federal Automated Vehicle Governance in the United States

To understand the origins of context of AV policy in the United States, it is best to examine federal policy first as this is where all new vehicle design standards default to.⁵² The lead agency in developing vehicle policy design standards is the US Department of Transportation – National Highway and Traffic Safety Administration (NHTSA). Specifically, NHTSA regulates vehicle design standards through the Federal Motor Vehicle Safety Standards (FMVSS) to regulate vehicle safety design standards. The FMVSS ensures that vehicles contain certain onboard components such as brakes, seatbelts and mirrors for a safe driving experience. By default, the FMVSS as of 2021 is prescribed in a manner that assumes there is always a human driver and

⁵¹ Lew Fulton, Jacob Mason, and Dominique Meroux, “Three Revolutions in Urban Transportation” (Institute of Transportation Studies - University of California, Davis, 2017), https://steps.ucdavis.edu/wp-content/uploads/2017/05/STEPS_ITDP-3R-Report-5-10-2017-2.pdf.

⁵² Kevin Vincent, “A Regulatory Framework for Autonomous Vehicle Deployment and Safety” (SAFE, May 2021), <https://2uj256fs8px404p3p217nvkd-wpengine.netdna-ssl.com/wp-content/uploads/2021/05/Kevin-Vincent-Regulatory-Framework.pdf>.

does not apply to vehicle electronics and rather focuses on mechanical vehicle components.⁵³

Therefore, when applying the design of an automated vehicle to the FMVSS, most standards are not applicable since the FMVSS applies only to vehicles designed for human drivers rather than “computer drivers”. As a result, the FMVSS needs to be updated and modernized to reflect the needs of new vehicle technology known as automated driving systems (ADS).

In the meantime, AV development companies must deal with the archaic vehicle safety standards. For ADS developers to legally test their vehicles they must adhere to the human centric FMVSS in their AV designs such as including a steering wheel, mirrors, and pedals, as pointless as they might be. AV companies can receive an exemption from FMVSS compliance from NHTSA, however exemptions are given on a case by case basis. Ultimately the outdated FMVSS indicates that the federal government does not have an official binding/enforceable AV regulation. Rather the USDOT’s stance serves as “voluntary guidance” through Automated Driving Systems (ADS): Vision for Safety 2.0. Within the document NHTSA included its non-regulatory approach in providing support and guidance to ADS companies through 12 priority safety design elements. Vehicle design is strictly voluntary meaning that companies may or may not choose to follow any of the 12 Safety elements included in the ADS 2.0.⁵⁴

Based on the traditional role of NHTSA, the federal government’s role in the AV industry is already oriented towards regulating safety of AV design standards. The result of all of the federal action (or rather inactions) is that the federal government does not have an official binding policy towards AVs. AV developers must comply with outdated vehicle design standards which are not

⁵³ Vincent, “Regulatory Framework for Autonomous Vehicle Safety.”

⁵⁴ “Automated Driving Systems: A Vision for Safety 2.0” (U.S. Department of Transportation, n.d.), https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf.

relevant to new technology, leaving states need to figure out how to deal with adopting these technologies first hand. With the lack of an official federal policy, States are free to choose what they would like (or not like) to take actions on within the context of AVs.

5.1 Policy Patchwork - AV Governance at the State Level

The federal government has left it up to states to decide how to deal (or not deal) with AV adoption within their respective jurisdictions. The resulting nationwide effect has created a “policy patchwork” landscape which enables states to create incremental policies as their AV programs grow and AV technology develops.^{55 56} This inefficient policy process is ultimately hindering technological innovation as AV companies need to adhere to each different set of AV policies if they are operating/ testing AVs in multiple different states.⁵⁷ Traditionally the role of states and regulation of vehicles go to licensing and registering as well as regulating driver behavior such as giving citations for erratic driving. These roles still apply to AVs deployment at the state level and have been adopted by California, Michigan and Arizona. However, if the lack of federal regulation continues, AV companies may have to comply with AV regulations from fifty different state jurisdictions.

Even before examining the progress states have made (or not made) towards advancing social and environmental outcomes of AV technology it’s clear that, a lack of federal policy has already created an inefficient policy landscape to adopt automated vehicles. While some states such as California is well prepared to encourage sustainable adoption of AVs, others may be

⁵⁵ Kelly Fleming, “Technology Is Outpacing State Automated Vehicle Policy,” *UC Davis - Policy Institute*, April 1, 2020, 11.

⁵⁶ Kevin Vincent, “A Regulatory Framework for Autonomous Vehicle Deployment and Safety” (SAFE, May 2021), <https://2uj256fs8px404p3p217nvkd-wpengine.netdna-ssl.com/wp-content/uploads/2021/05/Kevin-Vincent-Regulatory-Framework.pdf>.

⁵⁷ Vincent, “Regulatory Framework for Autonomous Vehicle Safety.”

lagging behind focusing on other policy priorities. Using the AV justice framework for reference, this paper will look into state AV policies and planning actions through the equity framework to see which states are closest (or farthest) to achieving maximum social benefits for all its communities. To examine the impact of a lack of federal policy, and see if states are emerging towards an ideal future, this paper will examine the policy landscape of California, Arizona and Michigan as they have been ground zero for AV deployment in the US.

Chapter 6) Methods - Framework for Analysis

To gain a further understanding of local and state trends in AV space, the next Chapters (7-9) will examine the diverse nature of local and state AV policies and planning documents in California, Michigan and Arizona through the AV justice framework lens. The reasons for selecting these states pertains to each state's relation to automotive, technology and AV deployment.

First California has historically been the national leader for technology sector and therefore is home the most AV development companies in the US. In addition to being home to numerous technology companies, the state also has a history of passing progressive climate change legislation indicating a potential to apply climate related policies to AVs. The second state included in this analysis is Michigan, which is historically home to numerous automotive manufactures which bring a wealth of economic development to the state. However, considering recent developments and trends towards the three revolutions in transportation, these trends can present disruptive changes to the traditional automotive manufacturers. The last state in this

analysis includes Arizona. Arizona was selected based on its early declaration (2015) to allow for AVs to be tested on public roads in the state.

The National Conference of State Legislatures (NCSL) - AV State Bill Tracking Database, was used to identify legislative bills and executive orders related to AVs enacted in each state. Bills listed in the NCSL AV database were cross referenced with each state legislature's website to verify bill passage and bill description. Other state actions such as executive orders signed by governors were also considered within this analysis along with key state documents created by state agencies to understand broader efforts in AV planning with respect to sustainable and equitable policies.

Tables (10, 11, and 12) in Appendix A were also created to categorize AV policies in the different categories into four **policy themes (Industrial, Safety, Social and Environmental)**. Each State policy is also given a Policy Action description along with a more specific description on how the policy may help or hinder the sustainable or equitable adoption of AV's if relevant. It's important to note that these State **policy themes** are different than Chapter 4's local **policy paths (environmental sustainability, land-use, government investment, and mobility)**. The reason for using different policy categories for evaluating state and local AV policies and planning actions is due to the varying roles and levels of progress each level of government has. Due to the early nature of AV technology, some governments are more prepared than others.

6.1) Methods – Local AV Documents

With regards to the local level AV planning documents, the below will address how each domain presents opportunities to apply the AV justice framework. Based on the guiding justice principles, the AV justice framework seeks to achieve three justice-oriented goals to prevent

perpetuating injustices caused by the transportation system. Doing so can improve existing conditions within the following domains of local and state transportation planning and policy: **environmental sustainability, land-use, government investment, and mobility.**

For local **land-use**, the AV impact pertains to how shared AVs can reduce the need for car-centric infrastructure such as parking. To address the **TJ principle**, I will examine how and if local governments have incorporated a community engagement process and community input in how land can be reallocated to community needs addressing the transportation justice principle. To address the **EJ principle**, I will seek to identify ways that AV infrastructure and services can prevent or avoid creating environmental burdens. This specifically means looking to see if documents or policies mention adopting AVs as ZEVs.

For **government investment**, TJ principle can be achieved by including the community voices in the distribution of public funds of AV related pilots and infrastructure projects. This can ensure that both public dollars are efficiently spent by meeting community needs. A possible process which can achieve this is through the participatory budgeting process.⁵⁸ Specifically, I will attempt to identify how community voices are being included within the planning process particularly from historically marginalized communities.

For **mobility**, I will identify how AV policies and plans seek to improve mobility for the mobility disadvantaged. Specifically, actions which steer AVs to support multi-modal transportation will be called out. To address the mobility justice principle, I will identify how and if local governments plan on using AV to enhance mobility for the mobility disadvantaged without competing or reducing ridership with other modes.

⁵⁸ Karner et al., "From Transportation Equity to Transportation Justice: Within, Through and Beyond the State."

For **environmental susitnability**, I will attempt to identify if and how local and state governments are pursuing to adopt AV with a shared ownership model along with ZEV technology.

Chapter 7) Michigan – State AV Policy

The State of Michigan’s has deep historic and economic roots in the traditional automotive industry. Home to Ford, General Motors, Stellantis and numerous other automotive manufactures, the State is well poised to support the adoption of AVs, as long as traditional automotive manufactures can quickly pivot to develop AV technology. According to the NCSL - Autonomous Vehicle Bill Database, Michigan has a total of eight enacted pieces of legislation.⁵⁹ Some of which have catered to the needs of traditional automotive manufacturers. An important component of the State AV Policy in Michigan pertains to a bi-partisan bill package passed in 2016-2017 known as the **SAVE (Safe Automated Vehicle) Act** containing four bills (SB 995, 996, 997 and 998). Much of the SAVE Act contains details in which AVs can legally operate within the State, such as allowing for operation of driverless AVs on streets or highways in Michigan, proper protocol and procedure for an AV in an accident, and liability of third parties for after maker modifications to automated driving systems. The SAVE bill package allows for driverless and on-demand AVs to operate in the state through the provision of a legal framework. One clarification SB 996 makes is to only allowing for “motor vehicle

⁵⁹ “Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation,” National Conference of State Legislatures, accessed August 9, 2022, <https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx>.

manufactures” to participate in the SAVE Act. This means that for any entity testing AV in the State of Michigan they must first obtain a “manufacture plate” or M-Plate by meeting certain criteria.⁶⁰ Other criteria needed to receive an M-Plate include, testing for at least 1 million miles, vehicle compliance with NHTSA’s FMVSS and obtain \$10 million insurance policy. ⁶¹ Available information on the number of companies with “M-Plates” was limited.

Other key attributes to AV Policy in Michigan is the creation of leadership committees and councils at the state level. Specifically, Executive Order 2020 -2 created the *Michigan Office for Future Mobility and Electrification* (OFME) and transferred its policy advisory role from the Michigan Department of Transportation to the Michigan Economic Development Corporation. The Council of Future Mobility and Electrification plays an advisory within OFME to increase Michigan’s international competitiveness in the AV space by advancing Michigan state policy. ⁶² The Council is comprised of a variety of stakeholders which provide voices from businesses, State Department Directors, insurance agencies and disability organizations. The development of this Council allows for a long term leadership commitment to plan for the future of mobility across the state.

House Bill (HB) 5335 known as the Michigan Infrastructure Council Act, is another action taken by the state to allow for more strategic public investment by creating the Michigan Infrastructure Council. While the Act is focused on numerous types of public infrastructure investment, the Council is directed to develop investment recommendations and plans for two AV areas. The first pertains to broadband and telecommunications which contain provisions for only for

⁶⁰ “Legislative Update: SAVE Act Paves Way for Autonomous Vehicle Testing in Michigan,” Detroit Regional Chamber, September 6, 2016, <https://www.detroitchamber.com/legislative-update-save-act-paves-way-for-autonomous-vehicle-testing-in-michigan/>.

⁶¹ Mike Kowall, “Senate Bill 995,” Pub. L. No. 332, § 663, 6 (2016), 995.

⁶² Susan Corbin, “Council on Future Mobility and Electrification” (Michigan, 2020), <https://www.michiganbusiness.org/492f6d/globalassets/documents/mobility/cfme-report-final.pdf>.

transportation space only meaning the Council is directed to provide the state with recommendations on wireless communication related investments towards transportation only. Furthermore, the other bill provisions relating to AVs which include appropriations for the Transportation Asset Management Council (TAMC). The TAMC is tasked with developing an asset management plan to provide the state with an estimate for needed funds to improve road infrastructure.

7.1) Michigan Initiatives – State Funding at the Local Level

The State of Michigan has initiatives to invest locally across the state through its **Connected Vehicle Program** which is comprised of the **Connected Automated Vehicle Corridor (CAV Corridor)** and the **Michigan Mobility Challenge**. The Connected Vehicle Program is broadly focused on improving connected vehicle infrastructure including, on board (vehicle) equipment, road side equipment and the transportation network subsystem.⁶³ The goal of the CAV program is to future proof connected vehicle infrastructure across the state to ensure the ability for vehicles and road side infrastructure to effectively communicate. The **CAV Corridor** and the **Mobility Challenge** are two separate programs supporting AV testing, infrastructure and deployment of local mobility solutions.

The **CAV Corridor** seeks to create highway lanes dedicated for connected automated vehicles along Interstate-94 connecting the City of Detroit and Ann Arbor, Michigan through public and private partnerships seen in **Figure 1** below. Through public and private investment, the project has received a total of \$130 million.

⁶³ “Connected Vehicles,” Michigan Department of Transportation, accessed August 7, 2022, <https://www.michigan.gov/mdot/travel/mobility/initiatives/connected-vehicles>.



Figure 1) CAV Corridor Project Area ⁶⁴

Along the project area, the state does also seek to support AV connectivity for its Opportunity Zones within nearby communities in between Ann Arbor and Detroit as seen in **Figure 2** below. Opportunity Zones are highlighted in the green areas while the red line indicates the CAV Corridor path. Connection to centralized locations along the path will also include the University of Michigan, Detroit Metropolitan Airport and Michigan’s Central Station. ⁶⁵

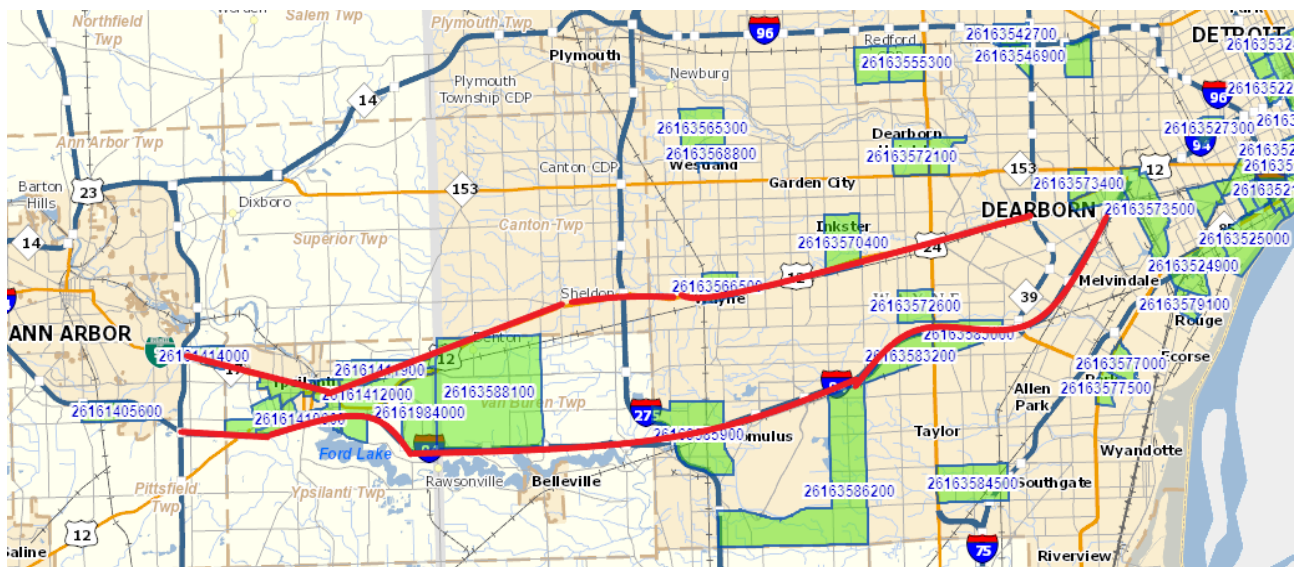


Figure 2) Michigan’s Opportunity Zones along the CAV Corridor path

⁶⁴ “Michigan Project,” Cavnu, accessed August 7, 2022, <https://www.cavnu.com/michigan-project/>.

⁶⁵ “Connected Vehicles.”

Led by a partnership between Michigan’s Department of Transportation and a private company known as Cavnue, the program will initially focus on connected busses and shared mobility and later expanding to connected freight and non-automated vehicles but will broadly support mixed vehicle traffic. Cavnue will serve as the “Master Developer” in supporting regional partners in creating the physical, digital, and operational infrastructure to create safe and efficient usage of Michigan roadways. Similar to how highway technology created more efficient ways of travel, the Corridor seeks to provide similar benefits for its CAV users. Many of the other policy goals of this project include creating consensus among industry players for standard-based approaches, increasing accessibility, affordability and equity to align regional planning goals. ⁶⁶ It is so far unclear how Cavnue and Michigan DOT will back its commitment for affordability and equity. Michigan DOT also offers a grant funding initiative (**Michigan Mobility Challenge**) under the **Connected Vehicle Program** during the Rick Snyder administration. In 2018 Governor Rick Snyder announced the \$8 million grant initiative to address mobility gaps for mobility disadvantaged groups including “seniors, persons with disabilities, and veterans across the state.”⁶⁷ The program intends on creating public-private partnerships between technology providers, advocacy organizations, state agencies and transportation providers to create local mobility solutions. Over 40 pilot projects were submitted (totaling over \$27 million) with only 13 projects awarded allocating \$100,000 to \$2.1 million per project. ⁶⁸ Of these 13 projects, only 1 of them pertain to directly funding passenger AV pilots.

⁶⁶ “MDOT - CAV Corridor,” accessed May 24, 2021, https://www.michigan.gov/mdot/0,4616,7-151-9621_101547--,00.html.

⁶⁷ Janet Geissler, “Mobility Challenge,” accessed August 7, 2022, <https://www.michigan.gov/mdot/travel/mobility/initiatives/mobility-challenge>.

⁶⁸ Janet Geissler, “Mobility Challenge,” accessed August 7, 2022, <https://www.michigan.gov/mdot/travel/mobility/initiatives/mobility-challenge>.

This single AV Pilot is known as the New Autonomous Mobility Vision for Michigan. The Pilot produced and operated two low-speed accessible AV shuttles within a campus testing environment. The program received \$2.1 million to test and pilot these shuttles initially to provide trips within a campus at the Battle Creek Veterans Affairs (VA) Medical Center. The project site later changed to a similar campus testing environment at West Michigan University due to the lack of readiness at the VA Medical Center. A large portion of this pilot went into redesigning an existing proprietary shuttle to be compliant with US DOT ADA specifications (49 CFR, Part 38). A major vehicle design change included creating a storable wheelchair accessible ramp with along with wheelchair securements on board the vehicle. Unfortunately during implementation of the pilot's passenger service, the modified wheelchair ramp was not used by any riders.⁶⁹ Despite the lack in utilization of the accessibility design features, the 2018 Mobility Platform funded pilots for non-automated mobility solutions for people with disabilities to access transit. These pilots sought to fill mobility gaps across the state to meet diverse mobility needs by enhancing transit service through technological solutions. Overall this \$8 million investment funded the testing an implementation of technological mobility solutions to serve the transportation disadvantaged.

In 2020 Governor Gretchen Whitmer announced the **Mobility Funding Platform** involving a partnership between the Michigan DOT and the OFME indicating the states willingness to continue investing in innovative mobility solutions. The learnings from the 2018 Mobility Challenge were taken into account in developing the 2020 Mobility Funding Platform (MFP). The MFP targeted investments and policy priorities to continue supporting the testing of AVs in

⁶⁹ "New Autonomous Mobility Vision for Michigan," https://www.michigan.gov/documents/mdot/Final_Summary_685411_7.pdf.

closed settings and real-world environments of innovative mobility solutions.⁷⁰ The program goals were reoriented to broadly include equity and sustainable mobility solutions rather than explicitly filling mobility gaps for the mobility disadvantaged. The funding platform will accelerate investment in three focus areas including; EV adoption through infrastructure (*Sustainable Futures*), reduce mobility barriers to increase access and affordability (*Equitable Futures*) and support *multi-modal transportation* through connected and automated transportation. Overall these grant initiative guidelines potentially promise a more sustainable and equitable transportation systems.

Since the inception of the Mobility funding platform, Governor Whitmer has announced the 2020 program will allocate \$1.6 million through three separate funding rounds from 2021-2022. The program accepts applications and offers awards on a rolling basis and prioritizes investment to fill community mobility gaps through technological solutions. Furthermore, applicants in need of mobility solutions are able to apply and partner with technology and mobility service providers to fund pilots which fill community mobility needs while demonstrating and testing technological capabilities. Of these three funding rounds, \$350,000 was allocated toward three project partners focusing on automated vehicle pilot testing. These three projects (Mitsubishi Electric Automotive America, Stantec and iSmartWays) focused on testing connected vehicle infrastructure and automated freight which prioritized industrial applications of AVs.⁷¹ Other awarded projects include transportation electrification and equitable and affordable

⁷⁰ Charlie Tyson, “Michigan Office of Future Mobility and Electrification” (Michigan Economic Development Corporation, n.d.), <https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Travel/Mobility/Public-Transportation/Resources/Tech-Talk/January-2022-Michigan-Mobility-Funding-Platform.pdf?rev=a483123ea8ac433b9f3a1e336d5cd471&hash=9BB0677003E8F866685DE5B32FA36E21#:~:text=Michigan%20Mobility%20Funding%20Platform%20was,sites%20and%20real%2Dworld%20environments.&text=Applications%20are%20rolling%20and%20reviewed%20every%20three%20months.>

⁷¹“Governor Whitmer Announces Grants to Bolster Mobility Industry and Increase Accessibility in the State | Michigan Business.”

transportation options. These other funded projects seek to develop technological solutions for people with cognitive and visual disabilities but do not incorporate AV technology but generally addressed mobility injustices.⁷²

7.2) Michigan AV Policy and Planning - AV Justice Framework Discussion

As seen with the Governors transition from Rick Snyder to Gretchen Whitmer, the state has set its policy funding priorities to expand beyond just improving mobility gaps for the mobility disadvantaged. With the updated 2020 **Mobility Funding Platform**, the state has clearly stated its policy initiatives to invest in a more equitable, sustainable and modern transportation system by. The state's policy priorities bring bringing clean transportation technology to meet community mobility creating a path way to a more socially equitable and environmentally sustainable transportation system by providing incentives rather than regulations. As seen with the 2018 Mobility Challenge and the 2020 Mobility Funding platform, Michigan has only funded one AV pilot (New Autonomous Mobility Vision for Michigan) which explicitly seeks to reduce mobility barriers for people with disabilities. Other AV pilots funded were only for industrial purposes rather than community-based solutions since funds were dedicated towards providing private sector AV solutions. The fact that Michigan has funded a limited amount AV pilots for community driven solutions, can be due to limitations in the economic feasibility and nascent technology of the AVs. However, the funding guidelines and policy initiatives presented in the 2020 Mobility Funding Platform demonstrate the States willingness to incentivize community based mobility solutions through public private partnerships.

⁷² "Governor Whitmer Announces Grants to Bolster Mobility Industry and Increase Accessibility in the State | Michigan Business."

Despite this progress from the Michigan’s mobility funding programs, future funding programs from the Michigan’s Office of Future Mobility and Electrification and Department of Transportation must be aware of funding AV technology for industrial applications due to labor impacts to the freight sector which can disproportionately impact workers of color.^{73 74} While labor impacts of automation are not within the scope of this document, state investments initiatives must prepare for and how automation can negatively impact worker’s ability to find high quality jobs.

7.3) Michigan Local Governments - Justice Framework

In identifying local planning documents dedicated to AV adoption, there were no such documents available from two of the largest cities; Detroit and Grand Rapids. The City of Detroit released two documents (Transportation & Sustainability Plans) which mention very little about AVs. The local municipal planning organization – Southeast Michigan Council of Governments (SEMCOG) released their 2045 Regional Transportation Plan in 2019 which includes policy recommendations and planning initiatives for connected AVs.

Detroit’s Strategic Transportation Plan mentions supporting AV adoption with state economic development goals in mind. These goals pertain to demonstrating AV technology and infrastructure to ultimately gain the safety, congestion and economic benefits, failing to acknowledge environmental or social impacts of AVs. Detroit’s *Sustainability Action Agenda*

⁷³ Joel Ervice, “Freight Automation - Dangers, Threats and Opportunities for Health and Equity” (American Planning Association, n.d.), https://phoinstitute.wpenginepowered.com/wp-content/uploads/2021/04/RAMP_freightreport_web.pdf

⁷⁴ Jennifer Henaghan, “Preparing Communities for Autonomous Vehicles” (American Planning Association, n.d.). https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Autonomous-Vehicles-Symposium-Report.pdf

released in 2019, fails to mention anything pertaining to AVs. However, the plan included goals to reduce dependency on private vehicles by providing alternative modes.⁷⁵

At the regional level, the metropolitan planning organization, Southeast Michigan Council of Governments (SEMCOG), identified several AV impacts within its *2045 Regional Transportation Plan* which pertain to the equity framework and the negative impacts of AVs through its planning process.⁷⁶ Similar to the local planning documents in California and Arizona, SEMCOG identified scenarios of opportunities and risk for AV adoption. The 2045 Plan identifies CAVs' potential ability to enhance mobility for vulnerable groups. This opportunity includes providing additional transportation options through shared AVs reducing transportation cost. The plan highlights how the safety and efficiency benefits of AVs can potentially increase greenfield development based on changes in consumer behavior. These changes assume that suburbanization will increase which can degrade transit service due to the lower population. To address this potential impact, the document mentions that CAVs should not replace transit but rather be used to address first/last mile transit gaps within these suburban areas.⁷⁷ Similar to Tempe, Arizona, the SEMCOG sees the reduced need for road space and parking as opportunities to create more compact mixed-use urban environment. Other land-use considerations involved reallocating car-centric infrastructure dedicated to more compact mixed-use development improving access to amenities and improve community well-being.

⁷⁵ City of Detroit, "Strategic Plan for Transportation" (City of Detroit, 2022), <https://detroitmi.gov/Portals/0/docs/deptoftransportation/DetroitStrategicPlanForTransportation.pdf>.

⁷⁶ Southeast Michigan Council Area of Governments, "2045 Regional Transportation Plan for Southeast Michigan" (SEMCOG, 2019), <https://semcog.org/desktopmodules/SEMCOG.Publications/GetFile.ashx?filename=2045RegionalTransportationPlanForSoutheastMichiganMarch2019.pdf>.

⁷⁷"2045 Regional Transportation Plan for Southeast Michigan."

7.3.1) CAV Infrastructure

SEMCOGs 2045 Plan also presented challenges with regards to who should pay for CAV infrastructure? Suggestions in the plan include collaboration between communities and CAV companies to ensure that CAV infrastructure provides local benefits. From a transportation justice perspective, engagement between CAV companies and communities can ensure that local concerns are being heard within the CAV planning process which can meet TJ concerns. However due to the limited authority metropolitan planning organization have, it's unclear if local governments will incorporate this recommendation.

From a mobility justice perspective, the SEMCOG defines equity by ensuring that benefits of CAVs, enhance mobility for the mobility disadvantaged. Additionally, the barriers around payment methods were also of concern since they can prevent disadvantaged communities from accessing AVs and other emerging transportation technologies. These payment methods including credit cards, smart phones and those with poor internet access. No action recommendations were provided for those who lacked payment methods. However, the State of Michigan announced a *Mobility Wallet Challenge* in 2022 administered by the OFME. The goal of the Challenge is to provide a single payment platform streamlining the payment and collection process for transit services to increase personal mobility for Michigan residents.⁷⁸ This mobility wallet pilot seen in other cities,^{79 80} could create an effective solution to those lacking payment

⁷⁸ Michigan DOT, "Mobility Wallet Challenge to Improve Access to Transportation Services Statewide," 2022, <https://www.michigan.gov/mdot/news-outreach/pressreleases/2022/07/28/mobility-wallet-challenge-to-improve-access-to-transportation-services-statewide>.

⁷⁹ "LCTI: South Los Angeles Universal Basic Mobility Pilot Program | California Air Resources Board," Sustainable Transportation Equity Project (STEP) Implementation Grant, 2022, <https://ww2.arb.ca.gov/lcti-south-los-angeles-universal-basic-mobility-pilot-program>.

⁸⁰ City of Oakland, "City of Oakland | Universal Basic Mobility Pilot," accessed August 17, 2022, <https://www.oaklandca.gov/topics/universal-basic-mobility>.

methods. It is unclear so far who the mobility wallet recipients will be. Other State agencies involved with supporting the Mobility Wallet include, the OFME, MDOT, Michigan Department of Labor and Economic Opportunity and the Michigan Poverty Task Force.⁸¹ The inclusion of the Poverty Task Force indicate that the mobility wallet could be intended for Michigan’s low-income and disadvantaged communities.

⁸¹ “Mobility Wallet Challenge to Improve Access to Transportation Services Statewide.”

Chapter 8) Arizona – AV Policy

The State of Arizona tells a much different story to why the state is favorable towards AVs developers. Unlike Michigan or California, Arizona does not have deep roots in automotive manufacturing nor the technology industry. From an initial geographic and planning perspective the sprawling metropolitan region of Phoenix, Arizona provides AV developers with flat geography, little inclement weather, wide roads with clearly marked streets and sprawling land uses provide the “perfect place” to test AVs.⁸² With this local context Governor Doug Ducey has been the champion of AV developers and has encouraged AV companies to test in the State directly competing with other states. As of 2022, eleven AV development companies are now testing their vehicles and running AV services in the State.⁸³

Since 2015, Governor Ducey used his executive powers to embrace AV companies and encourage AV testing in the State to compete with California’s Silicon Valley.⁸⁴ Executive Order (EO) 2015-09 specifically supports AV testing in Arizona by giving authority to Arizona Department of Transportation and Public Safety to take steps to support AV testing on public roads. A potential equity implication of this could be the creation of unsafe road conditions for all users. The EO also creates a committee known as the Governor’s Office of **Self-Driving Vehicle Oversight Committee** which is comprised mainly of Arizona State Department directors from Transportation, Insurance, and Public Safety as well as leaders from the University of Arizona. Similar to Michigan’s Office of Future Mobility and Electrification, the

⁸²Marshall, “32 Hours in Chandler, Arizona, the Self-Driving Capital of the World.”

⁸³ Arizona DOT, “Autonomous Vehicles Testing and Operating in the State of Arizona | ADOT,” accessed December 7, 2022, <https://azdot.gov/motor-vehicles/professional-services/autonomous-vehicles-testing-and-operating-state-arizona>.

⁸⁴Cecilia Kang, “Where Self-Driving Cars Go to Learn,” *The New York Times*, November 11, 2017, sec. Technology, <https://www.nytimes.com/2017/11/11/technology/arizona-tech-industry-favorite-self-driving-hub.html>. Kang.

office serves to provide advice and guidance from Arizona's Universities, Department of Transportation and Public Safety on AV testing in the State. However, according to public record the Oversight Committee has only met twice with only one of their meetings are on public record.⁸⁵ The Oversight Committees meeting in 2016 to provide policy guidance of committee members on Governor Ducey's Executive Orders and an overview of AV technology.^{86 87}

Arizona's EO 2018-09 established the **Institute of Automated Mobility** within Arizona's Commerce Authority (economic development agency). The goal of the Institute is to encourage collaboration between academia, policy makers, AV developers and insurance companies to serve as a testing ground for ADS technology and connected vehicle infrastructure. Furthermore, the EO establishes that the Institute will coordinate with the Arizona Department of Transportation and Public Safety to develop public policy recommendations modernizing Arizona's laws and to accommodate for AVs.

As of 2022 there has been three bills that has been introduced to the Arizona State legislature and signed by the Governor. House Bill 2813 which was passed in early 2021, sets the legislative framework for ADS developers to test their vehicles in the state. The bill defines key definitions such as automated vehicles, levels of automation, and general provisions to clarify the legal framework for AVs to operate and test in on public roads. This bill can be compared to Michigan's SAVE Act previously discussed, but it's not as extensive. Both Michigan's and Arizona have provided definitions for AV operation and ensure that there is a legal framework for AV deployment and testing. It's important to point out that while Arizona's HB 2813 was

⁸⁵ Thad Miller et al., "Autonomous Vehicles in Tempe: Opportunities and Risk" (Arizona State University, n.d.).

⁸⁶ "Self-Driving Vehicle Oversight Committee - Meeting Minutes" (Arizona Department of Transportation, August 15, 2016), <https://azdot.gov/sites/default/files/2019/04/sdvc-minutes-081516.pdf>.

⁸⁷ "Arizona Self-Driving Vehicle Oversight Committee | ADOT," accessed June 9, 2021, <https://azdot.gov/about/boards-and-committees/arizona-self-driving-vehicle-oversight-committee>.

enacted in 2021, the State has allowed and encouraged AV testing despite the lack of a legislative framework since the Governors 2015 EO 2018-09 which permits the testing of AVs. EO-09 can be considered HB 2813s predecessor. HB 2813 is essentially a codified version of EO 2018-09. For more information on Arizona policies and executive orders see **Table 10** in Appendix A.

In 2022 the State Legislature of Arizona has also passed an addition two bills (2273 and 1333). SB 1333 contains definitions and operational restrictions pertaining to “neighborhood occupantless electric vehicles” and “neighborhood electric vehicles.” A neighborhood occupantless electric vehicle is a vehicle not “intended to or marketed for human occupancy.”⁸⁸ The bill enforces neighborhood occupantless electric vehicles to the same safety vehicle standards to which automated vehicles must comply with in the state. The reasons for this can be due to the Waymo’s rapid expansion of its driverless Level 4 AVs in the greater Phoenix area which begun in 2020 with approximately a 300 – 400 vehicle fleet in Arizona.^{89 90} House Bill 2273 passed in 2022 also includes regulatory action for automated vehicles being operated by transportation network companies and on-demand autonomous vehicle network such as Waymo. The bill states that vehicles (automated or human operated) operated by either service must meet vehicle safety and state emission standards.

⁸⁸ Gowan David, “Senate Bill 1333,” Pub. L. No. 1333, § 9-500.48, Chapter 4 Title 9 (2021), <https://www.azleg.gov/legtext/55leg/1R/bills/SB1333P.pdf>.

⁸⁹ “Chandler Is the First City Nationwide to Partner with Waymo for Autonomous Vehicle Ride-Hailing Program,” City of Chandler, June 24, 2019, <https://www.chandleraz.gov/news-center/chandler-first-city-nationwide-partner-waymo-autonomous-vehicle-ride-hailing-program>.

⁹⁰ Michael DeKort, “Waymo Is Unwilling to Prove Their L4 Driverless Vehicle Does No Evil,” *Medium* (blog), November 3, 2019, <https://imispgh.medium.com/waymo-is-unwilling-to-prove-their-l4-driverless-vehicle-does-no-evil-bc92e198d45>.

8.1) Local AV Planning and Policy

Based on the Governor’s executive orders and Arizona State legislation, local municipalities and AV companies must rush to identify their response to the deployment and operation of these technologies on local roadways. The greater question at stake is, how can local municipalities guide AV adoption towards the justice framework?

At the local level Waymo launched in local municipalities of Chandler, Tempe, Mesa and Gilbert in the greater Phoenix area to allow for driverless ride-hailing services.⁹¹⁹² Lyft has also direct all request of driverless vehicles in Chandler to Waymo vehicles.⁹³ Waymo’s operations initially began with safety drivers in the vehicles and only provided service to a select trusted few. As they’re AV technology has mapped more of the city, Waymo now provides Level-4 driverless on-demand service within a pre-determined geographic area in the local municipalities as seen in

Figure 3.

⁹¹ “Chandler Is the First City Nationwide to Partner with Waymo for Autonomous Vehicle Ride-Hailing Program.”

⁹² Andrew J. Hawkins, “Waymo Will Allow More People to Ride in Its Fully Driverless Vehicles in Phoenix,” The Verge, October 8, 2020, <https://www.theverge.com/2020/10/8/21507814/waymo-driverless-cars-allow-more-customers-phoenix>.

⁹³ Hawkins.

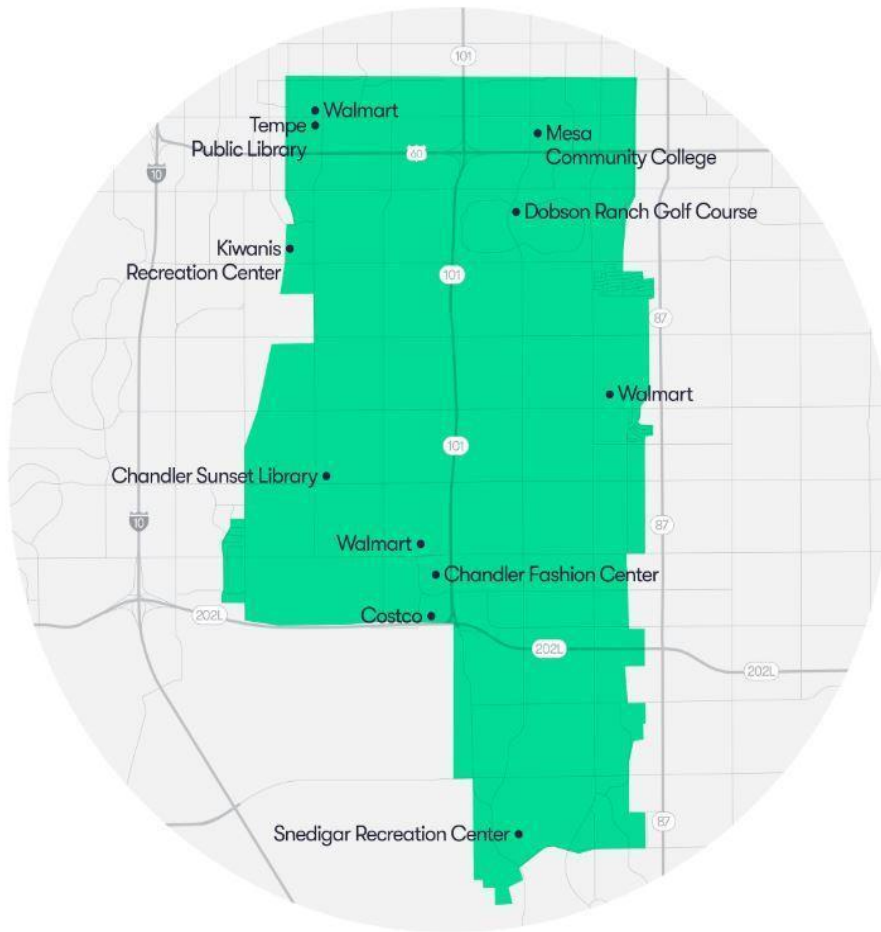


Figure 3) Geo-fenced area of Waymos on-demand AV service in Phoenix, Arizona as of 2022 ⁹⁴

Another important public and private sector partnership includes Valley Metro (public transit agency), and Waymo. This partnership initially provided first/last mile service to transit stops and park and ride lots bolstering transit access by enabling commuters with non-walkable distances to now be able to access transit. This partnership begun in 2018 with Valley Metro’s exiting bus and light-rail services. ⁹⁵ Phase I of the pilot was only open to Valley Metro employees living in Chandler, connecting them to ride-hailing trips via Waymo’s phone

⁹⁴ “Waymo One App Experience,” Waymo, 2022, <https://waymo.com/whereyoucango/>.

⁹⁵ “Waypoint - The Official Waymo Blog: Partnering with Valley Metro to Explore Public Transportation Solutions,” Waymo Blog, accessed July 21, 2022, <https://blog.waymo.com/2019/08/partnering-with-valley-metro-to-explore.html>.

application. Phase II included feedback from Phase I and focused on serving underserved populations participating in Valley Metro's RideChoice program. The RideChoice program provides highly subsidized curb-to-curb ride hailing services with eligible taxi companies, Uber and Lyft services for those who are mobility disadvantaged including the elderly (65+), people with disabilities or low-income.⁹⁶ This partnership between Waymo and the RideChoice program included funding from the Federal Transit Administration's (FTA) Mobility on Demand Sandbox Program to fund the service implementation and research travel behavior impacts of the program participants.

The inclusion for Waymo into the RideChoice program lasted six months and required participants to have a smart phone to use Waymo's ride-hailing application. Feedback received from Phase II includes Waymos limited geographic service. Eligible participants must have lived within Waymo's existing geofenced service area and could not begin or end trips outside the service area. With regards to improved mobility access, RideChoice users of Waymo indicated that Waymo's AV service was the preferred mobility choice over other options RideChoice (taxis, bus, paratransit and transportation networking companies.)⁹⁷ Another key perceptions researchers identified was that participants liked Waymos on-demand service due to the possibility to give up their personal vehicle which was indicated by those who are unable to drive due to age-related issues.⁹⁸ While this is a positive indicator to Waymos ability to reduce reliance on personal vehicles, survey respondents were not as comfortable with sharing trips with strangers when compared to sharing rides with known individuals (family or friends). In

⁹⁶ Stopher et al., "An Evaluation of the Valley Metro?"

⁹⁷ Stopher et al., "An Evaluation of the Valley Metro?"

⁹⁸ Stopher et al., "An Evaluation of the Valley Metro?"

terms of impacts to other transportation modes, there was a decreased usage in other modes specifically with TNC services for Waymo users.⁹⁹

8.2) Arizona Local Governments Taking Action

As a result of the Arizona's Governor declaring the state as a testing ground for AVs, the City of Tempe has taken action to identify the risk and opportunities of having AVs operate in their jurisdiction. The city released a document titled Autonomous Vehicles in Tempe: Opportunities and Risks which provides a comprehensive overview of local policy priorities focusing on how Tempe can harness AV technology to meet existing city goals. Through scenario planning, the document lays out how AVs may impact Tempe's Strategic Strategies to develop local policy and planning strategies for AV pilots and investment opportunities.¹⁰⁰ Scenario Planning involves thinking about the future and developing ways to respond to its uncertainties. It creates insight into possible alternative futures through surveying the present reality, creating future projections, identify internal and external inferential factors to produce a set of possible future scenarios.¹⁰¹

The document also indicates a high level of collaboration majorly with stakeholders including internal city departments, representatives from Arizona State University and several non-governments organizations to plan for uncertainties around road safety, community relationships, and impacts to local transit. Existing priority performance metrics to be prioritized for AV

⁹⁹ Stopher et al., "An Evaluation of the Valley Metro?"

¹⁰⁰ Miller et al., "Autonomous Vehicles in Tempe: Opportunities and Risk."

¹⁰¹ "Scenario Planning," American Planning Association, accessed August 13, 2022, <https://www.planning.org/knowledgebase/scenarioplanning/>.

planning include, 1) disability inclusion, 2) reduction in traffic collisions, 3) a multi-modal city, 4) carbon neutrality by 2035, 5) high-quality transit, and 6) reduced travel times. To meet these performance metrics, the City lays out five Strategic strategies seen below.

Table 4) Tempe’s Strategic Priorities and AV Impact Areas *

	Safe and Secure Community Connections	Strong Community Connections	Quality of Life	Sustainable Growth and Development	Long-Term Financial Stability and Vitality
Existing Strategic Plan Priorities	" Ensuring a safe and secure community through a commitment to public safety and justice."	"Developing and maintaining a strong community connection by emphasizing the importance of open government, customer service and communication with community members."	"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."	"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."	"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."
AV Impact Areas to Strategic Priorities	Traffic Safety	Data Governance and sharing	Accessibility for youth and elderly	Emissions and climate impact	Revenue impact
	Emergency Response	Public Transportation	Equity – access to new mobility options	Compact urban development	Infrastructure needs
	Cybersecurity	AV Governance	20-minute neighborhoods		Labor market impacts
	Liability and Public Safety	Public Perception			
		Congestion			

*Adopted from *Autonomous Vehicle in Tempe: Opportunities and Risk*

8.3) Arizona - AV Framework Discussion

Of the risk and opportunities identified in **Table 4**, Tempe’s document lays out several **Strategic Actions**, and **Pilot and Investment Opportunities** leading to near term **Recommended Next Steps**. Out of these three actionable items, the **Pilots and Investment Opportunities** provide recommendations which meet criteria within the AV Framework by addressing the negative impacts AVs may create. First, the **Investment Opportunities** mention AV service should complement existing transit services through first/last mile connections and neighborhood shuttles establishing that AV adoption will enhance transit investments rather than directly compete for ridership. For lower-income communities to benefit from this AV service, AV

deployments must reach their geographic neighborhood. Therefore, a **Pilot Opportunity** mentioned is provide on-demand or fixed-route AV and paratransit service to people with disabilities, the elderly and low-income communities addressing mobility injustice concerns.

Recommended Next Steps did not provide opportunities to ensure AV service would serve the city's mobility disadvantaged. Rather the pilot opportunity serves as a guiding action to allocate resources for future AV deployments.

From an environmental justice perspective, the document mentions reducing the dependence on single occupancy vehicles through “fleet autonomous vehicles electric shared” or FAVES. This can decrease traffic congestion and reduce mobile source emission meeting city sustainability goals. From a transportation justice perspective, the documented recommended developing a community engagement process in partnership with Arizona State University and industry. This partnership will work with local communities identify existing community mobility needs and develop ways for emerging technology to meet these needs. While this creates a path for an inclusive transportation planning process it is unclear how much of the community's input will be considered into pilots. The **Pilots and Opportunities** section directly address all three elements of the equity framework while also providing ways to mitigate future negative impacts of AVs with regard to sprawl, reducing VMT and mobile source emissions.

Chapter 9) California - AV Governance

The State of California has a history of being a leader in climate change policy and is home to one of the largest sectors for technological innovation in the world. California has been ground zero for the development and testing of many of the new transportation technologies and is home to many of these AV companies such as Amazon's - Zoox, Google's - Waymo, General Motor's – Cruise as well as Lyft and Uber. State policies such as Senate Bill (SB) 32 set goals for greenhouse gas reduction in a state where transportation emissions account for 40% of all GHG emissions.¹⁰² The combination of California's legacy in enacting emission reduction legislation and its deep connection to the technology sector, has allowed for the California State legislature to be well equip to incorporating sustainable and equitable policies into the transportation system. Similar to the research role academic institutions have in Michigan and Arizona in AV deployment, the University of California also provides a policy advising role based on sound research on numerous transportation topics, enabling the State to make educated and informed policy decisions. Based on the NCSL AV Data base, California has the most AV related polices passed in comparison to Arizona and Michigan, this next section will specifically address the most relevant policies which pertain to sustainability and social equity.

As of 2020, California has 14 enacted pieces of legislation which is directed towards AV technology.¹⁰³ Of these polices, 7 of them pertain to encouraging the sustainable adoption of AVs. The inception of California's AV Policy begins with SB 1298 directing the California Department of Motor Vehicles to be the lead agency in developing rules and guidelines for

¹⁰² "California Greenhouse Gas Emissions for 2000 to 2018," Emissions Inventory (California Air Resources Board, 2020), https://ww3.arb.ca.gov/cc/inventory/pubs/reports/2000_2018/ghg_inventory_trends_00-18.pdf.

¹⁰³ Stephen Wong and Susan Shaheen, "Synthesis of State-Level Planning and Strategic Actions on Automated Vehicles: Lessons and Policy Guidance for California," ITS Report (UC Berkeley: UC Institute of Transportation Studies, September 2020), <https://escholarship.org/content/qt6mf030xb/qt6mf030xb.pdf?t=qhrujm&v=lg>.

safely testing AVs within the State. As a result, the DMV created the Autonomous Vehicle Permit Program and currently have 49 registered AV businesses with permits testing on California's public roads with a driver.¹⁰⁴ 7 of these companies have permits for driverless testing, meaning companies can test on public roads without a driver in the vehicle.¹⁰⁵ 3 of these 7 companies (Cruise, Nuro and Waymo) have Deployment permits enabling these companies to charge a fee to the public for use of their AVs services.¹⁰⁶ Currently there are no policies or rules within the DMV AV program which encourage permit holders to test electric or shared. SB 1298 also provides consultation privilege to the California Highway Patrol and the University of California to address policy topics pertaining to vehicle safety, vehicle technology and autonomous system design.¹⁰⁷

Another key piece of enacted legislation is SB 1014 also known as the Clean Miles Standard. The Bill directs, the California Air Resources Board (CARB) and the California Public Utilities Commission (CPUC) to develop and implement a plan enabling TNC drivers to use zero-emission vehicles (ZEV). The purpose is to meet California's ZEV adoption and emission reduction goals. Furthermore, the bill encourages drivers to increase the number of pooled rides and reduce deadheading miles to bolster meeting state emissions reduction standards.¹⁰⁸ The regulation states that online ride-hailing platforms that use automated vehicles must comply with GHG emission and VMT reduction goals put forth by CARB and the CPUC. While SB 1014 is

¹⁰⁴ "Autonomous Vehicle Testing Permit Holders," California DMV, accessed May 25, 2021, <https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/autonomous-vehicle-testing-permit-holders/>.

¹⁰⁵ "Autonomous Vehicle Testing Permit Holders."

¹⁰⁶ "Autonomous Vehicle Testing Permit Holders."

¹⁰⁷ Padilla, "Senate Bill No. 1298" (n.d.), http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_1251-1300/sb_1298_bill_20120925_chaptered.pdf.

¹⁰⁸ "California Requires Zero-Emissions Vehicle Use for Ridesharing Services, Another Step Toward Achieving the State's Climate Goals," California Air Resources Board, accessed May 25, 2021, <https://content.govdelivery.com/accounts/CARB/bulletins/2da5a7a>.

intended to support electrification of TNC services the bill sets the path for automated vehicles used by TNCs to be zero-emission and shared in the near future.¹⁰⁹

SB 500 was passed in 2022 ensures that automated vehicles with a gross weight of 8,501 pounds or less must operate with zero-emission vehicle technology. This mandate directs light-duty vehicles and some medium-duty vehicles with Level 3-5 technology to operate with ZEV technology by 2031.¹¹⁰ The bill does not mandate heavy-duty vehicles to operate as ZEVs leaving a policy gap for AVs with freight applications.

California's approach of having a high number of regulations relative to the other states has resulted in a restrictive AV testing landscape can be attributed to the high concentration of technology companies in the state. As seen in the California DMV records, there are 49 AV companies registered to test within the state. Due to the abundance of AV companies and technology workforce there is no need to attract more to the state, but rather there is a greater need to control and regulate the companies guiding them to safely and sustainably test and deploy AVs. This is rather quite the opposite of both Michigan and Arizona as they are likely to compete and attract these businesses away from California's Silicon Valley for economic development purposes.

¹⁰⁹ Wong and Shaheen, "Synthesis of State-Level Planning and Strategic Actions on Automated Vehicles: Lessons and Policy Guidance for California."

¹¹⁰ "2021 – Senate Bill 500 (Min, Dave), Autonomous Vehicles: Zero Emissions (Chaptered) | California Air Resources Board," accessed August 5, 2022, <https://ww2.arb.ca.gov/2021-senate-bill-500-min-dave-autonomous-vehicles-zero-emissions-chaptered>.

9.1) California AV Planning Document – CalSTA and OPR

The California State Transportation Agency (CalSTA) and the Governor’s Office of Planning and Research (OPR) have both released AV planning and policy documents which include all three elements of the AV justice framework. OPR’s document titled, *Automated Vehicle Principles for Healthy and Sustainable Communities*, was released in 2018 and lays out the first steps to a cohesive AV planning and policy agenda in the state.

The goal of OPRs document was to align existing state priorities for “climate, air-quality, health, environment, land-use quality of life and equity”¹¹¹ *Principles* acknowledge the potential numerous risk AVs pose to society and provide *Strategies* to address them. These risk which pertain to the AV justice framework include, increased congestion, VMT, GHG emissions, and sprawl leading to poorer health and social equity outcomes. To address these potential negative outcomes, *Key Principles* are provided which orient AV deployment to provide comprehensive guidance for state-wide AV planning.

Table 5) Office of Planning and Research Policy Priorities

Key Principle	Strategy
Shared-Use	Deploy AVs as shared vehicles contrary to personal vehicle ownership
Pooled	Encourage shared pooling and prioritized passenger safety and comfort
Low-Emissions	Deploy AVs as ZEVs and implement eco-driving strategies
Right-Sized	Ensure AVs are sufficiently size, not oversized
Multi-Modalism	Deploy AVs as part of multi-modal system for efficient and sustainable movement
Efficient Land-Use	Support in-fill and compact development to reduce sprawl complementing
Complete and Livable Streets	Prioritize people over vehicles to improve safety of vulnerable road users, provide
Transportation Equity	Reduce barriers to mobility for low-income, disadvantaged and peoples with

*Adopted from *Automated Vehicle Principles for Healthy and Sustainable Communities*

¹¹¹ Chris Ganson, “Automated Vehicle Principles for Healthy and Sustainable Communities” (Office of Planning and Research, n.d.), https://opr.ca.gov/docs/20181115-California_Automated_Vehicle_Principles_for_Healthy_and_Sustainable_Communities.pdf.

In June 2022 the CalSTA released the state updated policy and planning priorities titled *Driving the Future: Autonomous Vehicles Strategic Framework Vision and Guiding Principles*. Similar to the OPR AV principles, the Framework is the result of a collaborate inter-state agency and external stakeholder collaboration. The document lays out the States AV planning vision along with high-level Guiding Principles aligning existing state wide efforts to reduce mobile source emissions, enhance mobility, increase safety and future-proof the workforce. Below is **Table 6** which provides a summary of CalSTAs framework.

Table 6) CalSTA AV Policy and Planning Priorities

Guiding Principle	Description
Environment	Deploy ZEV AVs to reduce mobile emissions and VMT and promote smart growth of working and natural lands
Equity	Reduce systematic inequities by providing affordable and convenient mobility through AV deployment
High-Quality Jobs	Require jobs to be high-quality with good wages and benefits in the AV industrial transition
Inclusivity and Equitable Access	Provide universal design and routes to improve AV benefits for all road users
Partnerships	Integrate AVs into the economy through collaboration, joint investment and shared responsibility among all stakeholders
Public Health and Livability	Ensure that AVs are adopted as a part of a multimodal system to improve public health
Safety	Increase safety for all road users through AV operation, design and Infrastructure investments
Shared Economic Benefit	Create an inclusive economic future for all Californians to benefit from the transition and growth of the AV industry

*Adopted from CalSTA’s *Strategic Framework*

When comparing both the OPR and CalSTA AV Planning documents, it’s clear that CalSTA has expanded the list of AV planning priorities beyond OPRs environmental and land-use *Key Principles*. OPRs 2018 document focused on reducing the environmental and land-use impacts by providing solutions which would mitigate VMT, and mobile source emissions. Of the eight *Principles*, six of them (*Shared-Use, Pooled, Low-Emissions, Right-Sized, Multi-Modalism, and*

Efficient Land-Use) reduce the environmental impacts of the transportation and land-use nexus. CalSTA's document still includes these planning priorities with its *Environment and Public Health and Livability Guiding Principles*. However, the addition of economic priorities (*High-Quality Jobs, Shared Economic Benefit*) and equity principles (*Equity, Inclusivity and Equitable Access, and Safety*), expand state AV Planning priorities beyond OPRs environmental and equity planning principles.

9.2) Local Level Pilot and Deployments – San Francisco

SB 1298 established the Autonomous Vehicle Passenger Service Programs which was authorized by the California Public Utilities Commission (CPUC) and administered by the California Department of Motor Vehicles. Since then numerous AV companies (Nuro, Waymo and Cruise) have been issued **Driverless Autonomous Vehicle Passenger Deployment Permits** authorized by the CPUC. Despite objection from the City of San Francisco in 2022 Cruise was granted permission to provide passenger service to the general public with 30 electric AVs operating at a maximum of 30 mph between 10 p.m. and 6 a.m. in San Francisco.¹¹² Previously Cruise was only given authority to test AVs within the DMV's **Driverless Testing Program** and was not permitted to offer rides outside of the testing program. Similar to Waymo's deployment in Tempe, Cruise's operational-design-domain (OOD) is limited to a predetermined geographic area in San Francisco.

¹¹² Aichi Daniel, "Cruise LLC's Reply to Protest and Comments to Cruise's Application for Driverless Deployment Permit - Tier 3 Advice Letter" (California Public Utilities Commission, December 6, 2021), <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/consumer-protection-and-enforcement-division/documents/tlab/av-programs/phase-i-av-deployment-program-al-status/20211206-cruise-llcs-reply-to-protest-and-comments-to-application-for-driverless-deployment-permit.pdf%5D>.

Considering the deployment of AV technology on local San Francisco streets, how has local planning efforts developed for AV technology? The following section will address preparatory planning actions to local planning as a result of this state action. Specifically, I will look to local planning actions, priorities and policies in the San Francisco, Bay Area.

In 2018 Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG) released an **Autonomous Vehicles Perspective Paper** laying out foundational planning principles and goals for AV adoption in the Bay Area. Through future scenario planning the document provides a planning and policy framework based on existing regional planning goals (**Horizon Initiative**) from 2050 Bay Area Master Plan. See **Table 7** for more details on the Horizon planning goals and how they are incorporated into existing planning initiatives. Similar to Tempe's AV document, this paper calls upon the **Horizon Initiatives** existing goals to see how AV propose opportunities and risk to meeting these goals. **Strategic Actions** are then proposed for each Horizon principle to reduce risks and increase the likeliness of an opportunistic future guided by the principles. After the Strategic Actions are provided, **Example Applications** were synthesized to provide actionable items for local and regional decision makers. The Horizon Guiding Principles which highlight local action for a more socially equitable and environmentally sustainable pertain to the **Affordable, Connected, Diverse and Healthy Principles**. It's important to note that while the **Vibrant Principle** does not differently pertain to the sustainable or equitable adoption defined by the Equity Framework, it creates goals for an inclusive workforce to ensure that all communities can equitably benefit in the transition to AV adoption.

Table 7) AV Strategic Planning Actions and Recommendations (Bay Area)*

	Affordable	Connected		Diverse	Healthy	Vibrant
Horizon Guiding Principle	Leverage reduced parking demand to increase housing supply, reduce housing cost and decrease sprawl.	Expand a quality transportation system to provide fast, and frequent intercity trips providing local transportation options.		The Bay Area remains a diverse and inclusive area for all peoples	Protect environmental resources, reduce the regions environmental impact and protect residents from environmental harms.	Establish the region as an innovative leader, creating quality jobs and financial resources for all communities
Strategy Areas	Housing and Transportation Nexus	Transit	Pricing	Environmental Justice and Mobility Justice	Traffic Safety and Resource Conservation	Labor and Economic Development
Strategic Actions	Repurpose off-street parking for infill	Double down on high capacity bus and rail corridors	Price fairly through dynamic road pricing	Mandates the equitable provision of mobility services with transparent reporting	Cap speed limits in downtown and in neighbors	Strengthen capacity of training programs to expand opportunities in the AV industry for impacted jobs
	Institute parking maximums	Provide suburban areas with demand-responsive transit	Design smart streets for the dynamic allocation of the right of way	Subsidize public transit innovations, replacing fixed route transit in some Communities of Concern	Mandate that all AVs are ZEVs and support EV infrastructure	Support industrially zoned lands to be industry clusters for AV production, distribution and repair
	Control greenfield development	Develop mobility-as-a-service (MaaS) platform for information and services	Develop data sharing protocols	Prioritize AV services or programs that serve Communities of Concern	Reduce hacking vulnerability for connected AVs	Pilot innovative AV deployments to spur job opportunities
Example Application	Housing Opportunity Sites in an Autonomous Future	Regional Demand Responsive AV Transit	Dynamic Pricing Opportunities	Equitable AV service	Vision Zero 2.0	Mobility New Deal
	Off and on-street parking garages and parking lots indicate opportunities for infill development for more affordable housing and alternative transportation infrastructure if AVs are shared	Replace fixed-route bus service with automated demand-response transit in low-density areas to provide first-and-last mile connections to existing trunk lines	Implement a regionally collaborative dynamic road pricing to alleviate in major cities and corridors and recuperate lost parking revenue	Ensure that AV mobility service providers are held accountable to address transportation injustice through developing clear targets, creating ambitious equity metrics, to ensure AV service provides equitable outcomes.	Reduce transportation-related public health issues pertaining to road safety and mobile source emissions.	Increase job access to low to medium income workers who will lose jobs to automation

*Adopted from the Bay Area’s *Autonomous Vehicle Perspectives Paper*

9.3) California - AV Framework Discussion

The Autonomous Vehicle Perspectives Paper provides insight into the Bay Area’s priorities to AV adoption. The summary of the Bay Area Plan can be found in **Table 7** above. With regards to the AV Framework, there are direct calls to ensure that AVs are adopted equitably and sustainably. The **Diverse** Horizon Principle specifically seeks calls upon elements of environmental and mobility justices concerns to ensure that AV services will be provided equitably by enhancing existing rail transit investments while replacing fix-route bus transit. The opportunities listed acknowledge that AVs can improve mobility access through a universal AV design for the mobility disadvantaged while stating that private access to AVs can limit mobility access. Additionally, the Diverse principle defines “EJ” with regards to how AVs may facilitate

less car-centric infrastructure (mainly parking) leading to the reallocation of parking land-uses. The EJ risk involved here include the how placement of new land-use opportunities such as housing, AV maintenance and charging facilities will impact nearby communities. As AVs are expected to reduce the need for exiting land-uses such as parking, it creates opportunities to reallocate these land-uses to housing and alternative transportation infrastructure. EJ concerns and opportunities are brought up with regard to the distributive impacts of how the new reallocated infrastructure (housing, alternative transportation infrastructure and AV facilities) can create negative impacts to nearby communities of concern. Additionally, it brings up the concern that these same communities of concern may not receive the benefits of AV service or associated new land-uses creating similar distributive justice issues with highway infrastructure.

These EJ concerns are directly related to the negative impacts of AVs previously addressed (placement of transportation infrastructure). The **Strategic Actions** and the **Example Application** only provide solutions to ensuring AV service is equitable through mandated data reporting and the subsidies of AV service near existing transit and communities of concern.

Chapter 10) Policy Analysis – State Actions

Each state has taken their individual approaches to AV adoption whether its focused on industrial, economic development, infrastructure or sustainability policies and programs. This section will analyze key features and characteristics of each policy and planning landscape to see what types of progress has been made with an emphasis on sustainable and equitable AV adoption. First general trends are identified in the governance landscapes for all the states in the following Sections (10.1 – 10.5). Section 10.6 will provide an analysis of all planning and policy

actions at the state level based on the AV justice framework. These policy and planning actions include, enacted state legislation, governor’s executive orders and AV planning documents published by a state agency if one has been published. **Table 8** is provided at the end of the chapter summarizing how each State has made progressed with regard to policy actions (Policy Paths and Principles).

10.1) State Leadership – Councils and Committee

Both Arizona and Michigan have established some form of lead committee or council to guide and develop statewide AV policies established through legislation or executive action. California failed to pass legislation in 2020 (SB 66) which would have created the **Council on the Future of Transportation**. The Council would serve as an advisory role to the California legislature and the Governor’s Office to promote equity, road safety, public health and environmental goals for AV adoption. Despite SB 66 failing to pass through the legislature, the **Multi-Agency Workgroup on AV Deployment for Healthy and Sustainable Communities** remains as the dedicated inter-agency collaboration focused on developing AV policy across California. Consisting of 12 state departments, the workgroup promotes multi-agency collaboration to maximize the environmental benefits of AVs while mitigating the technologies social negative cost. Specific AV impact areas the group addresses include “GHG and criteria pollutant emissions, land-use patterns, VMT, health, and equitable access.”¹¹³ With direction of the workgroup, the California Governor’s Office of Planning and Research (OPR) has developed non-binding AV adoption principles to serve as a high-level policy framework for equitable and sustainable AV policy in the state. This document released in 2018 is known as the **AV**

¹¹³ Ganson, “Automated Vehicle Principles for Healthy and Sustainable Communities.”

Principles for Healthy and Sustainable Communities. In August 2022 another workgroup member known as the California State Transportation Agency (CalSTA) released their **AV Strategic Framework Vision and Guiding Principles** which elaborates OPR’s previous guiding principles and incorporates five State documents including a ZEV Market Development Strategy and the Climate Action Plan for Transportation Infrastructure.

In Arizona, EO 2015 – 09 created the **Governor’s Office of Self Driving Vehicle Oversight Committee** and the **Institute of Automated Mobility (IAM)**. The IAM is housed within the Arizona State Commerce Authority which focuses on economic development across the state. Meanwhile Michigan’s EO 2020 – 02 and HB 5335 created the **Office of Future Mobility and Electrification (OFME)** as well as the **Michigan Infrastructure Council** to guide AV policy and road investments respectively. Similar to Arizona’s IAM, Michigan’s OFME is housed within Michigan’s Economic Development Corporation which contain similar priorities for economic development.

Both Arizona and Michigan have embedded a leadership group through an executive order or state legislation to further modernize their state’s AV infrastructure and policy. This ensures that each state has a dedicated entity to supporting the AV industry as the technology matures. In terms of sustainability, through EO 2020 - 02 Michigan has allowed for a representative from the Department of Environment, Great Lakes and Energy to serve as voting member. This representative is potentially one of the only voices to speak on environmental aspects of AV policy in the state. Governor Whitmer has received criticism for not including more environmental, transit and non-motorized leaders.¹¹⁴

¹¹⁴ “Key Groups Left out of Council of Future Mobility and Electrification,” Michigan Environmental Council, October 23, 2020, https://www.environmentalcouncil.org/key_groups_left_out_of_council_of_future_mobility_and_electrification.

Even though the AV leadership groups in Arizona and Michigan do not prioritize sustainable or equitable AV adoption within their policies, California can learn from these leadership examples to provide a coordinated state effort to modernize AV policy and planning. SB 66 proposed in California's State Legislature in 2019 would do just that by inviting numerous government, NGO, academic and businesses organizations to the same table to provide multi-faceted, interdisciplinary and comprehensive approach to AV state policy and planning. One main difference between California's SB 66, and Michigan's OFME and Arizona's Oversight Committee is the comprehensiveness of the stakeholder list is within SB 66 leadership council. Arizona does not include NGOs, local governments and other key organizations within its Oversight Committee and only permits academic and government officials. Michigan does allow for businesses, and other non-government organizations but heavily focuses on including businesses.¹¹⁵ The comprehensive stakeholder list in SB 66 is missing in both Michigan and Arizona's AV stakeholder list. This could be due to priorities over economic development over sustainability and equitable mobility.

10.2) California's Dominance in Sustainable and Equitable AV Policy

In comparing policies between Arizona and Michigan's AV Policy's is relatively minimal when compared to California's AV policies. Arizona has only one sustainable policy (HB 2273) which mandates that vehicles operated by TNCs must comply with Arizona's mobile emission standards. This is similar to California's Clean Miles Standard (SB 1014) but not as stringent

¹¹⁵ Corbin, "Council on Future Mobility and Electrification."

since Arizona’s policy only requires TNC comply with existing vehicle emission standards rather than reduce emissions over time.

Michigan has EO 2020 – 9 which created a dedicated state agency (OFME) to encourage sustainable AV policies through appointed leadership. However, there are zero policies that intersect with VMT, or emission reduction from Arizona or Michigan directly. As mentioned in the previous section, Arizona and Michigan have taken an economic development stance towards AV adoption to compete with California’s Silicon Valley.^{116 117} This type of competitive “race to the top” may be hindering the prioritization of other key AV adoption priorities such as engagement with local governments, and reducing the negative impacts of AV such as safety, equity and sustainability. For example, Arizona’s Governor Ducey prioritized attracting AV businesses to the state over safety when passing EO 2015 – 09. The lack of a comprehensive safety and testing regulation at the time, could have led to the unfortunate death of a pedestrian – Elaine Herzberg caused by Uber.^{118 119} A year after this incident, EO 2018-09 was passed by the Governor Ducey clarifying safer testing rules for vehicles with higher levels of autonomy which may have resulted from this incident.

Meanwhile the State of Michigan, along with local governments and private businesses are in the process of developing a 40-mile corridor to create a Connected and Automated Vehicle Corridor (CAV-C).¹²⁰ While this may be an innovative project, building a road dedicated to AV technology will most certainly lead to induced demand; increasing VMT and GHG emissions if

¹¹⁶ Kang, “Where Self-Driving Cars Go to Learn.”

¹¹⁷ Corbin, “Council on Future Mobility and Electrification.”

¹¹⁸ Vincent, “Regulatory Framework for Autonomous Vehicle Safety.”

¹¹⁹ Troy Griggs and Daisuke Wakabayashi, “How a Self-Driving Uber Killed a Pedestrian in Arizona,” *The New York Times*, March 20, 2018, sec. Technology, <https://www.nytimes.com/interactive/2018/03/20/us/self-driving-uber-pedestrian-killed.html>

¹²⁰ “MDOT - CAV Corridor.”

passenger AVs are not electrified nor pool. California's SB 500 and SB 1014 would serve as great example for Michigan to mitigate GHG emissions from the CAV- C by mandating the electrification of light-duty AVs. This project is in the early development phase but indicates Michigan's willingness to lead the AV industry and demonstrate the potential of CAV technology.

When considering what policies could best be diffused into Arizona and Michigan to encourage the sustainable adoption of AVs, California state and local policy serves best as the policy diffuser for environmental sustainability. **Tables 10, 11 and 12** shows the number of AV related policies in all three states. The list of California policies (**Table 12**) is not exhaustive and only shows policies which encourage the sustainable adoption of AVs. SB 1014 is possibly one of the best example policies which encourage GHG and VMT reduction for future ride hailing services using AVs. While not initially intended for AVs, this policy would especially be effective in States that are already testing AV ride hailing services such as Arizona and California with Waymo and Cruise now deploying driverless AVs. ^{121 122}

While California has policies which promote AV adoption sustainability there are still gap areas which limit its progress. As previously mentioned, California's DMV has currently permitted the testing of 49 AV companies. While a small minority of these companies are/ have tested electric (Cruise and Zoox), it's very unclear whether they will commit to an electric deployment without binding legislation such as SB 500. This is especially concerning considering Waymo is testing the majority of its AV fleet with PHEV's. ¹²³ Despite the lack of regulation and policy, trends

¹²¹ "Chandler Is the First City Nationwide to Partner with Waymo for Autonomous Vehicle Ride-Hailing Program."

¹²² Hawkins, "Waymo's Self-Driving Cars Are Now Available on Lyft's App in Phoenix."

¹²³ "Waypoint - The Official Waymo Blog: Waymo and Fiat Chrysler Automobiles (FCA) Expand Autonomous Driving Technology Partnership," Waymo Blog, accessed May 26, 2021, <https://blog.waymo.com/2020/07/waymo-and-fiat-chrysler-automobiles-fca.html>.

identified in each local planning document indicate that these local governments envision AVs to be deployed as electric in the near future. While California’s state legislature has mandated that light duty AVs will be electric (SB 500), Tempe and SEMOCG envision AVs to deploy as electric in the near future. But without mandating AV to be electric, it is unclear whether or not AV companies will actually deploy electric AVs. The state of Arizona and Michigan both have the opportunity to mandate the AVs be deployed as electric AVs to reduce local mobile source emissions addressing EJ concerns.

10.3) Other State Approaches – Economic Development and Safety

As previously stated for both Michigan and Arizona, these two states have taken steps towards using AV adoption to advanced economic development priorities in each state. For Michigan the administrative placement of Michigan’s Office of Future Mobility and Electrification within the Economic Development Corporation (MEDC), focuses on attracting AV and mobility manufactures to the state. In partnership with Michigan Department of Transportation (MDOT) and Department of Labor and Economic Opportunity (MLEO) the state has developed an internal process for increasing AV testing and deployment in partnership with the private sector to reap its economic benefits. The MLEO focuses on attracting and creating a workforce ready to meet the needs of AV developers and testers such as the companies that partner with the MEDC or Universities. The role of MDOT and OFME comes into play to provide the private sector opportunities to test AV technology with AV infrastructure.¹²⁴ The result of Michigan’s SAVE Act and executive orders have resulted in the emphasis for AV testing and deployment to support

¹²⁴ “Office of Future Mobility and Electrification | Michigan Business,” Michigan Economic Development Corporation (MEDC), accessed June 9, 2021, <https://www.michiganbusiness.org/ofme/>.

Michigan's economic development. MDOT provided \$8 million (Mobility Challenge) to partner with mobility service providers to provide mobility services for vulnerable travelers, such as disabled and elderly travelers. The Michigan Mobility Challenge and resulted in the funding of 13 mobility projects one of which included providing automated mobility services for disabled persons at Western Michigan University.¹²⁵ The continuation of the Mobility Funding platform further expanding Michigan's state funding into innovating mobility companies reorienting the state mobility funding priorities to sustainable, equitable and multi-modal transportation. The Mobility Funding Platform serves as a policy initiative embedded within economic development goals, but is guided by its the three funding priorities. The Platform is a combined policy initiative that can spur economic development within the mobility industry broadly while investing in local mobility benefits through its three guidelines.

The State of Arizona has taken a much less comprehensive approach akin to "laissez-faire" providing little direction and leadership for local governments. In identifying the "policy outputs" of the IAM and the Governor's Office of Self Driving Vehicle Oversight Committee, there is very limited information available on the goals and achievement each entity has achieved when compared to Michigan's actions. The Oversight Committee do not constantly meet and lack the leadership Executive Order 2015-09 envisioned. Their leadership role seems to be non-existent since the Committee has only met once in 2016 since its existence, and never reconvened even after the death of Elaine Herzberg.¹²⁶ As for the IAM, the Institute has begun to focus on developing safety measures which can potentially have a nationwide impact.

Specifically, in partnership with key private sector AV stakeholders, Universities and State

¹²⁵ "New Autonomous Mobility Vision for Michigan."

¹²⁶ "Arizona Self-Driving Vehicle Oversight Committee | ADOT."

agencies, the IAM is working to develop Safety Performance Metrics to assess how “safe” an AV can be.¹²⁷ Currently, there is no consensus on how to assess whether or not the driving behavior of an AV is “safe.” This still remains to be a barrier at the Federal level in NHTSA’s FMVSS.^{128 129} However, it could take time to develop these standards.

10.4) State AV Adoption Paths – Infrastructure and Road User Charges

CAV infrastructure deployment is a top policy and planning priority in the State of Michigan. Their Connected Vehicle program strongly supports demonstrating CAV infrastructure to maximize efficiency for better transportation demand management. The CAV Corridor project is the best example of the state seeking to demonstrate this technology. However, the local government and MPO of Tempe and the SEMCOG question local need for this infrastructure and question who will pay for it? Impacts of government investment can lead to detrimental social and environmental disparities as seen with highway infrastructure. Public CAV infrastructure initiatives must not blindly exclude local communities and overshadow the needs of communities. CAV companies, local and state governments and local communities must be well informed and engaged within the CAV planning process to understand how it may impact their community especially with regard to security and privacy data collection.¹³⁰ Engagement and

¹²⁷ “Projects - DRIVING SAFETY PERFORMANCE METRICS FOR ADS-EQUIPPED VEHICLES,” accessed June 9, 2021, <https://www.azcommerce.com/iam/projects>.

¹²⁸ Mollie Cohen D’Agostino, “ANPRM - Part 571 – Request for Comments on NHTSA’s Framework for Automated Driving System Safety” (UC Davis Policy Institute, February 2021).

¹²⁹ Vincent, “Regulatory Framework for Autonomous Vehicle Safety.”

¹³⁰ Dasom Lee and David J. Hess, “Public Concerns and Connected and Automated Vehicles: Safety, Privacy, and Data Security,” *Humanities and Social Sciences Communications* 9, no. 1 (March 22, 2022): 1–13, <https://doi.org/10.1057/s41599-022-01110-x>.

collaboration should seek to provide intentional benefits for local communities through technological innovation.

A foreseeable opportunity for local and state governments to engage with its communities could be in planning for CAV infrastructure and road-user-chargers (RUC). RUCs were strong local policy recommendations in the Bay Area and in Michigan. RUCs provide policy intervention opportunities to encourage shared AVs, reducing congestion and single occupancy vehicles. However, RUC programs can create negative social implications. Low-income drivers can be forced to spend a higher percentage of their income on transportation leading to low levels of mobility due to institutional actions. These planning actions should rather identify equitable priorities through a meaningful community engagement process to prevent placing financial burdens on low-income drivers.¹³¹ This can lead to pricing structures which balance equity and efficiency while ultimately encouraging multi-modal travel. Considerations to how RUC revenue should be reallocated also reflect the balance between efficiency and equity to meet sustainable transportation goals and reducing the burden on low-income drivers. Data collection of CAV infrastructure, should also seek to create equity metrics to ensure equity and environmental goals are being tracked and met.¹³²

¹³¹ Mollie Cohen D'Agostino, Paige Pellaton, and Brittany White, "Equitable Congestion Pricing," December 1, 2020, <https://doi.org/10.7922/G2RF5S92>.

¹³² Cohen D'Agostino, Pellaton, and White, "Equitable Congestion Pricing."

10.5) State - Shared AV Deployment

When identifying what states are making progress towards shared AVs, California has clearly taken the lead by demonstrating the policy initiatives to reduce VMT and other impacts through sharing. This is particularly seen within both OPRs 2018 *AV Principles* document and CalSTA's 2022 *AV Strategic Framework*. In OPRs document, *Pooled* usage is a Key Principle used to encourage sharing of AVs while the *Shared-Use* principle prioritizes passenger safety. These same policy initiatives were also reflected in CalSTA's 2022 update of the California's statewide AV planning priorities through their *Environment - Guiding Principle* to mitigate unsustainable impacts to land-use. Additionally, the passage of SB 1014 also mandates that AV ride-hailing services to reduce their VMT which can also lead to pooled AV rides across the state. SB 1014 is possibly the strongest policy out of all the other state which set the path for shared AV usage to reduce VMT.

For the State of Michigan, their desire to deploy AVs as shared vehicles is more unclear relative to California. There are no policies which explicit in reducing VMT through shared AVs.

However, there are similar policy themes which the *Mobility Funding Platform* (MFP) which align with OPRs and CalSTAs principles. Of the MFPs three investment priority areas, *Multimodal transportation* could give priority investments for shared AVs. However, since the program's inception, investments in shared AVs have only been limited to campus testing environments. Michigan's investment in the CAV Corridor could potentially lead to road user charges (RUCs). However, it's unclear how a RUC program would be equitably developed and implemented.

For the State of Arizona, there are no policies or planning documents which encouraging shared AVs. Rather the private sector (Waymo) has taken the initiative by offering shared AV services

within local jurisdictions in the Phoenix metropolitan area. Rather than the state taking the initiative to encourage shared AVs, the local government of Tempe has mentioned through its AV Planning document to publically invest in fleets of shared and electric vehicles.

When comparing the how states are encouraging shared AVs, California is the only state to enact a policy which discourages VMT through SB 1014. Michigan and Arizona do not have any policies or documents which explicitly encouraged shared pooled AVs.

10.6) AV Justice Discussion – State Level Planning and Policies

Each state has made different levels progress towards meeting the AV justice policy principles and the policy paths. This section will highlight AV planning actions and policies which hinder or achieve AV justice within the state of focus. **Table 8** summarizes these trends indicating that California has made the most progress to achieving sustainable and equitable outcomes of AV adoption followed by Michigan and Arizona.

To indicate the level of progress for the policy actions, each cell in **Table 8** was given a color depending on the following criteria. Green was given if the state indicated direct and dedicated leadership and policy initiatives which include enacted legislative policy which directly addresses future issues and past injustices, and public funds directed towards the policy action which meet criteria of the AV justice framework. A cell received yellow indicating minimal progress. Yellow was warranted for policy actions which provides the indirect policy initiatives or programs which achieve the AV justice framework. For example, a yellow cell was provided if the policy action was not aggressive enough compared to other polices (i.e. California’s SB 1014 vs Arizona’s HB 2273). If the state had conflicting policy actions (i.e. Michigan’s

Government Investment Policy Path) yellow was also given. Finally, a cell was given red if the state failed to include any policy initiatives, programs or executive orders which directly or indirectly address the AV policy action.

10.6.1) California

Focusing first on California, the release of the 2018 OPR's and 2022 CalSTA AV Planning documents is one of the leading highlights which directly address most of the MJ, TJ and EJ principle concerns. Specifically, OPR's document heavily focused on the environmental and land-use impacts of AVs by providing key guiding principles to establish the state environmental goals for AV adoption. These principles include, shared AV to reduce reliance on personal vehicles, pooled AVs which are comfortable and safe for passengers, and deploying AVs as low or zero-emission vehicles addressing EJ concerns. From a mobility perspective, OPR includes the principle – “Part of an efficient multimodal system” which will bolster transit services by first and last miles trips and replacing existing low-quality transit routes.

With regards to the TJ principle in the 2018 OPR document, there is little mention of how the state plans on engaging with local communities throughout the AV planning process. However, of the eight guiding Principles mentioned, one of them is “Transportation Equity.” OPR uses this term as if it were mobility justice. Specifically, the principle mentions improving affordable mobility options through AVs particularly for low-income and disadvantaged groups and people with physical disabilities.¹³³

¹³³ Ganson, “Automated Vehicle Principles for Healthy and Sustainable Communities.”

Since the 2018 OPR document, CalSTA has also released its *Strategic Framework* in 2022 building off these efforts. CalSTA’s principles were only included in **Table 8** since they are the most recent policy actions. Similar to the OPR document, CalSTA’s document aligns existing state wide efforts by prioritize AV planning efforts which directly address elements of the AV Justice framework. For environmental justice, the document provides the Environment guiding principle which combines priorities for the ZEV and shared deployment of AVs. Additionally, the Environment principle also includes the Land-Use policy path by prioritizing that AVs promote the smart growth of natural and working lands. For mobility, environmental and transportation justice, the document includes the Equity principle which calls for reducing systematic inequities through AV deployments. By engaging with local communities within the AV Planning process this principle explicitly addresses TJ concerns by reducing systematic environmental mobility injustices which have disproportionately burden low-income and communities of color.¹³⁴

For the Policy Paths, CalSTA’s principles and several state policies directly address concerns in the AV justice framework. The strongest policy path California has progress is Environmental Sustainability. The passage of both SB 500 and SB 1014, indicate that AVs will be adopted sustainability. Specifically, SB 500 mandates that light duty AVs deploy as electric vehicles by 2030 mitigating impacts to local air-quality and GHG emissions. SB 1014 mandates that TNCs must increase zero-emission miles and promote VMT reduction strategies setting the stage for AV passenger services.¹³⁵

¹³⁴ CalSTA, “Autonomous Vehicles Strategic Framework | CalSTA,” accessed October 17, 2022, <https://calsta.ca.gov/subject-areas/autonomous-vehicles-strategic-framework>.

¹³⁵ “Clean Miles Standard | California Air Resources Board,” accessed January 23, 2021, <https://ww2.arb.ca.gov/our-work/programs/clean-miles-standard/about>.

California indicates its policy leadership for the AV Justice framework given that the state released two separate AV policy guidance documents which include all of the policy actions. While statewide AV planning documents are absent in both Michigan and Arizona, they could serve as model examples for other states to learn from.

10.6.2) Michigan

When applying the AV Justice Framework to Michigan's policies, all of the policies listed in **Table 11** only support industrial purposes for the AV industry. Given Michigan's economic development policy initiatives, enacting industrial focused policies gives local AV companies a potential competitive advantaged especially when provide funding initiatives such as the Mobility Funding Platform. Given the lack of AV justice policies enacted, the MFP does indirectly address various elements of the framework.

Table 8 indicates how the MFP has made progress within the various policy paths and policy principles. The MPF publically funds innovative mobility projects based on three funding criteria (multimodal, zero-emission and equitable transportation) projects which creates the path for community oriented shared and electric AV deployments. Several rounds of funding have already been implemented which used the funding criteria awarding several AV projects. Of these AV projects only one of them (New Autonomous Mobility Vision for Michigan) funded a shared and electric AV pilot designed to serve people with physical disabilities addressing MJ and EJ concerns. For TJ, the MPF inherently provides a collaborative environment to create community centered solutions through public and private partnerships. The MPF actively seeks to connect anyone from the public to private businesses to create innovative sustainable and equitable mobility solutions. With the provision of incentives over regulation, Michigan can still

support the nascent nature of the AV industry as it grows without requiring stringent policies. However, Michigan received yellow for all of its Policy Principles indicating minimal progress to achieve the AV justice framework. The reason is due to the lack of regulation given the potential risk AVs pose to equity and sustainability. Providing incentives may be effective in meeting the economic development goals to grow its clean and emerging mobility sector, however these goals may overshadow the equity and sustainability

Another AV planning activity seen in Michigan includes the development and implementation of the CAV Corridor project. The CAV projects represent exacerbating potential risk with CAV deployment. These risk include, increasing mobility only for private AV owners while limiting mobility for low-income and disadvantage groups such as non-AV owners, and people with disabilities. Recent legislation passed in 2022 indicate that the CAV project is underway SB 706 provides Michigan Department of Transportation with the ability to designate roadways dedicated for connected automated vehicles.¹³⁶ While this may be an innovative key step to yielding the mobility and efficiency benefits of AVs, it's unclear how the CAV corridor project will meet concerns presented in the AV justice framework. Specifically, how will vulnerable communities and travelers will benefit from this expensive infrastructure project?

¹³⁶ “Council of Future Mobility and Electrification - 2022 Report” (Office of Future Mobility and Electrification, 2022), https://www.michigan.gov/leo/-/media/Project/Websites/leo/Documents/OFME/CFME-Report-112022.pdf?mkt_tok=MzMxLVhSVy0zODcAAAGIaRjH0VRxCj6DD2H_tSeQdZcSWHy7VOV41cLQThz7SNd3EfiPU5qNEpbC20iPT4q_JDvRgdrdh8nflsvUjBcZhP0GRFM_kKGb9sD3q11X0Q.

10.6.3) Arizona

After reviewing existing policies and executive orders in Arizona, it's clear that very little progress has occurred at the state level for the AV framework. Arizona has lacks policy actions in almost all Policy Principles and Policy Paths. Of the six policy actions in **Table 10**, only one (HB 2273) hints at environmental sustainability by mandating vehicle emission standard compliance for ride-hailing companies. When comparing this policy to other states, it does not provide aggressive enough emission reduction goals such as California's SB 1014. All other executive orders and policies do not pertain to the AV justice framework but rather focus on Industrial or Safety AV policies.

When applying the AV justice framework to other state planning and policy actions, most of these actions failed to directly address the framework as seen in **Table 8**. Of the three Policy Principles, transportation justice was slightly addressed through the provision of the **Institute of Automated Mobility**. The purpose of the institute is to serve as a collaborative testing grounds for AV stakeholders to participate in the development of the industry. While the Institute is directed to help grow the AV industry by providing controlled conditions for testing, it's unclear what community engagement process will be for the general public since its heavily focused on supporting the private AV sector.¹³⁷ The local government of Tempe, Arizona mentioned the Institute could be a possible way for local governments to engage with the state, in light of the lack of AV deployment guidance from the State.¹³⁸

When comparing all of the policy and planning actions, Arizona had the least amount of policies in general and lacked a State-wide AV planning document. A possible reason for the lack of AV

¹³⁷ "Arizona Commerce Authority - Institute for Automated Mobility."

¹³⁸ Thad Miller et al., "Autonomous Vehicles in Tempe: Opportunities and Risk" (Arizona State University, n.d.), https://ifis.asu.edu/sites/default/files/tempe_av_report_-_final.pdf.

actions could be due to the lack of regulation that the legislature and the governor want to impose on the industry. However, as seen with the tragic incident with Elaine Herzberg, the lack of regulation could lead to unsafe and inequitable transportation system for venerable road-users.

Table 8) Summary of State AV Justice Policy Framework

Policy Path	California	Michigan	Arizona
Government Investment	CalSTA Principle (Safety) - Increase safety for all road users through AV operation, design and infrastructure investments	<p>HB 5335 - Creates the Michigan Infrastructure Council, but there is little direction from state leadership about how funds will be spent equitably.</p> <p>Michigan Mobility Funding Platform - The program is designed to support collaboration across industries, sectors and local communities to create community driven mobility solutions.</p> <p>CAV Corridor - This public private partnership will potentially fund several million in CAV infrastructure. However, it's unclear what the community engagement processes will look like.</p>	N/A
Mobility	<p>CalSTA Principle (Equity) - Acknowledges historic mobility injustices of highways</p> <p>CalSTA Principle (Inclusive and Equitable Access) - Acknowledges mobility injustices of car-centrism and potential barriers to mobility AVs can impose</p>	Michigan Mobility Funding Platform - Equitable Futures	N/A
Environmental Sustainability	<p>SB 500 - Light Duty AV electrification mandate</p> <p>SB 1014 - GHG and VMT reduction goals set for AV passenger services</p> <p>CalSTA (Environment) - Deploy ZEV AVs to reduce mobile emissions and VMT and promote smart growth of working and natural lands</p>	Michigan Mobility Funding Platform - Sustainable Futures principle which can potentially invest in ZEV AV services.	HB 2273 - Vehicle emission compliance for ridehailing services.
Land-Use	CalSTA Principle (Environment) - Deploy ZEV AVs to reduce mobile emissions and VMT and promote smart growth of working and natural lands	N/A	N/A
Policy Principle			
Environmental Justice	CalSTA Principles (Environment) - Create policies which encourage ZEV deployment of AVs and reduce land-use impacts	Mobility Funding Platform - Sustainable Futures	N/A
Mobility Justice	<p>CalSTA Principles (Public Health and Livability) explicitly seeks to encourage multimodal transportation</p> <p>CalSTA Principle (Safety) seeks to address safety for vulnerable road users interactions with AVs</p>	Mobility Funding Platform - Equitable Futures	N/A
Transportation Justice	<p>CalSTA Principles (Equity) Acknowledges disproportionate burdens from US transportation history</p> <p>CalSTA Principle (Partnerships) seeks to integrate AVs into the CA economy through engagement with various stakeholders including community based groups</p>	Mobility Funding Platform - Creates open platform for anyone (including community organizations) to obtain funding and partner with private businesses to meet their mobility needs	Institute of Automated Mobility - Provides opportunities for stakeholders to engage in AV Planning. But engagement would only benefit private and public stakeholders rather than community partners.

Chapter 11) Challenges for Local Governments

This following section will focus on key findings and trends occurring at the local level in each state. By using the AV justice framework, I will identify ways local governments are adopting AVs in the following areas; **land-use, mobility and access, government investment, and environmental sustainability.**

11.1) Land-Use

Similar to San Francisco's (Bay Area) and Tempe's AV document, the SEMCOG uses scenario planning to identify challenges and risk around CAV adoption. With regard to land-use implications both (San Francisco and Tempe) documents included land-use as opportunities for AV planning and policy intervention. San Francisco's included regional opportunities devoted to non-car-centric infrastructure highly focused on affordable housing within its Affordable – Horizon Principle by instituting parking maximums, controlling green field development and reallocating off-street parking for infill development. Furthermore, the affordable principle also includes a Housing Opportunity Sites map indicating existing parking infrastructure which could be future opportunities for in-fill development within the Bay area seen in **Figure 4** below.

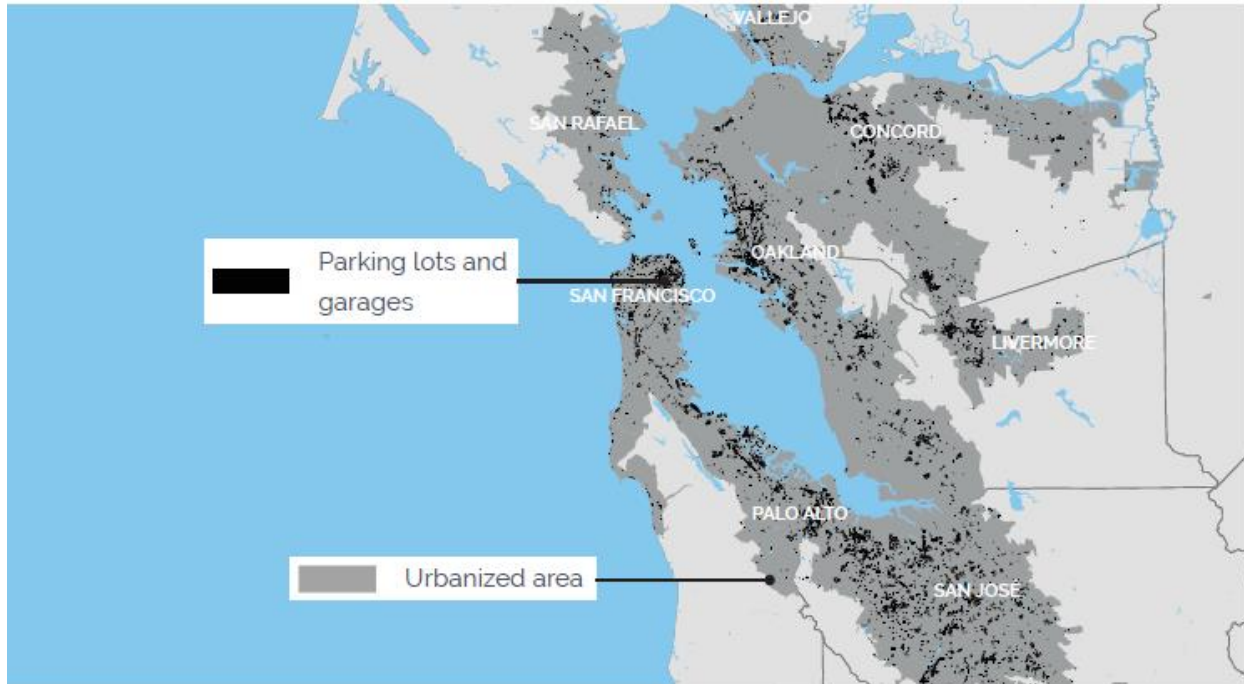


Figure 4) Example Application of Housing Opportunities

Tempe on the other hand still has uncertainties about future land-use and infrastructure changes and seek to engage with local municipalities and agencies to ensure develop solutions. However, Tempe’s document mentions land-use opportunities from the reduced need for parking if AVs are shared. While San Francisco is ahead in understanding to repurpose parking infrastructure for infill or alternative infrastructure, Tempe still questions the uncertainties AVs bring and how it will impact land-use and will resort to discussions with various stakeholders to develop possible solutions.

With regards to Michigan local governments, their local planning documents mentioned little about land use implications. The SEMCOG does provided an analysis of how land-use may change in the future with regards to housing market trends but does not provide recommendation actions or policies which mitigate sprawl. SEMCOG seems to support CAV technology to bolster transit service rather than replace it, especially for the mobility disadvantaged in suburban areas as seen in both San Francisco and Tempe.

11.2) Mobility

All of the three local governments and regions, all supported improving mobility and access of existing transit services through the integration of AVs/CAV. These recommendations all fall within the desire to enhance and complement transit investments through AV service supporting the AV justice framework. In particular, they have all identified the opportunity to serve the mobility disadvantaged to support first/last-mile service to transit addressing the MJ principle. Tempe recommended piloting opportunities for first/last mile AV service and AV para-transit equivalent services especially for those who are mobility disadvantaged. The Bay Area seeks to further increase capacity in transit and rail first while planning for AVs to enhance these services to relieve corridor congestion between its major cities. Both (Tempe and the Bay Area) overall envision AVs to enhance existing transit services and potentially replace fixed route transit with AVs. Detroit's Strategic Transportation Plan sees opportunities for AVs integrations into transit through infrastructure investment but does not demonstrate increasing access for its low-income residents as a priority yet. SEMCOG similarly supports the MJ principle by improving transit services, but does not provide clear policy paths to do so.

Overall, the three local and regional governments acknowledge that to some extent AVs should be integrated into transit. Tempe and the Bay Area heavily acknowledge that AVs should complement and enhance existing transit services to address mobility gaps. Meanwhile AV transit integration is slightly addressed at the State of Michigan (OFME) through the **Mobility Funding Platform** and regional (SEMCOG) level through their **2045 Regional Transportation Plan**. The reason why very little was mentioned about AV transit integrations could be due to the prominence of other initiatives such as the economic development of AVs and CAV

infrastructure deployment in Michigan. However, Michigan's State AV initiatives indicate that transit agencies are engaging with the Mobility Challenge to further support transit modernization through application program interfaces and vehicle design features to assist people with disabilities to access transit services.

11.3) Government Investment

As for government investment, Michigan state is taking that lead to invest in partnerships with AV companies to test and develop the technology to reap CAV benefits first. The Connected Vehicle program (Michigan Mobility Funding Platform and CAV Corridor) indicate Michigan's willingness to test and invest in connected road side infrastructure and AV pilots. Detroit's Strategic Transportation Plan indicates that its pursuing funding from the Federal Highway Administration to implement CAV technology pilots within the region.¹³⁹ While these activities greatly support economic development priorities, they potentially will overshadow the sustainability and equity challenges in the AV justice framework.

Tempe still questions who will pay for the infrastructure while the Bay Area does not directly express the need for CAV infrastructure yet. A regional RUC program was expressed in the Bay Area's Plan which present opportunities to implement CAV infrastructure to mitigate increases in VMT. Local Bay Area actions to deploying infrastructure were not addressed, instead RUC program development is more of a priority. This could be a result from the concentration of AV testing on public roads in the State.

¹³⁹ "Strategic Plan for Transportation."

11.4) Environmental Sustainability

All three local planning documents envision a future of shared and electric AVs. Tempe acknowledges that future AV deployments will be electric which can support local climate actions goals within its Sustainable Growth and Development principle. Specifically, Tempe's plan includes pilot recommendations to support deployment and potentially funding fleets of automated vehicles electric (FAVES) to increase mobility access and reduce mobile emissions.

The Bay Area Plan indicates that regulatory action is needed to ensure that AVs be electric as a core recommendation. The California State legislature passed SB 500 mandating that all light-duty vehicles operating in the state should be electric by 2030 addressing local concerns for mobile source emissions. SEMCOG does not provide any policy or planning recommendations to solely support electric AVs. Rather their report implies that AVs will become electric and deploy in fleets in the near future. The SEMCOG mainly address AVs impacts to local land use decisions.

Overall, based on the three planning documents reviewed, two of the three local planning documents reviewed indicate that Tempe and San Francisco want to adopt AVs sustainably and equitably as defined by the AV justice framework. With a dedicated AV planning document, their goals and ambitions for AV planning were clearly identified in Arizona and California. Michigan's AV actions indicate that the state is taking the lead to AV planning by having local agencies follow state economic development initiatives to reap the economic, transportation and safety benefits of CAV technology. In tandem with the State's efforts, they are providing incentives to deploy AVs through their Mobility Funding Platform to ensure the deployment of mobility solutions equitably and sustainably. However, the lack of a dedicated AV planning

document could create local planning challenges especially if the state does not provide guidance as seen in Arizona.

11.5) Tensions between State and Local – Tempe and the Bay Area

These tensions or conflict points were seen in San Francisco and Tempe. The City of San Francisco, SF County Transportation Authority and SF Municipal Transportation Agency expressed issues with the lack wheel-chair accessible vehicles (WAVs) and issues around parking for on/off boarding passengers on the public right-of-way.¹⁴⁰ Despite these objections, the CPUC granted Cruise the permission to provide and charge driverless rides to the public in June 2022.¹⁴¹

Tempe’s AV document stated very little engagement with local jurisdictions by the state for AV deployment guidance since the Dug Ducey’s Executive Orders. However, Tempe sees opportunities to engage the state through the Institute of Automated Mobility which mainly serves as a research and testing space for AV industry. It is unclear why there is little engagement with local municipalities in Arizona. However, Tempe indicates the need for clear guidance from the state to support safe and equitable AV adoption.

State governments must be proactive in addressing local government concerns for AV deployments and ensure community concerns are heard and considered throughout this process. They must provide them opportunities to inform state decision makers on the impacts of AVs in

¹⁴⁰ Rachel Peterson, “Resolution Approving Cruise LLC’s Application for Phase I Driverless Autonomous Vehicle Passenger Service Deployment Program” (California Public Utilities Commission, n.d.), <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M481/K896/481896441.PDF>.

¹⁴¹ Peterson, “Resolution Approving Cruise LLC’s Application for Phase I Driverless Autonomous Vehicle Passenger Service Deployment Program.”

their community if they seek to reap the long term benefits of AV service and to prevent perpetuating past injustices.

11. 6) Local Government - Policy Principles

San Francisco and Tempe have both indicated their direction towards the policy principles (EJ, TJ, and MJ) in the AV justice framework. This was achieved through their AV planning documents which provide planning principles, investment opportunities and actionable items.

Table 9 provides a general summary for each local government Policy Path and Principle.

Overall both San Francisco and Tempe are well guided in the direction towards the AV justice framework since both published dedicated AV planning documents. SEMOG failed to account for the AV justice framework since they lacked an AV document.

While San Francisco had resources from CalSTA and OPR AV documents to guide the development of their own AV documents, Tempe was limited in terms of guidance from the state. The lack of guidance from the state of Arizona, could be a potential barrier for local AV planning in Tempe, Arizona which was mentioned in their planning document. This could present TJ issues leading to unequitable outcomes for AV deployment locally. Despite these local constraints, the Tempe AV document prioritized the environmental and equity goals within the justice framework, even with lack of direction from the state.

For both Detroit and SEMCOG, neither had a planning document dedicated for AVs. Detroit's Climate Agenda and SEMCOG's 2045 document were used for this analysis in place of a dedicated AV document. After reviewing these documents, both failed to directly include anything which addressed the AV justice framework. SEMCOG's discussion about the impact of

AVs on land-use was the most oriented towards addressing AV’s environmental and congestion issues, but did not present solutions to address them. Detroit’s Climate Agenda did not mention AVs but did include a planning initiative to reduce reliance on personally owned vehicles for transportation. The reason for the lack of local planning leadership in the AV space could a result from the State of Michigan’s leadership and dominance in the AV planning a policy space. The OFME is the lead agency providing policy direction to the State in to remain economically competitive both globally and nationally. As previously mentioned these economic development priorities could be overshadowing susitnability and equity concerns in the AV justice framework.

Table 9) Local Government AV Justice Framework Summary

Policy Path	San Francisco	SEMCOG	Tempe
Government Investment	Horizon Principle (Connected) - Investments in transit across the Bay Area to support regional demand responsive transit	N/A	Pilots and Investment Opprotunities - First/last mile AV transit connections CAV Infrastrucutre funding questions. Strategic Plan Priority (Long-Term Financial Stability and Vitality) Potential environmental and congestion benefits of implementing RUC.
Mobility	Horizon Principle (Connected and Diverse) Investments for improvements in mobility options for transit especially for mobility-disadvantaged	N/A	Pilot Opprotunities - on-demand /fixed route services for disadvantaged communities
Environmental Sustainability	Horizon Principle (Diverse, Healthy) - Support investments and planning for ZEV infrastructure	N/A	Pilot Opprotunities - Recommends deploying FAVES (Fleets of automated electric vehicles)
Land-Use	Horizon Principles (Affordable, Connected) Identified locations for housing opprotunities to replace parking infrastructure	2045 Transporation Plan - Includes discussion of AVs impact to land-use change	Sustainable Growth and Development - Promote compact urban development reducing the needs for car-centric infrastrucutre
Policy Principle			
Environmental Justice	Horizon Principle (Healthy) - Mandating AVs operate as ZEVs to improve air quality	N/A	Sustainable Growth and Development - AVs should deploy as electric reducing GHG and reduce VMT if land-use policies encourage compact development Pilot Opprotunity - Use AVs to reduce single occupancy vehicles
Mobility Justice	Horizon Principle (Diverse) -Ensures that AV services are provided equitably to the mobility disadvantaged Horizon Principle (Connected) - Supports futher transit investments enhanced by AV services especially for Communités of Concern	Policy Initiative (Transit) - increases transit services for all communities to support Policy Initiative (Intercity Transport) - increases transit services and quality for regional travel	Pilot Opprotunities - Use AVs to provide accesible low-cost travel for low income travelers Next Steps - Support AV projects through public private partnerships
Transportation Justice	Horizon Planning (Diverse) Develop community based metrics and targets to track how AV services can create equitable outcomes. However, the CPUC has granted AV Deployment permits dispite local concerns and resitance by local planning agencies.	Policy Initiative - Need to consider aging population in the planning process	Pilot Opprotunities - Develop a community engagement process for AVs to meet local mobility needs

Chapter 12) Future of AVs in the United States

After examining actions and policies at all levels of governments towards AVs, it is clear local and regional agencies are taking the lead to deploy and plan for AVs equitably and sustainability with the only exception being California. Other state priorities such as safety, testing and infrastructure are being addressed first within Arizona and Michigan, while California seems to be the only state addressing the AV justice framework at the state and local levels. At the federal level, barriers to AV developers and states include the dire need to modernize the FMVSS and develop ways to ensure AVs are safe.

At the state level barriers which prevent the adoption of sustainable and equitable vehicle technology can potentially be due to competition between states to attract AV developers from high regulatory environments (California) to lower regulatory environments (Arizona and Michigan).¹⁴² Each state has developed its own list of policy priorities in the adoption of AVs. After examining State regulatory landscapes of Michigan and Arizona, AV justice has taken a backseat to economic development, safety and AV testing. California is the only state exhibiting their commitment to the AV justice framework through its dedicated AV planning documents. Michigan has taken the approach of providing incentives for innovative mobility solutions which can encourage equitable and sustainable testing of AVs across the state. However, the provision of incentives over regulation may prove to be ineffective policy in the long run due to the financial burdens it creates for the state. Michigan and Arizona can learn from California sustainability policies by mandating the electrification of AV passenger service and mitigate their VMT impacts through a policy similar to SB 500 and SB 1014. Similarly, California can learn from the state leadership councils which can provide insight into other aspects of AV adoption

¹⁴² Vincent, “Regulatory Framework for Autonomous Vehicle Safety.”

the state may be lacking in. Ultimately, these different approaches may be leading to a fragmented AV policy landscape which is in dire need for federal intervention. These different approaches however, can give way to innovative ways of policy adoption through policy diffusion and information sharing.

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Appendix A)

Table 10) Arizona’s State Policies for AV Adoption

Arizona Enacted Legislation	Year Enacted	Policy Category	Policy Action	Outcome	Social or Environmental Implications
HB 2273	2022	TNC Industrial Policy	Updates State standards for TNC vehicle safety emission inspection requirements for drivers	Ensures TNC vehicles (automated or not) are in compliance with state vehicle safety and emissions standards	Ensures that Avs operated by TNCs meet minimum State vehicle emission and safety standards.
SB 1333	2022	Industrial Policy/ Safety	Sets operational and liability rules for Neighborhood Occupantless Electric Vehicles operating on public roads.	Sets prodecures for occupantless NEV operation and vehicle collision with regard to state and local authority.	Potentially increase in VMT since it clarifies can Avs to operate without occupants
HB 2813	2021	Industrial Policy	AV governance becomes binding state legislation	Basic legislative framework for AV operation which codefies previous executive orders.	NA
Executive Orders					
EO 2015 - 09	2015	Industrial Policy	Allows for AV testing and authorizes State departments to develop testing and operations guidelines	Unsafe testing conditions and little guidance to local governments about implications	NA
EO 2018 - 04	2018	Safety	Clarifies conditions of AV testing with higher levels of autonomy along with coordination with State Departments	Safer testing conditions	NA
EO 2018 - 09	2018	Industrial Policy	Provides testing ground and facilities for interdisciplinary approach to AV adoption	Institute of Automated Mobility	NA

Table 11) Michigan State Polices for AV Adoption

Enacted Legislation	Policy Category	Policy Action	Outcome	Social or Environmental Implications
HB 5335	Industrial	Public Asset Management to support road infrastructure and vehicle connectivity	Michigan Infrastructure Council	NA
HB 5749	Industrial	Clarifies Safe Vehicle Platooning	Vehicle platooning	NA
SB 995	Industrial	Clarification of operation, Future state wide planning	Michigan Council of Future Mobility within the MDOT	NA
SB 996	Industrial		Allows for AV Testing via SAVE Project	NA
SB 997	Industrial	Official testing grounds in Michigan to test AVs	Establish American Center for Mobility	NA
SB 998	Industrial	Workforce development	3rd parties can modify ADS vehicles according to OEMs	NA
SB 169	Industrial	Provides basic definitions of AV technology for legislative framework	Legislative framework	NA
SB 663	Industrial	Reduces liability for 3rd party AV modifications	workforce protection	NA
Executive Orders				
EO 2020-02	Industrial	Provides State long term planning and policy for AVs through labor and economic development.	Michigan Coucil of Future Mobility and Electrification	Creates state ledership dedicated to deploying Avs with possibilities to ensure sustainable and equitable adoption

Table 12) California State Policies for AV Adoption

Enacted Legislation	Policy Category	Policy Action	Outcome	Sustainability and Equity Implications
SB 1298	Safety	Directs CPUC and CHP to develop safe testing standards for Avs	DMV AV Pilot and Deployment Program	NA
SB 1014	Sustainability	Creates enforceable GHG and VMT reduction targets for ridehailing companies	Clean Miles Standard Program	Provides future path for TNCs to operate AV as electric
AB 1184	Sustainability	Local agencies in the Bay Area can tax AV ride-hailing services in a manner that encourages shared and electric trips of AV.	Transportation funding	Creates pricing mechanisms to ensure AVs are pooled and electric
SB 595	Industrial	Impose an increased bridge toll in the Bay Area to fund congestions reduction projects and program to improve transportation infrastructure	First and last mile SAV transit connector	Demonstrates AV technology supporting transit service
SB 1204	Industrial	Expands eligibility of State funding for the California Clean Trucks Rule to include automated vehicles	Incentives are made available to automate freight	NA
AB 1444	Sustainability	Allows for the Livermore Amador Valley Transit Authority to test an SAV to serve as a transit connector	Successful public private partnership	Demonstrates AV technology supporting transit service
AB 1073	Industrial/Sustainability	Expands eligibility of State funding for the California Clean Trucks Rule to include zero emission vehicles	Incentives are available to purchase HD ZEVs that have ADS	NA
SB 500	Sustainability	Requires all AVs, which meet certain conditions to be operating as electric past a certain date	TBA	Ensures light duty Avs operate as electric