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California Automated Vehicle Policy Strategies

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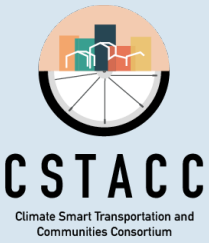
EXECUTIVE SUMMARY

Senate Bill (SB) 1298 granted the California Department of Motor Vehicles (DMV) a legislative mandate to develop the Autonomous Vehicle Program. In this landmark 2012 bill, the DMV is allowed to "consult with the [California Highway Patrol (CHP)], Institute of Transportation Studies at the University of California, or any other entity DMV identifies that has expertise in automotive technology, automotive safety, and autonomous system design."[2] This issue paper is offered to the State of California in the spirit of this consultation privilege. This research is also a project component of the Climate Smart Transportation and Communities Consortium (C-STACC) for the Strategic Growth Council (SGC) (Task 3.4.4). A review draft of this issue paper was submitted to the California State Transportation Agency (CalSTA) in March 2021 in response to their solicitation for feedback of the draft Automated Vehicle (AV) Framework. This paper leverages the eight principles for AV policy included in the draft CalSTA framework:[3]

- Environment
- Equity
- Inclusive Design
- Partnerships
- Public Health and Livability
- Quality Jobs
- Safety
- Shared Prosperity



This Issue Paper is part of the Climate Smart Transportation and Communities Consortium, launched in late 2018 with a grant from the CA Strategic Growth Council to conduct research that addresses transportation-related environmental impacts that fall disproportionately on the most vulnerable populations while meeting the mobility needs of society, fostering healthy and equitable communities, and supporting economic growth. The CSTACC is led by the Institute of Transportation Studies at UC Davis, in close collaboration with partners at UC Berkeley, UC Irvine, UC Los Angeles, UC Riverside, and the University of Southern California.

1. The authors would like to thank the stakeholders who provided review comments and feedback including representatives from California executive agencies (California Public Utilities Commission, Governor's Office of Planning and Research) local agencies (City of Sacramento, City of San Francisco, Santa Barbara County Association of Governments, Sacramento Air Quality Management District) community organizations and advocates (The Greenlining Institute, TransForm, California Transit Association), and industry representatives (BMW, Cruise Automation, Zoox).

2. Senate Bill 1298, Padilla, "Vehicles: Autonomous Vehicles: Safety and Performance Requirements," Pub. L. No. 1298, § 38750, Division 16.6 Vehicle (2012). https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB1298.

3. California State Transportation Agency, "Working Draft: Autonomous Vehicles Strategic Framework Draft Vision and Guiding Principles" (2021). https://docplayer.net/215299821-Working-draft-autonomous-vehicles-strategic-framework-draft-vision-and-guiding-principles-last-updated-january-13-2021.html.

POLICY OPTIONS

This issue paper highlights a top-ten list of options to align AV policy with California's priorities for sustainable and equitable transportation. The list is not ordered or ranked from best to worst. Next steps for researchers and policymakers will be to refine policy mechanisms, identify challenges that require urgent or ongoing action, and estimate outcomes that these policies might affect. State executive agencies working with the Legislature can leverage the following set of model policies as a blueprint for moving the state and the AV sector forward together:

1. **Encourage shared AV service to connect underserved Californians to public transit.** New grant and public transportation finance opportunities can both support shared AV service that complements transit and allow more flexibility in the use of existing transit capital and operating funds. The State could require that AV passenger service companies that wish to partner with transit agencies demonstrate that they operate a significant share of their service in disadvantaged communities (DACs).
2. **Discourage personal ownership of AVs and low- and no-occupancy AV travel.** Lawmakers could achieve this outcome by levying registration fees and road user fees to price greenhouse gases (GHGs) per mile. A feebate model for these fees can direct revenues to more efficient modes of travel (including public transit, biking, and walking), equitable access, and maintenance of public infrastructure.
3. **Encourage AVs to be deployed as zero emission vehicles (ZEVs).** AV electrification could be achieved in several ways, with regulations and incentives (e.g., extra ZEV credits, setting timelines for vehicle suppliers to electrify AVs sooner than legacy petroleum-powered vehicles). The State can also target investments in public charging infrastructure that could meet the needs of AVs.
4. **Ensure AV passenger service is available to rural and suburban communities, especially low-income or DACs.** A balancing act is necessary to ensure that less-dense rural and suburban communities (where costs of AV passenger services are likely to be more expensive) are not left out. A possible strategy for the State is to develop guidance for communities on ways to conduct a community-needs assessment for rural and suburban communities to lead in determining whether and what types of AV service is a good fit. The State can also award tax credits or subsidies to individuals and companies for meeting AV service goals in rural DACs and other less dense areas that meet specific criteria.
5. **Address safety both for passengers inside AVs, and for pedestrians, bicyclists, and all people who will interact with AVs.** To achieve safety and security outcomes, State policy can expand regulations on passenger service and cargo AVs, using a set of clear safety performance measures (e.g., rates of injuries and fatalities, incidents of cybersecurity attacks) and align data collection methodologies to meaningfully measure these safety outcomes (see #9 for more on data collection). The State can also strengthen AV reporting requirements to provide accountability and more public information for AV-related safety incidents, ensuring there is no disparity in safety outcomes by race, income, or mode—including bicyclists and pedestrians.
6. **Establish workforce impact mitigation strategies associated with vehicle automation.** The State can invest in understanding how partial automation[4] technologies can yield safety benefits for drivers, other vehicles, other road users, and pedestrians. The State can also develop retraining programs that help transportation network companies (TNCs) and other drivers gain the skills they need to find future work, and it can target data collection strategies toward monitoring workforce shifts. A robust stakeholder engagement process that includes drivers will ensure more effective strategies.
7. **Ensure that booking and payment for AV services allows seamless multi-modal connections and is accessible to all Californians.** Strategies to achieve this should center around making AV service complementary to public transit in practice. This can include open-loop payment requirements,

4. The term "partial automation" refers to the "Level 2" automation score in the Society for Automotive Engineers "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles" (J3016_2021041) (2021). In this taxonomy Level 0: No Driving Automation, Level 1: Driver Assistance, Level 2: Partial Driving Automation, Level 3: Conditional Driving Automation, Level 4: High Driving Automation, Level 5: Full Driving Automation.

as well as open application programming interfaces (open-APIs) to enable booking and payment interoperability with transit service. State agencies can also direct resources to transit and new mobility providers so they can offer online or telephone booking as well as multilingual booking.

8. **Envision a pathway for achieving equivalent AV passenger service for people with physical, sensory, or cognitive disabilities, ensuring that AV providers are compliant with the Americans with Disabilities Act (ADA).** This effort might begin with defining key terminology as it relates to AVs—including the terms "accessibility," "accessible AV service," and "equivalent AV passenger service"—and applying this terminology across agencies. The State could also include establishing guidelines to connect parallel regulatory efforts aimed at encouraging more wheelchair-accessible service in TNCs with those instructing the AV Program (CPUC rulemaking 12-12-011). The State could also include support for community-led efforts to increase AV availability for people with disabilities and door-to-door services to support AV services (e.g., a trained individual who can aid individuals in accessing the vehicle going beyond the curb).
9. **Align data collection across agencies to achieve public objectives.** The State can strengthen data-analysis protocols that complement existing and planned data collection strategies. By connecting data to specific performance measures (e.g. wheelchair accessible rides, injuries, fatalities, cybersecurity attacks, etc.) the State can make effective use of data that are being collected by DMV and California Public Utilities Commission (CPUC). This effort could also include establishing a California data repository or participating in a federal data clearinghouse to make better use of big data from AV service providers to inform state, regional, and local planning while preserving traveler privacy, proprietary interests of companies, and limiting data access.
10. **Provide direction to both manufacturers and operators on insurance requirements and liability.** This effort could include establishing more specific AV insurance minimums to match liability risks for different fleet sizes and risk profiles (e.g., cybersecurity issues, algorithmic priorities, sensors, or infrastructure). It could also identify insurance requirements for companies and individuals who may carry liabilities for operation and use of AVs (e.g., individual owners, fleet owners, and TNCs).

INTRODUCTION

Fifty-six companies have received permits to test automated vehicles (AVs) in California (with 54 currently opperating), but lawmakers know little about the rapidly evolving AV industry. According to the California Department of Motor Vehicles (DMV), Waymo and Cruise have the largest fleets and have traveled the most miles in testing (see page 16 for more information about AVs in California).[5] However, most of the permitted companies are lesser known. Our estimates show that 40% of the permitted AV companies will likely provide business-to-business (B2B) AV software or hardware, and 10% of companies plan to sell passenger vehicles privately to companies or consumers. We estimate 14% of permitted companies will likely host an exclusively shared taxi fleet business model and 17% likely plan to offer a blended business model that might offer a combination of cargo, taxi, and direct vehicle sales.[6]

There are also open questions about whether the market will result in electrified AVs, which will be a key determinant affecting their greenhouse gas (GHG) impacts, given that AVs may be high-mileage vehicles. Our assessment shows that among those enterprises making information public (excluding software/hardware/B2B companies), 53% of AV

5. California Department of Motor Vehicles, Disengagement Reports, https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/disengagement-reports. Accessed May 2021.
6. See Digital Appendix A for details on our assessment of the California permitted companies https://airtable.com/shrIfbmqaGZtvbhbL/tblaPIkTHKXxA6IVr.

companies are testing with gas-powered vehicles, while only 47% are testing with electric vehicles (EVs). Deployment looks more sustainable, with the majority of reported companies pledging to go electric. However, less than half of companies have announced whether they plan to deploy with EVs, which makes parsing these assessments difficult for the industry as a whole. Furthermore, there is no guarantee that companies will electrify in the absence of binding requirements.[7]

Our research also reveals known and unknown issues (see Figure 1), including the potential for inequitable outcomes if AVs are not available to disadvantaged communities (DACs) and people with disabilities. Communities will need to carefully thread a needle to determine whether and how AV service will be advantageous. These decisions should include ongoing community engagements, reflecting the diverse preferences and priorities of California's communities, as we collectively chart the considerable unknowns in the AV sector.

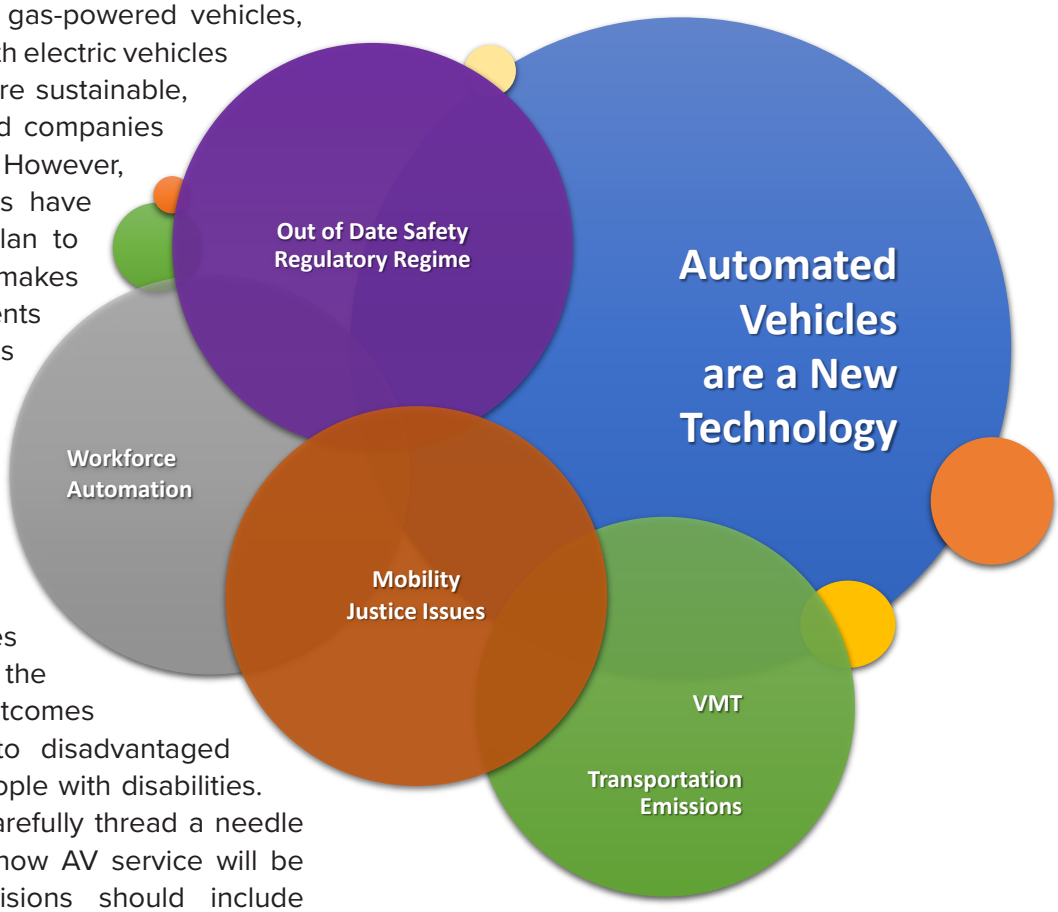


Figure 1. Known and unknown problems associated with AVs

To inform this issue paper, we engaged stakeholders from community organizations to help unpack the complex set of issues surrounding AVs including transit access, shared mobility enterprises, and how AVs will fit into an expanding multi-modal transportation landscape. Their feedback, along with feedback from government and industry stakeholders, is reflected in the policy strategies listed in this issue paper. Our research demonstrates that regulating this new and relatively unknown industry is not simple; many of the issues are complex and interact with social and environmental issues far larger than AVs. Nevertheless, we hope this research can inform the proposed California Council on the Future of Transportation[8] as the State charts a pathway for AV safety, equity, mobility, and sustainability.

ORGANIZATION OF THIS REPORT

This issue paper begins with the findings. Readers can read on for background. The first section highlights policy solutions for AVs by outlining a top-ten list of policy solutions for California to support AV safety, mobility, equity and sustainability. To keep each top-ten menu section brief we highlight direct connections to policy gaps and outline a set of potential policy mechanisms. The second part of this report expands on the challenges and provides background research that contributed to the development of the first section. (See Background Section page 15 for more information).

7. See Digital Appendix A for details on our assessment of the California permitted companies https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr.

8. "SB 66 California Council on the Future of Transportation: Advisory Committee: Autonomous Vehicle Technology.," Title II Government § Chapter 1.5 (commencing with Section 13985) of Part 4.5 of Division 3 (n.d.), 66.

TOP-TEN CALIFORNIA AV POLICY STRATEGIES

Policy #1: Encourage shared AV service to connect under-served Californians to public transit.
(California State Transportation Agency (CalSTA) AV Framework Principles: Environment, Equity, Partnerships, Public Health and Livability, Safety)

Potential Policy Mechanisms	Implementing Agencies
1a. Provide new grant opportunities for shared AV service that complements transit and is compliant with the Americans with Disabilities Act (ADA). Target funds at agencies, organizations, and/or as direct subsidies for low-income or other disadvantaged users.	California Transportation Commission (CTC), Caltrans, California Public Utilities Commission (CPUC), local governments, transit agencies (CA Legislature)
1b. Ensure transit agencies have spending flexibility in their capital and operating budgets to support transit-complementary shared AV passenger services in under-served communities and for with people with physical, sensory, or cognitive disabilities.	CTC, Caltrans, local governments, transit agencies (CA Legislature)
1c. Require or incentivize AV passenger service companies to demonstrate that they operate an equitable share of service in DACs in order to qualify for state permit programs or receive credits.	CPUC, DMV, metropolitan planning organizations, local agencies

How does this policy fill a gap in existing state policy and advance key policy priorities?

Existing law includes state climate goals (SB 32, AB 1493, SB 375), state vehicle miles traveled (VMT) reduction goals (SB 743, SB 2050), and supports strategies to provide improved access to zero emission vehicles (ZEVs) to low-income communities (SB 350). Shared, automated, and electric vehicles (SAEVs) may offer an opportunity to serve these objectives by improving ridership on transit service—without initially deploying AVs in place of driven transit vehicles.

Dozens of AVs are being piloted or deployed as shuttles around the country and the world, providing neighborhood circulator service using technology available today.[9] However, a large barrier for U.S. transit agencies to bring AVs to bear is funding availability and a lack of funding flexibility; they are unable to use capital funds for operating innovative pilots and fund transitions of pilots to full-scale deployments.[10,11]

Funding will need to cover a range of costs including transit agency costs and direct fare subsidies. Furthermore, tying funding availability to equity outcomes may also ensure that state investments are justly distributed. AV transit service can also serve people with disabilities. Paratransit service, compliant with the ADA, provides public and private service to individuals who cannot use standard transit service. Automating some of this service may improve mobility options for everyone, but there is limited AV testing or deployment that complies with Title II of the ADA. There are several Wheelchair accessible AVs, but none that our research identified as ADA compliant. Title II prohibits discrimination by transportation services provided by government entities. ADA compliance would therefore be a critical component of an automated transit program. (See "Policy #8: Envision a pathway to achieving equivalent AV passenger service for people with disabilities that ensures AV providers are compliant with the ADA." on page 12 for a discussion about Title III of the ADA, which addresses private sector AV service.)

9. Shared-Use Mobility Center, "MOD Learning Center," Autonomous Vehicle Case Studies. https://learn.sharedusemobilitycenter.org/search/?keyword=&topics=288&doctypes=&resourcetypes=learning_module%2Ccasestudy%2Cmultimedia%2Coverview%2Cmetro&modes=&partners=&orderby=relevance&tab=tile

10. Nathaniel Ford, "Keynote" (3 Revolutions Policy Conference 2021, Davis, CA, March 3, 2021) https://www.youtube.com/watch?v=xSebSXvQQGg.

11. Susan Shaheen and Stephen Wong, "Public Transit and Shared Mobility COVID-19 Recovery: Policy strategies and Research Needs," January 2021, https://escholarship.org/uc/item/9nh6w2gq

Policy #2: Discourage personal ownership of AVs, and among personally owned AVs discourage low- and no-occupancy AV travel.
(CalSTA Principles: Environment, Equity, Partnerships, Public Health and Livability, Shared Prosperity)

Potential Policy Mechanisms	Implementing Agencies
2a. Levy a registration fee for personally owned AVs.	DMV (CA Legislature)
2b. Levy a road user fee that charges privately owned AVs on a GHG-per-mile basis (with additional charges for empty miles) while ensuring user privacy.	CTC, Caltrans, CPUC (CA Legislature)
2c. Establish a feebate model to use revenues generated from fees to support more efficient modes of travel (including transit, biking, and walking), equitable access, and maintenance of public infrastructure.	CTC, local agencies, transit agencies (CA Legislature)

How does this policy fill a gap in existing state policy and advance key policy priorities?

Reducing solo-occupant travel has been a decades-long priority for the State of California. Some efforts to address and mitigate VMT, such as SB 375, have been limited by weak enforcement mechanisms and a lack of incentives.[12] Others, such as SB 743, will only affect new development, and therefore will have more gradual impacts. VMT mitigation remains a key strategy in bringing transportation emissions down and meeting the carbon neutrality goals for the state. Imposing fees for privately owned AVs, which are estimated to be high-mileage vehicles, is a common-sense strategy. A statewide road user charge could provide a complementary option. While neither a registration fee nor a road user charge are new concepts, both are dynamic tools that can send price signals to manage demand while generating revenue for strategic transportation investments.[13]

Expanding the Caltrans/CalSTA Road Charge Program (SB 1077) to include AVs will help achieve the bill's objectives, which are to examine potential models and feasibility of road user charge pricing systems based on marginal road usage. AVs cannot be the only vehicles to participate in the next iteration of a road user charge program, but including these potentially high mileage vehicles makes sense. However, addressing equity and fairness questions will be central to any successful road user charge program to consider low-income and rural residents who may log more miles to meet basic needs.[14] (See "Pricing Policies to Address Congestion and Emissions" on page 21).

A feebate model might provide a revenue-neutral approach to discouraging private auto use while providing resources that will aid in the growth of AVs.[15] Feebates could, over time, create an incentive structure that encourages a higher percentage of shared AVs over privately owned AVs. Sharing will likely yield even greater energy and emissions benefits than electrification alone. A recent emissions assessment comparing a personally owned EV fleet to a SAEV fleet showed that the personally owned EV fleet experienced a 40% reduction in GHG emissions while the SAEV fleet experienced 70% emissions reduction when compared to a gasoline baseline. While it may not be feasible to get a 100% SAEV fleet in the state, policy makers can encourage a higher percentage of a SAEV fleet over privately owned EVs for maximum GHG reduction.[16]

12. Sarah Mawhorter, "Aligning Sustainable and Affordable Development in California," 2020, https://ternercenter.berkeley.edu/blog/aligning-sustainable-development/.
13. Alan Jenn and Kelly L. Fleming, "Road User Charge Administration: Lessons Learned from Fuel Taxes. UC Davis: National Center for Sustainable Transportation". 2021. https://escholarship.org/uc/item/0hx921n6
14. Paige Pellaton and Mollie Cohen D'Agostino, "Equitable Congestion Pricing," 2020, https://escholarship.org/uc/item/17h3k4db.
15. Alan Jenn and Daniel Sperling, "Developing a California Feebate Program to Support Transition to Zero Emission Vehicles" (UC Institute of Transportation Studies, 2020.), https://www.ucits.org/research-project/developing-a-California-feebate-program-to-support-transition-to-zero-emission-vehicles.
16. Colin J. R. Sheppard, Alan T. Jenn, Jeffery B. Greenblatt, Gordon S. Bauer, and Brian F. Gerke, "Private versus Shared, Automated Electric Vehicles for U.S. Personal Mobility: Energy Use, Greenhouse Gas Emissions, Grid Integration, and Cost Impacts," Environmental Science & Technology, 2021, 55 (5), 3229-3239 DOI: 10.1021/acs.est.0c06655

Policy #3: Encourage AVs to be deployed as ZEVs. (CalSTA Principles: Environment, Public Health and Livability)	
Potential Policy Mechanisms	**Implementing Agencies**
3a. Establish supply-side incentives such as awarding extra ZEV credit to manufacturers for committing to AVs that are ZEVs.	DMV (CA Legislature)
3b. Mandate that all AVs be rapidly electrified or incentivize such action.	CTC, Caltrans, CPUC (CA Legislature)
3c. Invest in public charging infrastructure that will meet the needs of AVs.	CTC, local agencies, transit agencies (CA Legislature)

How does this policy fill a gap in existing state policy and advance key policy priorities?

Privately owned AVs are estimated to increase per-capita VMT by 15%–20%, which could result in increased congestion and emissions.[17,18] These vehicles represent a gap in existing policy because they are not subject to the Clean Miles Standard (SB 1014), which will regulate emissions from SAEVs that are operated for passenger service (CPUC Rulemaking 12-12-011). The Clean Miles Standard will require SAEV fleets and transportation network companies (TNCs) to fully decarbonize their operations by 2030. They can achieve this target with a combination of 90% fleet electrification and complementary strategies, such as reducing deadheading (travel between passengers), or investing in pedestrian and bicycle infrastructure. Privately owned AVs will not be held to this clean standard, despite early evidence that partially automated privately owned vehicles are already demonstrating increased VMT. A recent study of EV owners with and without partial automation showed that the drivers with the partial automation capabilities drove more.[19]

Less is known about the VMT effects of automation in the freight sector, but cargo AVs will also fall outside of the Clean Miles Standard and could result in additional emissions. Therefore, directing policy targets and infrastructure investments to support electrifying the entire AV sector is essential.

A majority of AV companies testing in California (who have publicly addressed this topic) have made announcements that they are planning on deploying automated electric vehicles (AEVs), but our analysis shows that only 50% are currently testing with AEVs. While only two AV companies have announced plans to deploy using a gas-powered car (Argo AI and Voyage Auto), only one freight company, Nuro, has been granted a commercial deployment permit and is deploying an AEV (See page 21 for more on AV electrification).[20]

Electrification commitments among AV companies are admirable if they are more ambitious than EV timelines adopted by regulators. However, corporate announcements are not binding, and only policy will assure outcomes. Whether an incentive-based credit system or an EV mandate is the most equitable approach is still open for debate. State agencies can move forward with targeted charging infrastructure support without additional legislative actions (AB 2127). The status quo policy will require all auto manufacturers to electrify vehicles sold in California after 2035 (Executive Order N-79-20).[21] Setting a more ambitious timeline for AVs may be prudent, but it is out of scope of this analysis to specify a target year.

17. Lew Fulton, Jacob Mason, and Dominique Meroux, "Three Revolutions in Urban Transportation," 2017, https://itspubs.ucdavis.edu/publication_detail.php?id=2723.

18. Austin Brown, "Comments of UC Davis Policy Institute for Energy, Environment, and the Economy on the Commission's Regulation of Autonomous Vehicles Questions 2–8," February 2020. https://3rev.ucdavis.edu/sites/g/files/dgvnsk6431/files/files/page/AV%20Regulation%20Q2-8%202_10_20_1.pdf.

19. Scott Hardman, Rosaria M Berliner, and Gil Tal, "A First Look at Vehicle Miles Traveled in Partially- Automated Vehicles," September 2018. https://escholarship.org/uc/item/6kt1j7gj.

20. See Digital Appendix A for details on our assessment of the California permitted companies https://airtable.com/shrlfbmqaGZtvbhbL.

21. Governor Gavin Newsom, "Executive Order N-79-20." (2020), https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf.

Policy #4: Encourage AV mobility service providers to provide service in rural and suburban areas, and especially in low-income or DACs.
(CalSTA Principles: Equity, Safety, Public Health and Livability)

Potential Policy Mechanisms	Implementing Agencies
4a. Provide guidance for communities that are interested in AVs to first conduct a community needs assessment to ensure AV service is the right choice for their community and to ensure equitable and sustainable long-term outcomes.	CPUC, CalSTA
4b. Award state tax credits or direct subsidies to companies for meeting service goals for operating AVs in rural DACs, to expand mobility access or EV infrastructure availability for area residents.	CARB, CTC (CA Legislature)
4c. Mandate or incentivize minimum service thresholds for publicly funded AEV service in rural areas and rural DACs.	CTC, CalSTA, Caltrans (CA Legislature)

How does this policy fill a gap in existing state policy and advance key policy priorities?

There are some concerns that less-dense rural and suburban communities (where costs of AV passenger services are likely to be more expensive) will be left out of the tide of innovation coming to the transportation sector. It remains an open question whether there is a public responsibility to help ensure SAEV service reaches rural communities in an equitable and sustainable manner.

AVs may be a solution for rural and suburban areas that could benefit greatly from increased mobility and access.[22] In many rural and suburban communities, connecting to transit routes can be cost-prohibitive and less attractive to riders, thus door-to-door service and travel options have filled a gap where fixed-route service is less successful. The solutions identified here are designed to ensure that SAVs will be available in rural and suburban areas so that these communities are not left out of the transportation innovation tide. More research is needed to assess where SAEVs could play a role in California's diverse rural and suburban communities. Even so, a lesson can be learned from existing rural mobility pilots and programs in California. A prime example of a successful project is the California Council of Governments CalVans Rural Mobility program. CalVans operates two types of services—commuter vanpools and farmworker vanpools. Particularly for rural farmworker communities, CalVans vanpools meet a significant mobility gap among a population without access.[23]

Another example of a successful shared mobility solution for rural communities in California is the Míocar Pilot, which is an EV carsharing pilot in San Joaquin Valley established in August 2019 with goals "to explore the potential of a shared mobility service to offer a cost-effective mobility option for residents of rural disadvantaged communities and to help reduce greenhouse gas emissions." The pilot offers low-cost carsharing service to rural residents at affordable housing developments in agricultural communities. This pilot polled San Joaquin residents and found that some households were previously spending up to 56% of their household incomes on transportation. The Míocar service offers a low-cost and zero emission way to travel.[24] The San Joaquin Valley is also hosting a new app, Vamos Mobility, that enables trip planning and booking across transit agencies in the region. This app may provide a platform to expand shared mobility offerings, including AV service, in the region.[25]

22. Federal Transit Administration, University of Iowa, and National Advanced Driving Simulator, "Automated Driving Systems (ADS) for Rural America Demonstration Data Management Plan (DMP)," n.d., https://www.transit.dot.gov/sites/fta.dot.gov/files/2020-10/FTA-Research-Report-No-0174.pdf.

23. Bill Higgins, "CALCOG Regions Partner via CalVans to Improve Rural Mobility," 2019. https://calcog.org/regions-partner-via-calvans-to-improve-rural-mobility.

24. Caroline Rodier, Brian Harold, and Yunwan Zhang, "Early Results from an Electric Vehicle Carsharing Service in Rural Disadvantaged Communities in the San Joaquin Valley," 2021. https://escholarship.org/uc/item/0rj0z090.

25. Tuup Oy, Vamos Mobility, 2020, https://apps.apple.com/us/app/vamos-mobility/id1466761354.

Policy #5: Address safety both for passengers inside AVs, and for pedestrians, bicyclists, and all people who will interact with AVs.
(CalSTA Principles: Safety, Inclusive Design, Equity)

Potential Policy Mechanisms	Implementing Agencies
5a. Establish regulations that hold passenger service AVs to a set of safety and security performance measures and align data collection to outcomes.	DMV, Caltrans, CPUC, CalSTA, California Highway Patrol (CHP)
5b. Establish regulations that hold AV cargo providers to a set of clear safety and security performance measures for cargo AVs.	DMV, Caltrans, CalSTA, CHP
5c. Establish AV reporting requirements that encourage public accountability for AV-related safety incidents, and ensure there is no disparity in safety outcomes by race, income, or mode.	DMV, CPUC, CalSTA (CA Legislature)

How does this policy fill a gap in existing state policy and advance key policy priorities?

California Vehicle Code requires that AV manufacturers make a number of safety assurances to test on public roads (e.g. AVs were tested in circumstances that simulate public roads, AVs have a remote operator, and AVs meet insurance requirements).[26] These requirements go a step further than the Voluntary Safety Self-Assessments (VSSAs) established by the National Highway Traffic Safety Administration (NHTSA). California's permits can be revoked if safety assurances are not upheld, but they still rely on the good-faith reporting of manufacturers. CalSTA has suggested NHTSA expand the VSSA process to include an "automated driving systems (ADS) competency evaluation."[27] But industry stakeholders tend to prefer performance-based safety standards, rather than pre-market evaluation, and many manufacturers have told NHTSA that they support the development of regulations that follow industry safety standards (e.g., UL 4600, ISO 26262, and ISO 21448).[28] (See page 17 for more on safety standards.)

Given this regulatory flux, a State AV or ADS competency evaluation is not advisable, because federal AV regulatory reforms are expected to emerge over the next several years. Nevertheless, states can set performance measures for current AV testing and operation to ensure continuous improvement of safety outcomes.

Regulators may also need to look beyond vehicle safety. According to UC Davis research, *Safety* is "the condition of being secure from accidental harm" whereas, "*security* is defined to be the condition of being safe from intentional harm."[29] AV security issues range from in-vehicle security among passengers to cybersecurity concerns (e.g., rogue actors co-opting vehicles or data). States have clearer purview over passenger security issues. The CPUC requires AV companies to submit a Passenger Safety Plan outlining how they intend to orient consumers to the technology, minimize risks, and respond to harassment or hostile individuals aboard. On the other hand, automotive cybersecurity is already a federal regulatory priority. NHTSA released guidance on automotive cybersecurity in late 2020, acknowledging the additional risks for AV operation.[30] More cohesive policy may follow, but in the meantime, state regulators can also work to evaluate cybersecurity guidance and set outcomes bases performance measures that prepare law enforcement with tools to prevent and address any automotive criminal activity.

26. Statute, "Division 16.6 Autonomous Vehicles," 38750–38755 Vehicle § 2 (2012).
27. "Comment from California State Transportation Agency Posted by the National Highway Traffic Safety Administration on Mar 7, 2021. Docket NHTSA-2020-0106-0662." https://www.regulations.gov/comment/NHTSA-2020-0106-0662.
28. "Comment from Self-Driving Coalition for Safer Streets Posted by the National Highway Traffic Safety Administration on Apr 1, 2021 Docket NHTSA-2020-0106-0753," https://www.regulations.gov/comment/NHTSA-2020-0106-0753.
29. Kenneth S. Kurani, "User Perceptions of Safety and Security: A Framework for a Transition to Electric-Shared-Automated Vehicles," White Paper (Institute of Transportation Studies, University of California, Davis, 2019), https://doi.org/10.7922/G2891438.
30. National Highway Traffic Safety Administration, "Cybersecurity Best Practices for the Safety of Modern Vehicles," Agency/Docket Number: NHTSA-2020-0087, January 12, 2021, https://www.federalregister.gov/documents/2021/01/12/2021-00390/cybersecurity-best-practices-for-the-safety-of-modern-vehicles.

Policy #6: Establish workforce impact mitigation strategies associated with vehicle automation.
(CalSTA Principles: Equity, Quality jobs, Shared Prosperity)

Potential Policy Mechanisms	Implementing Agencies
6a. Provide incentives for commercial operators to invest in partial automation technologies that can yield safety benefits for drivers, other vehicles, other road users, and pedestrians.	CPUC, CTC, Caltrans, California Air Resources Board (CARB), CA Labor and Workforce Development Agency (LWDA)
6b. Develop retraining programs that help drivers gain skills they need to find future work.	LWDA, Caltrans
6c. Target data collection strategies toward monitoring workforce effects.	CalSTA, LWDA
6d. Ensure that a robust stakeholder engagement process includes drivers such that they can contribute their knowledge and expertise toward the transportation innovation sector.	CalSTA, LWDA

How does this policy fill a gap in existing state policy and advance key policy priorities?

There are many unknowns about the workforce impacts of automation but what is known is that change is inevitable. Thousands of vehicle drivers can expect changes to aspects of their work in future decades and the State should prepare to respond.[31] While the transition for long-haul trucking workers is not expected to cause mass layoffs for drivers,[32] for workers in passenger service, transit system operations, and local freight, more research is needed to assess, prepare, and mitigate workforce impacts. More discussion is necessary to look beyond the initial transitional phase and envision how the state can manifest equitable employment gains in an automated future.

Public engagement in this area is essential. Existing law (AB 639) outlines a stakeholder engagement process to ensure that port automation for the Port of Los Angeles and the Port of Long Beach can help to achieve state GHG reduction goals, while incorporating feedback on job losses.[33] This process allowed industry representatives and labor to develop reasonable strategies for transitioning port facilities and employees in the face of an increasingly automated global freight industry, with mounting pressures for automation difficult to ignore. Executive Order N-17-19 convened the *Future of Work Commission* under the LWDA. The Commission aims in part to "support workers in transition" due to technical changes, climate change, etc. They are already working to identify, create, and train workers for the future jobs for emerging industries.[34] This Commission might consider investigating collaborative automation[35] opportunities where simple aspects of work are automated, but workers monitor safety and execute more complex aspects as needed.[36] The Commission could consider how to ensure fair wages for people tasked with monitoring AV systems and identify data collection priorities. Policy can steer technological innovation in such a way that it improves economic efficiencies, quality of work, safety, and environmental outcomes.[37]

31. Steve Viscelli, "Will Robotic Trucks Be 'Sweatshops on Wheels?'" Trucking Policy Fall 2020 (2020): 81–89. https://issues.org/robotic-autonomous-trucking-policy-sweatshops-viscelli/.
32. U.S. Department of Transportation, "Macroeconomic Impacts of Automated Driving Systems in Long-Haul Trucking," January 28, 2021, https://rosap.ntl.bts.gov/view/dot/54596.
33. "Bill Text - AB-639 California Workforce Development Board: Port Automation and Climate Change.," accessed June 15, 2021, https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB639.
34. Governor Gavin Newsom, "Executive Order N-17-19" (2019), https://www.gov.ca.gov/wp-content/uploads/2019/08/Future-of-Work-EO-N-17-19.pdf.
35. Otto Motors (blog), "The Impact of Automation on the Logistics Labor Market," December 17, 2019, https://ottomotors.com/blog/impact-of-automation-on-labor.
36. Otto Motors (blog), "The Impact of Automation on the Logistics Labor Market."
37. Steve Viscelli, "Will Robotic Trucks Be 'Sweatshops on Wheels?'" Trucking Policy Fall 2020 (2020): 81–89. https://issues.org/robotic-autonomous-trucking-policy-sweatshops-viscelli/.

Policy #7: Identify solutions to ensure that booking and payment for AV service allows seamless multi-modal connections and is accessible to all Californians.
(CalSTA Principles: Partnerships, Equity, Inclusive Design, Public Health and Livability)

Potential Policy Mechanisms	Implementing Agencies
7a. Require that all AV mobility providers use an open-loop payment system and have an open application programming interface (open-API) to enable booking and payment interoperability with transit service.	CPUC, Caltrans, DMV (CA Legislature)
7b. Require that mobility providers offer an alternative to credit or debit card payment, such as prepay cash options, or mobile payments, so passengers can circumvent traditional banking institutions if need be.	CPUC, Caltrans, DMV (CA Legislature)
7c. Provide resources for transit and new mobility providers to offer online or telephone booking, as well as smartphone app-based multilingual booking.	CPUC, Caltrans, DMV

How does this policy fill a gap in existing state policy and advance key policy priorities?

Seamless trip booking and payment between AVs and transit systems will enable AVs to serve first- and last-mile gaps. Individuals and households that lack access to high-quality transit or reliable vehicles can face a host of related access challenges that can worsen health and livability. For example, a lack of reliable transportation can reduce access to jobs, healthy food, healthcare, and recreational amenities.[38] If SAEVs are to address some of these mobility gaps, then the apps and payments must ensure that everyone can book, pay fares (if applicable), and ride.

State programs should strive to make booking and payment seamless for all users and address the unique needs of residents with disabilities, residents who lack access to traditional banking institutions, and residents without reliable internet or smartphone access. Fortunately, the State is already tackling many of these issues. Regarding seamless mobility payments, SB-111 in 2004 encouraged California to consider a "California Pass" calling for one option for payment on all transit systems.[39] Since then, the California Integrated Travel Project (Cal-ITP) was launched by CalSTA and Caltrans to improve interoperability for transit scheduling, booking, and payment integration and this program broadened the SB-111 term, launching the "California mobility marketplace."[40] Cal-ITP is piloting an integration solution for transit operators called an open-loop payment system, which allows touchless on-board payment by credit, debit, or mobile payment app.

An added benefit of this type of system is that it could be more readily integrated into private platforms or third-party apps that might allow riders to pay. Integration would allow riders to seamlessly combine SAEV trips with public transit options. For example, a SAEV trip and a transit leg of a journey could be bought using one click and the same payment method. However, considerations are necessary to address the unbanked or underbanked populations, or those who prefer the anonymity of cash. Alternatives like cash gift cards for sale at local establishments or distributed by mail could play a role. Similarly, phone-based booking can ensure inclusivity. State support of verbal phone-based services could expand support for local dial-a-ride service dispatchers to allow them to book SAEV rides for paratransit qualifying residents.[41]

38. Anne Brown and Brian Taylor, "Bridging the Gap between Mobility Haves and Have-Nots," in Three Revolutions: (Island Press, 2018).
39. "State Reporting Requirements," Pub. L. No. 111, 14036.6.(2) (2004), http://www.leginfo.ca.gov/pub/03-04/statute/ch_0151-0200/ch_193_st_2004_sb_111.
40. California Integrated Travel Project, "What Is Cal-ITP?," n.d., https://www.camobilitymarketplace.org/.
41. Tom Lackey, "Transit Operators: Paratransit and Dial-a-Ride Services: Assessment.," Pub. L. No. 1351 (n.d.), http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB1351.

Policy #8: Envision a pathway to achieving equivalent AV passenger service for people with disabilities that ensures AV providers are compliant with the ADA.
(CalSTA Principles: Equity, Inclusive Design, Public Health and Livability)

Potential Policy Mechanisms	Implementing Agencies
8a. Define key terminology as it relates to AVs, including the terms "accessibility," "accessible AV service," and "equivalent AV passenger service," and apply it across agency activities.	CPUC, Caltrans, DMV (CA Legislature)
8b. Establish guidelines to directly connect parallel regulatory efforts aimed at encouraging more wheelchair-accessible service in TNCs with those instructing the AV Deployment Program.	CPUC
8c. Fund community-owned enterprises or nonprofit organizations that can increase the availability of AV service for people with disabilities and determine specific priorities for passenger service operation.	CPUC, Caltrans, DMV

How does this policy fill a gap in existing state policy and advance key policy priorities?

According to the CDC, 10.7% of Californians have mobility disabilities.[42] Currently no existing law explicitly requires private AV companies to provide ADA compliant service for the more than 4 million Californians with disabilities. But the courts may change this, depending on how they interpret the ADA. Title III, Section 12184 states, "No individual shall be discriminated against on the basis of disability in the full and equal enjoyment of specified public transportation services provided by a private entity."[43] District courts are still deliberating how to apply ADA Title III to TNCs, and these lawsuits may provide precedent that apply to future AV service.

Plaintiffs in a 2020 District Court case in California, Independent Living Center San Francisco et. al. Vs. Lyft Inc. argued that longer wait times and lack of late-night service is discriminatory under ADA Title III. The judge established that Lyft is a transportation company "covered under Section 12184,"[44,45] and Lyft should therefore "make reasonable modifications to rectify a discriminatory policy, practice, or procedure."[46] However, the judge denied to offer a summary judgment requiring Lyft to make specific modifications, despite considering the potential for reasonableness of several combined modifications (e.g., marketing, wheelchair accessible vehicle rentals to drivers, partnerships with transit agencies, etc.). The judge also recognized Lyft could receive millions in state support to implement modifications.[47] This support will come from the CPUC administered *Access for All Fund* (R19-02-12), which collects a ten-cent fee per TNC trip and redistributes the Fund among TNCs to increase availability of wheelchair-accessible vehicles.

CPUC needs to clarify how AV companies can draw upon this Access for All Fund since CPUC also administers the AV Deployment Program as part of the TNC rulemaking (R-12-12-11). The AV program aims to "expand the benefits of AV technologies to all Californians, including people with disabilities." To accomplish this goal, State agencies need to connect these two CPUC programs, build community partnerships to support the stated goals, and determine where specific supportive services may be necessary for AVs. For example, which AV companies can participate in the Access For All Fund? Could the Fund support personnel to help passengers in wheelchairs board, secure safety belts, and exit AVs?

42. Americans with Disability Act, Title III, Section 12184 (a), https://www.ada.gov/pubs/adastatute08.htm#12184a.
43. Americans with Disability Act, Title III, Section 12184 (a), https://www.ada.gov/pubs/adastatute08.htm#12184a.
44. Independent Living Resource Center San Francisco et al. Vs. Lyft Inc., No. C 19-01438 WHA (United States District Court, N.D. California November 3, 2020).
45. In a similar case, Equal Rights Center V. Uber Technologies, Inc. et al., No. JU 4.15 (United States District Court District of Columbia March 3, 2021). a D.C. district court judge has not made a determination of whether Uber is covered under Section 12184 of the ADA Title II.
46. Independent Living Resource Center San Francisco et al. Vs. Lyft Inc., No. C 19-01438 WHA (United States District Court, N.D. California November 3, 2020).
47. Independent Living Resource Center San Francisco et al. Vs. Lyft Inc., No. C 19-01438 WHA (United States District Court, N.D. California November 3, 2020).

Policy #9: Align data collection across agencies to achieve public objectives. (CalSTA Principles: Partnerships, Safety)	
Potential Policy Mechanisms	**Implementing Agencies**
9a. Establish data analysis protocols that complement existing and planned data collection strategies. By connecting data to concrete performance measures, the State can make effective use of the data that is being collected by DMV and CPUC.	CPUC, CARB (CA Legislature)
9b. Establish or participate in a data clearinghouse to make better use of big data from AV service providers to inform state, regional and local planning, while preserving privacy and limiting access.	CalSTA, CPUC, CARB, CTC (CA Legislature, Federal agencies)

How does this policy fill a gap in existing state policy and advance key policy priorities?

Governments can learn best during this early phase of AV testing and deployment if they can closely monitor early operations of AVs and collect data that will allow them to regulate effectively.[48] Both the CPUC and the DMV are collecting data on the activities of AV providers in testing and deployment (e.g., DMV is collecting a limited set of data points including counts of near-miss incidents, collisions, and miles driven), however there is no clear path for using this data in a meaningful way. Better articulating performance measures that align with statutory and regulatory goals, and communicating how data will be used, would make the data collection effort more worthwhile.

Performance measures can cover a range of topics. Regarding safety, they can include killed or seriously injured (KSI) rates, reporting (by user type, race, age), or incidents of cybersecurity crimes, or incidents where local custom conflicts with statutory requirements. Industry is prompting discussion of a wide range of safety standards for AVs, such as those outlined in UL 4600. (See page 18 for more detail on UL 4600.) If the state could collect comprehensive data that aligns to these standards, then reporting could be used to estimate correlations between negative performance outcomes and technological capacities such as safe weather conditions, mapping strategies, and hardware (e.g., number of lidar, cameras, remote capabilities). This would allow the state to more robustly assess how industry-wide safety failures correlate to AV technologies.[49]

The current CPUC strategy, which requires companies to provide considerable aggregated data, is a good start. But aggregation can blunt data utility and may not make the data collection effort adequate for encouraging industry-wide learning. A more granular data collection effort can also support industry-wide learning, but should California or federal agencies lead? Federal leadership on big data collection for AVs may be preferred because of the scale and costs of managing big datasets. Both the State and federal governments maintain many big datasets which include personally identifiable information (PII), which is vulnerable to user privacy issues as well as proprietary concerns from industry.

The U.S. Department of Transportation (USDOT) Secure Data Commons data-sharing platform could be a model for State or federal AV data storage. The Commons determines data access parameters for potential users (e.g., AV manufacturers, AV ride-hailing operators, cities, or researchers) and sets security protocols for differing levels of access to datasets. The Secure Data Commons platform allows analysts to execute statistical analyses within the Commons system, obviating the need to export big datasets.[50]

48. Austin Brown and Greg Rodriguez, Federal, State, and Local Governance of Automated Vehicles (2018). https://policyinstitute.ucdavis.edu/wp-content/uploads/AV-Governance_IssuePaper_1218.pdf.

49. California Department of Motor Vehicles, Disengagement Reports, https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/disengagement-reports/. Accessed May 2021.

50. Mollie Cohen D'Agostino, Paige Pellaton, and Austin Brown, Mobility Data Sharing: Challenges and Policy Recommendations (2019), https://escholarship.org/uc/item/4gw8g9ms.

Policy #10: Provide clear legislative direction that offers flexible options for covering risks and assigning liability. (CalSTA Principles: Partnerships, Safety)

Potential Policy Mechanisms	Implementing Agencies
10a. Establish more specific AV insurance minimums to appropriately match liability risks for AV fleets with different sizes and risk profiles (e.g., cybersecurity issues, algorithms, sensors, or infrastructure).	California Department of Insurance (CDI), DMV (CA Legislature)
10b. Identify liability insurance requirements for those who operate and use AVs (e.g., individual owners, fleet owners, TNCs).	California Department of Insurance (CDI), DMV

How does this policy fill a gap in existing state policy and advance key policy priorities?

The CDI has held several public meetings to assess the best path forward for insuring AVs. This work has contributed to current requirements for AV permit holders. The law states that AV manufacturers must have insurance from a licensed insurer and a surety bond of $5 million, or if the manufacturer can demonstrate a net worth of more than $5 million, they can apply to DMV for an instrument of self-insurance. These options are relatively comprehensive and provide manufacturers with choices. However, it is a one-size-fits-all approach. Because AV entities operate with a wide range of miles traveled, vehicle types, and in different scenarios, the $5 million coverage requirement may fit some, but not all, of the liability risk. AV manufacturers are not the only party carrying liability, and the law may need to expand insurance requirements to cover entities beyond the scope of AV manufacturers, identifying the unique liabilities of ride providers (e.g., TNCs or taxi companies) or fleet owners, who may lease AVs for use in a shared fleet or use AVs exclusively for private commercial or non-commercial uses.

For passenger service, this effort could work in concert with CPUC efforts, and for freight service it could work with Caltrans. Assessing risks for all these different types of stakeholders is a challenge because actuarial rates are difficult to estimate while the industry is young. Insurance firms today can base estimates for risk assessed over 100 billion VMT.[51] As the number of AV-driven miles grows, the track record can more reliably be used to assess risk, reducing the unknowns.

Looking forward, new types of insurance may be necessary. The Stevens Institute of Technology outlines three possible risks against which additional liability insurance may be needed for protection: AV cybersecurity, sensors and algorithms, and infrastructure problems. Stevens estimates that coverage for these risks could be costly to the AV industry, while generating billions in additional revenue for the insurance industry. Whether these outcomes are likely depends on the prevalence of companies choosing self-insurance or purchasing bonds.[52] A recent report from Rand claimed that the process for auto insurance claims will not radically change as AVs enter and potentially overtake the market. This report, based on extensive interviews with insurance stakeholders, states that the claims process and liability assessments for AVs will be quite similar to driven vehicles. However, Rand reflects that there is still ongoing debate about whether the existing no-fault insurance compensation schemes will be sufficient or new schemes will need to be developed.[53]

Industry hopes are that AV crashes are rarer with fewer fatalities, but AVs will still crash. In the short-term existing frameworks for vehicle insurance and liability that can apply to AVs, but as the market grows and stratifies new types of insurance may be necessary.

51. Gordon J. Anderson, Austin L. Brown, and Hannah R. Safford, "Reshaping Liability and Insurance Rules for Automated Vehicles," January 2019, https://policyinstitute.ucdavis.edu/wp-content/uploads/Liability_PolicyBrief_010819.pdf.

52. Lawrence Karp and Richard Kim, "Insuring Autonomous Vehicles: Opportunity Between Now And 2025" (Accenture and the Stevens Institute of Technology, The Innovation University, 2017), https://www.accenture.com/_acnmedia/pdf-60/accenture-insurance-autonomous-vehicles-pov.pdf.

53. Karlyn D. Stanley, Michelle Grise, and James M. Anderson, "Autonomous Vehicles and the Future of Auto Insurance" (Santa Monica, CA: Rand Corporation, 2020), https://www.rand.org/pubs/research_reports/RRA878-1.html.

BACKGROUND

Shared automated electric vehicles (SAEVs) have the potential to revolutionize our existing on-road transportation system. Research suggests that, if unregulated, AVs that are not shared or electric could increase transportation emissions, congestion, and overall vehicle miles traveled.[54] By setting strategic policy mechanisms today, the State can set guiding principles to ensure the safe, equitable, and sustainable adoption of SAEVs without hindering technological innovation. The model policies included in this document focused on increasing accessibility to all communities, encouraging sustainable adoption practices of AVs at the statewide level, and directing specific state agencies to address or implement these guiding principles. This section will expand on key points raised in the previous sections, providing historical background, context, and clarification.

HOW DID WE ARRIVE AT THE POLICY OPTIONS IN THIS ISSUE PAPER?

Our methodology includes a policy back-mapping exercise where we considered a set of key public problems that are emerging in this era of vehicle automation, and other tangential problems, and we worked to map solutions to address these problems. We were easily able to incorporate the CalSTA Framework's proposed principles, which aligned well with the problems we identified. The overlapping segments shown in Figure 1 convey that the key focus points for the policy solutions identified in this analysis were intersectional. In addition to the several known issues, related or tangential unknown problems may emerge as the AV industry matures. Each of these problems are briefly introduced in the following sections.

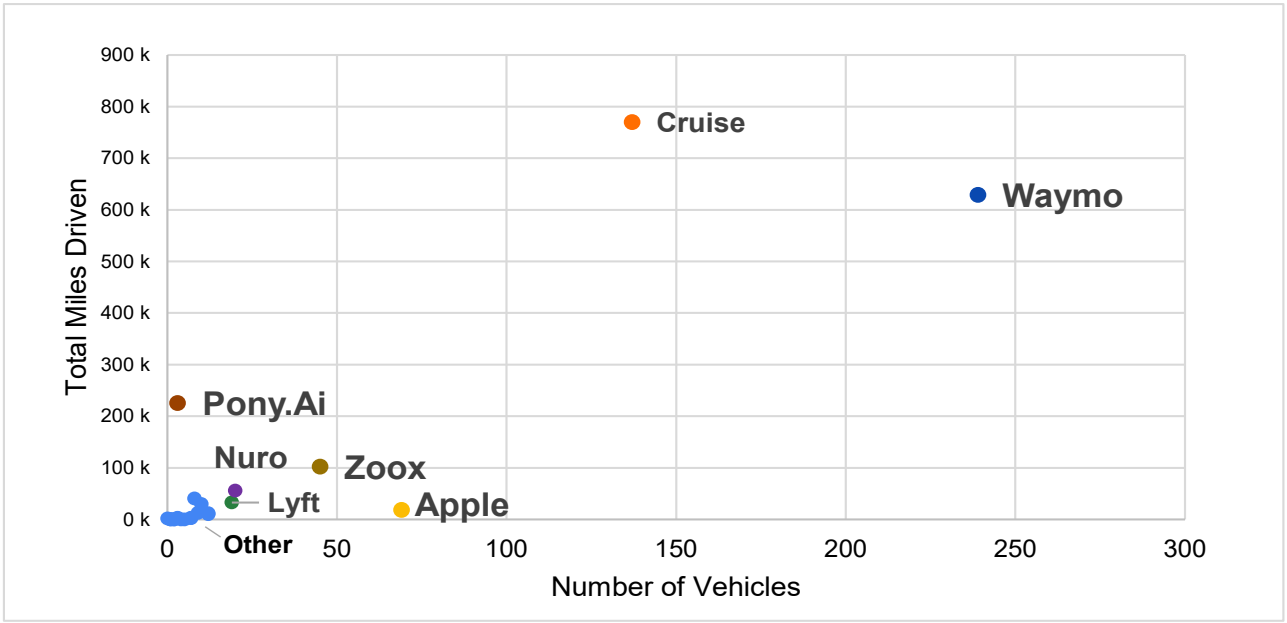


Figure 2. California DMV AV Testing Program 2020 mileage reporting vs. vehicle fleet.

(Data source: https://www.dmv.ca.gov/portal/file/2020-autonomous-mileage-reports-csv/)

54. Daniel Sperling, *Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future* (Island Press, 2018).

PROBLEM: AUTOMATED VEHICLES ARE A NEW TECHNOLOGY AND POLICY MAKERS ARE UNFAMILIAR WITH AV COMPANIES AND THE INDUSTRY

There are many outstanding questions about how the companies and vehicles will integrate into California's transportation landscape. Fifty-six companies have applied for permits to test autonomous vehicles in California (several are no longer operating or have merged with other permit-holders). Figure 2 shows the companies that were operating in 2020. The companies vary considerably in both size of vehicle fleets and number of miles driven.[55]

The DMV has approved permits for five passenger-service AV companies to test without a driver in the vehicle. All of these front-running companies (Autox Technologies; Baidu USA, LLC; Cruise, LLC; Waymo, LLC; Zoox, Inc.) have taken steps that indicate they are positioning their AVs to operate their service in a taxi or TNC-like ride-hailing business model (AV Passenger Service, as defined by the CPUC). industry trend toward use of AVs in shared fleets is not yet clear. As shown in Figure 3, among the DMV-issued permits to test AVs, roughly one-third (18 of 56) are likely to operate as passenger service operators. This assessment is the result of reviewing company public statements and should not be taken as fact, given that a company statement was not available in every case.[56]

However, as can be seen in Figure 3, our assessment shows that several companies may offer passenger service and sell vehicles directly to consumers or operate cargo service. So, blended business models are quite likely, and the business models will likely continue to vary widely.[57]

THE ROLE OF PUBLIC-PRIVATE PARTNERSHIPS

More collaboration between local government entities, organizations, universities, and AV passenger service providers is needed to ensure the successful deployment and operation of AV service in all communities. Through active participation with local agencies and organizations, transportation

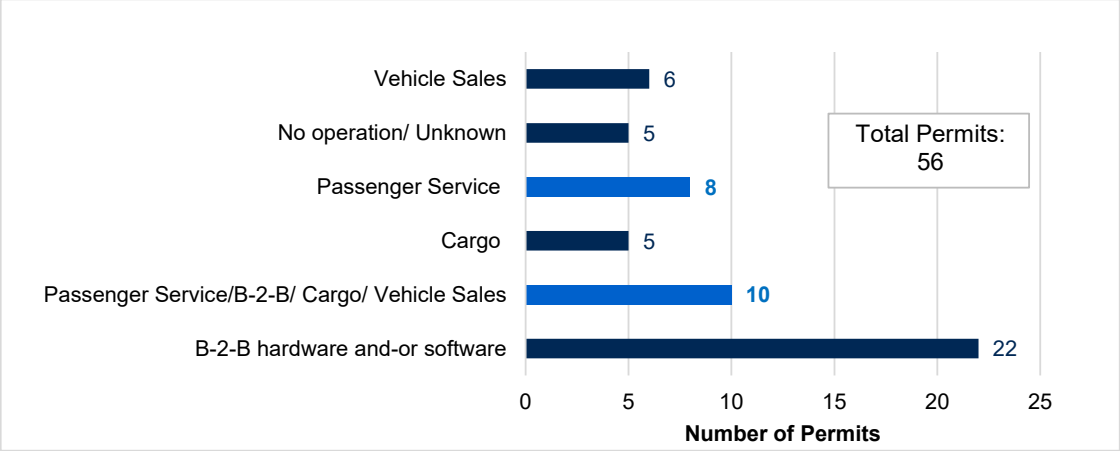


Figure 3. AV business models for companies with AV testing permits in California (as of March 2021)[57]

Whether these five companies reflect a full-scale services can help encourage AV adoption in a

55. See Digital Appendix A. for details on our assessment of the California permitted companies https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr
Data source: California Department of Motor Vehicles, "Disengagement Reports," 2020., https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/disengagement-reports/.

56. See Digital Appendix A. https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr.

57. See Digital Appendix A. https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr.

manner that is equitable and provides meaningful benefits. Community needs assessments can lead to successful outcomes, especially if they serve as the foundation to public-private partnerships (PPPs).

AV businesses would benefit greatly if their services could help transit agencies increase ridership. By providing first- and last-mile services, private-sector AV services could offer solutions that complement and enhance existing transit investments. Rather than competing with one another, private mobility service providers and transit agencies can partner to provide complementary services to enhance access to transit and mobility.

While private entities and local agencies may have concerns (e.g., data sharing and liability) about engaging in contractual agreements with each other, the State can play a pivotal role in encouraging PPPs at the local level. Research has shown that even before agreements are made between private and public entities, transit agencies are hesitant to engage private mobility service providers to expand or enhance their service. This could be due to the perception that private mobility service providers may not meet the needs of transit agencies. Even if attitudes towards PPPs are favorable, the greatest barrier is the perceived lack of financial viability to support these agreements. In rural areas that exhibit low demand for private mobility services and even public transit services, PPPs can meet the needs of those who may rely on these services. By partnering with local organizations and agencies, AV passenger service providers can identify opportunities for operations during low demand, thereby filling these service gaps and providing mobility to those who need it the most. However, funding availability is still greatly limited, even in rural areas. The State's role of supporting PPPs is primarily fiscal. To make PPPs attractive to private entities and especially local government entities, financial incentives may be needed to support contractual agreements. Funding should align with existing state priorities, and those projects that enhance existing transit services while mitigating GHG emissions and reducing congestion are in the best interest of the state. Performance metrics to meet these goals can be based on existing policies such as SB 375 and SB 32.

PROBLEM: THE SAFETY REGULATORY REGIME IS OUT OF DATE AND DOES NOT APPLY WELL TO AVS

As noted previously in Policy Section 5, auto manufacturers must follow federal vehicle safety standards set by NHTSA, but AV manufacturers can circumvent many of these safety standards through an exemption process that was created to streamline AV development and enable innovation. AV safety standards remain voluntary, with federal authorities deferring to the good-faith efforts of manufacturers. Given this laissez-faire approach there are many open questions about the State role in managing near-term security and cybersecurity issues. Setting

Highlighting Research on AV Policy Activities in Other U.S. States

States typically defer to federal vehicle standards, however as mentioned in Policy #5 on page 9, federal action on AVs has been limited to voluntary safety vehicle design standards. The federal government has left AV policy decisions up to the states. So far, state and regional policies vary greatly. Several trends in AV state governance have emerged. Most state AV policy in the U.S. is focused on safety and testing issues. Few states have focused on impacts to social equity, public health, public transit, goods movement, and emergency response. Only 14% of states have passed AV policy related to environmental impacts. AV policy in western states, including California, tends to focus on environmental impacts and on collisions and crashes. To become better prepared for AVs, California needs an improved comprehensive approach in addressing long-term and short-term AV impacts, as seen in other states, such as Michigan, Virginia, Texas, and Arizona.

Source: 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.

safety standards is a logical next step that can allow the industry to innovate while preserving public safety guardrails.

BACKGROUND ON AUTOMOTIVE SAFETY PERFORMANCE STANDARDS

INDUSTRY SAFETY STANDARDS

Several third parties have established safety standards for AVs, including UL 4600, which is a set of prompts that address only fully driverless AVs. UL 4600 addresses "safety case construction, risk analysis, safety relevant aspects of design process, testing, tool qualification, autonomy validation, data integrity, human-machine interaction (for non-drivers), life cycle concerns, metrics and conformance assessment."[58] Importantly, UL 4600 does not determine an ethical boundary for safety, i.e., how safe is safe enough in terms of killed or seriously injured (KSI) or other safety metrics. The standard simply raises guidelines for developers to understand the safety needs of different safety case characteristics and requires that developers set the parameters. The standard asks developers to provide evidence to support why they can meet a safety goal, e.g., "not hitting pedestrians of all types."[59] While UL 4600 is the most focused on driverless AVs, other industry standards including ISO 26262 and ISO 21448 have relevance.[60] Aligning interim state safety requirements with these standards could be an advisable near-term strategy, while regulations mature.

GLOBAL SAFETY STANDARDS

Globally, KSI rates are a common data point in discussion around commercial safety performance. They are often calculated as KSI per billion miles. KSI rates reflect auto design safety, but importantly are a limited metric. KSI in real-world environments are also a product of road design and land use limitations. Nevertheless, KSI metrics inform governmental efforts to address safety deficiencies and improve rights-of-

Crash Avoidance			Crashworthiness & Occupant Protection		
101 Controls and displays	**110** Tire selection and rims and motor home/recreation vehicle trailer load carrying capacity information	**124** Accelerator control systems	**201** Occupant protection in interior impact	**206** Door locks and door retention components	**216a** Roof crush resistance
102 Transmission shift position sequence, starter interlock, and transmission braking effect	**111** Rear visibility	**125** Warning devices	**202a** Head restraints	**207** Seating systems	**219** Windshield zone intrusion
103 Windshield defrosting and defogging systems	**113** Hood latch system	**126** Electronic stability control systems for light vehicles	**203** Impact protection for the driver from the steering control system	**208** Occupant crash protection	**222** School bus passenger seating and crash protection
104 Windshield wiping and washing systems	**114** Theft protection and rollaway prevention	**138** Tire pressure monitoring systems	**204** Steering control rearward displacement	**210** Seat belt assembly anchorages	**225** Child restraint anchorage systems
108 Lamps, reflective devices, and associated equipment	**118** Power operated window, partition, and roof panel systems	**141** Minimum sound requirements for hybrid and electric vehicles	**205** Glazing materials	**214** Side impact protection	**226** Ejection mitigation

Figure 4. Federal Motor Vehicle Safety Standards (FMVSS) those highlighted in yellow may need modification for AVs.

Source: National Highway Traffic Safety Administration, "FMVSS Considerations for Vehicles With Automated Driving Systems: Volume 1". https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/ads-dv_fmvss_vol1-042320-v8-tag.pdf

58. Underwriters Laboratories, "UL4600: Presenting the Standard for Safety for the Evaluation of Autonomous Vehicles and Other Products," 2019, https://ul.org/UL4600.
59. Underwriters Laboratories, "UL 4600: General Stakeholder Overview," https://collateral-library-production.s3.amazonaws.com/uploads/nfp/nfp_asset/attachment/1424/191010_UL4600_POLICY_Webinar.pdf.
60. National Highway Traffic Safety Administration, "See Comments on the Framework for Automated Driving System Safety," Pub. L. No. NHTSA-2020-0106-0001 (2021), https://www.regulations.gov/document/NHTSA-2020-0106-0001.

way. Furthermore, evaluation of KSI for a given area can help planners to install safety interventions, such as crosswalks at unsafe intersections or road diets to reduce speeds.[61] The automotive lethality rates of the past/present may soon become a relic if the best-case scenarios of AV safety are realized. This dream scenario is reliant on safety systems that are enabled to continually evolve, learn from fleet (and possibly industry-wide) mistakes, and rapidly iterate in order to improve upon prior performance. This type of iterative safety system, commonly referred to as a *safety loop*, is reliant on being able to collect (and share) observational data in a way that can be made meaningful to software systems.

FEDERAL SAFETY STANDARDS

Federal Motor Vehicle Safety Standards (FMVSS) are a linchpin of the automotive regulatory regime. Those FMVSS that may need modifications for AVs are highlighted in Figure 4. Several working groups were assembled to discuss these FMVSS specifics and identify best practices for alternatives. Some of these modifications are due to the lack of steering wheels, foot-operated brakes, etc., and others relate to the fact that AVs may have more rear-facing movement.

NHTSA GUIDANCE DOCUMENTS OR OTHER RELEVANT ACTIONS

Federal Automated Vehicle Policy published in September 2016 introduced vehicle performance guidance for AVs and discussed how to modernize regulatory tools. It importantly also outlined "State model policy." This was followed by Automated Driving Systems 2.0 (ADS 2.0), which expanded interpretations from the previous guidance document (Federal Automated Vehicles Policy) and included guidance for state governments to act. A key outcome of ADS 2.0 was that it established a new voluntary mechanism for assessing the safety of AVs, the 12-point Voluntary Safety Self-Assessments.[62] Then in 2018, USDOT released Automated Vehicles 3.0 (AV 3.0), which provides USDOT-wide multi-modal guidance and announced a plan to modernize terms such as "driver" and "operator" to be inclusive of non-human direction. The next guidance document, Automated Vehicles 4.0 (AV 4.0), issued in 2020, states that the administration prioritizes safety, although it provides limited details on how it would accomplish this goal.

The most recent Automated Vehicles Comprehensive Plan emphasizes exemptions and waivers as key tools. This plan also identifies industry-led voluntary technical standards, also referred to as voluntary consensus standards.[63] NHTSA's Proposed AV Safety Framework is a potential move toward a more cohesive safety policy. NHTSA issued this document in 2020, and it is an early fact finding step, and not a proposed policy or a final rule. It introduces a method to address both the software and hardware of the automated driving system (ADS), specifically only the ADS. This framework asks for feedback from the public on two key aspects of ADS safety: process measures (protocols and structure of the policy) and engineering measures (technical documentation). Whether the change in administration will impact the progress of this effort remains to be seen, but there is no guarantee the new USDOT leadership will advance this effort. Additional process measures for shared AV use include NHTSA coordinating with the Federal Transit Administration in their ongoing and robust transit automation research and demonstration efforts. NHTSA should work with the Federal Transit Administration to consider how public transit applications will impact safety, and whether AVs for transit use will meet requirements under the ADA.[64]

BACKGROUND ON CALIFORNIA ACTIONS TO DATE

SB 1298 and DMV Title 13 require that the California DMV must adopt safety regulation for purposes of AV safety and performance standards. In the adopted regulatory text are several key definitions. DMV states that a "'minimal risk condition' is a low-risk operating condition that an autonomous vehicle

61. Megan S. Ryerson and Long Carrie S; Davidson, Joshua H; Boggan, Camille M., "New Rules for Old Roads," Issues in Science and Technology 37, no. 2 (Winter 2021): 25–30.

62. National Highway Traffic Safety Administration, "Automated Driving Systems," https://www.nhtsa.gov/vehicle-manufacturers/automated-driving-systems.

63. "Automated Vehicles - Comprehensive Plan" (U.S. Department of Transportation, 2021.), https://www.transportation.gov/sites/dot.gov/files/2021-01/USDOT_AVCP.pdf.

64. Americans With Disabilities Act, Pub. L. No. 42, § 12101 U.S. Code Chapter 126 (1990).

Will Shared AVs Be Safer Than Personally Owned Driverless Vehicles?

More research is needed to better understand whether there are safety benefits to operating an AV as a shared fleet vehicle versus a privately owned vehicle. While it is possible that over-the-air updates will become a routine and ubiquitous part of automotive safety for driven and driverless vehicles, it is still possible that more reliable maintenance provided in a fleet might increase safety outcomes. Will shared fleets be more rapidly decommissioned if safety performance standards are not met? Such potential safety benefits should be further investigated, and there should be a robust discussion about the ongoing role of AV manufacturers in ensuring reliable vehicle performance—whether they are operated by the manufacturers, shared fleet operating companies, or private individuals.

automatically resorts to when either the automated driving systems fails Testing of Autonomous Vehicles or when the human driver fails to respond appropriately to a request to take over the dynamic driving task."[65] Vehicle manufacturers are required to demonstrate that if the vehicle falls outside of the operation design domain that they can transition to a minimal risk condition. (Note: AB 2734 and SB 145 (2017) made minor amendments to SB 1298.)

More recently, in late 2020, the CPUC passed Decision 20-11-046 (modified in Decision 21-05-017), which states that protecting passenger safety is one of the four goals. This decision authorizes deployment of Phase I Driver and Driverless Autonomous Vehicle Passenger Service. This decision advances a pilot that had restricted companies from charging fares or allowing passengers to share rides. The shared ride ban was due to concerns about safety among passengers in an unaccompanied driverless vehicle. As described in Policy Strategy #5, to address these security concerns companies that seek permits for driverless pilot and/or deployment service are required to submit a "Passenger Safety Plan that, among other things, describes the technologies, procedures and protocols, and redundancies that the applicant will implement to minimize safety risks to passengers traveling in a shared, driverless ride."[66] The Passenger Safety Plans are subject to input during a public review period, however, they are not binding requirements, nor do they connect to specific safety performance metrics. The CPUC added language to the final decision that says the safety scope applies to "all Californians, including people with disabilities." However, the decision lacks discrete actions or requirements to encourage or require more wheelchair-accessible AVs, or AVs that accommodate other physical, sensory, or cognitive disabilities.

PROBLEM: TRANSPORTATION EMISSIONS AND VMT ARE MAJOR CONTRIBUTORS TO AIR POLLUTION, AND AUTOMATED VEHICLES COULD BE HIGH-MILEAGE VEHICLES

Transportation emissions contribute 40% of all GHG emissions in the State of California.[67] Without policy intervention, AVs are likely to increase GHG emissions from transportation due to induced demand, as documented by research demonstrating their contributions to increased VMT and tailpipe emissions.[68,69] These likely outcomes are related in part to: a) widespread dominance of single-occupant travel resulting in emissions and congestion, and b) declining public transit usage that has been

65. State of California, "Testing of Autonomous Vehicles - Adopted Regulatory Text," Title 13, Division 1, Chapter 1 Article 3.7 Vehicles § (n.d.), https://www.dmv.ca.gov/portal/file/autonomous-vehicles-testing-without-a-driver-adopted-regulatory-text-pdf/.

66. Public Utilities Commission Of The State Of California, "Decision Authorizing Deployment Of Drivered And Driverless Autonomous Vehicle Passenger Service," Pub. L. No. Decision 20-11-046, PUC (2020), https://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=352185092.

67. "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.

68. Lew Fulton, Jacob Mason, and Dominique Meroux, "Three Revolutions in Urban Transportation," 2017, https://itspubs.ucdavis.edu/publication_detail.php?id=2723.

69. Caroline Rodier, Miguel Jaller, Elham Pourrahmani, Anmol Pahwa, Joschka Bischoff, Joel Freedman, "Automated Vehicles Are Expected to Increase Driving and Emissions Without Policy Intervention," 2020, https://doi.org/10.7922/G2G73BZW.

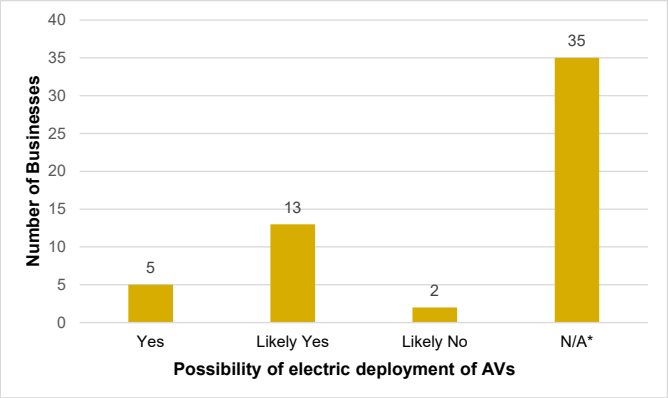


Figure 5. AV companies claiming to initially deploy with electric AVs among companies with AV testing permits in California (as of March 2021)

*B-2-B Software and Hardware Businesses

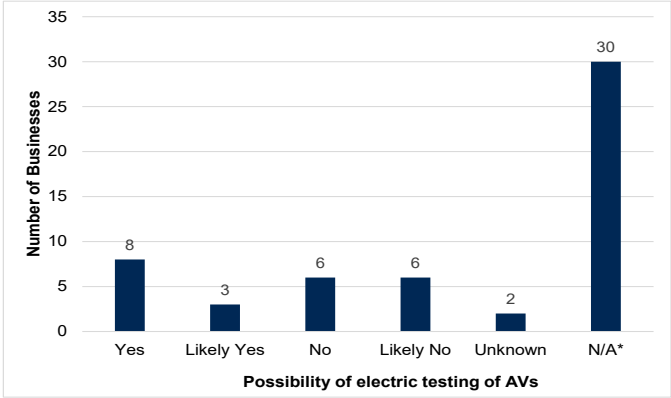


Figure 6. AV companies testing with electric AVs among companies with AV testing permits in California (as of March 2021)

*B-2-B Software and Hardware Businesses

exacerbated by COVID-19.[70, 71] The climate crisis is likely to disproportionately impact people in low-income and disadvantaged communities, who also face a disproportionate health burden of breathing harmful emissions.[72]

On a positive note, the AV industry is trending toward electrification, and most of the companies planning to deploy AVs claim they will be electric.[73] Figures 5 and 6 show an assessment of whether the permitted companies in California will deploy as EVs. It was difficult to assess whether they were just testing or will also deploy with EVs using available public information. However, among those that have made public their choice of vehicle drive trains, slightly more AV companies are assumed to be testing with non-electric (12) than with electric (11), and more AV companies are said to be planning to deploy using EVs (18) than not (2). It is critical to note that these types of pledges from companies are not binding resolutions, and without binding policies to hold the companies to these promises, there remains a gap that could lead to a new source of emissions from AVs in California.[74]

PRICING POLICIES TO ADDRESS CONGESTION AND EMISSIONS

Emissions policies that take a more comprehensive approach, rather than targeting the tailpipes of AVs, will also be an important part of the overall sustainable transportation strategy. A globally heralded comprehensive road pricing policy is "congestion pricing," which is a simple tolling system that charges drivers when entering a predetermined area, or cordon, where congestion is highest. Typically, the central purpose of congestion pricing is to alleviate congestion in dense urban downtown areas. Model examples of congestion pricing development and implementation can be seen in London, Stockholm, and Singapore. In North America, there are few

70. Giovanni Circella and Rosa Dominguez-Faus, "Impacts of the COVID-19 Pandemic on Transportation Use: Updates from UC Davis Behavioral Study," Institute of Transportation Studies Transportation and Climate Blog (blog), n.d., https://its.ucdavis.edu/blog-post/impacts-of-the-covid-19-pandemic-on-transportation-use-updates-from-uc-davis-behavioral-study/.

71. Brian Taylor and Jacob Wasserman, "Transportation, Coronavirus and COVID-19," blog, UCLA Institute of Transportation Studies (blog), 2020, https://www.its.ucla.edu/for-the-press/transportation-coronavirus-covid19/.

72. Marisa Johnson, "Undoing Oakland's History of Environmental Racism as We Address Climate Change in California," The Greenlining Institute (blog), May 12, 2017, https://greenlining.org/blog-category/2017/undoing-oaklands-history-environmental-racism.

73. See Digital Appendix A. for details on our assessment of the California permitted companies https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr
Data source: California Department of Motor Vehicles, "Disengagement Reports," 2020., https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/disengagement-reports/.

74. See Digital Appendix A. for details on our assessment of the California permitted companies https://airtable.com/shrlfbmqaGZtvbhbL/tblaPlkTHKXxA6lVr
Data source: California Department of Motor Vehicles, "Disengagement Reports," 2020., https://www.dmv.ca.gov/portal/vehicle-industry-services/autonomous-vehicles/disengagement-reports/.

examples: New York is in the process of implementing a congestion pricing system, while San Francisco, Los Angeles, and Seattle among other cities, have taken steps to investigate how to implement this strategy equitably.

Recent UC Davis research identified key features of equitable congestion pricing, including: 1) a meaningful community-engagement process, 2) pricing structures that are efficient yet equitable, 3) a transparent investment plan to induce travel demand for other transportation modes, and 4) secure and anonymous data reporting and analysis to track congestion pricing impacts and outcomes. These four factors are essential in developing socially equitable, economically efficient, and politically acceptable congestion pricing mechanisms.[75]

Other pricing policies include a road user charge, which is simply a fee per mile driven, which is typically considered as an alternative to a gas tax to generate revenue to finance transportation improvements. Oregon is the only state to have implemented a road user charge, but many other states, including California, are considering implementation. California orchestrated the largest pilot with 5,000+ vehicles participating from 2016–2017, but the project has yet to scale beyond this pilot.[76] A UC Davis study comparing electric vehicle registration fees to road user charges determined that the road user charge is likely a preferred strategy, because it follows the "user pays" principle and connects activities (e.g., driving) with fees directly. In contrast, a flat fee that would subsidize higher-mileage drivers.[77] Equity concerns about road user charges typically focus on the longer distances traveled in rural areas, as mentioned in policy strategy #4, and state lawmakers will need to address these concerns, while working to send necessary price signals about GHG impacts of travel.

Both congestion pricing and a road user charge can serve as mechanisms to decrease VMT in congested areas, reduce statewide transportation emissions to meet climate action goals, and generate revenues. Racial and social equity considerations need to be made early priorities to not exacerbate existing inequities that disadvantage vulnerable populations and have been caused by the current transportation system.

PROBLEM: INEQUITABLE MOBILITY IS EXACERBATING DISPARITIES

Mobility gaps create inequities for individuals, and the lack of access to high-quality transit or reliable vehicles can worsen other accessibility issues (e.g., access to jobs, food deserts, healthcare, recreational amenities).[78] These disparities deepen racial and economic divides and are often a product of a housing/transportation mismatch resulting in additional VMT. Mobility access challenges emerge when the costs of housing in urban areas is high, causing people to move to less dense areas to reduce their housing cost. People will then rely more on personally owned vehicles for increased mobility.

Policymakers have historically failed to listen directly to affected populations, and therefore lack knowledge about priorities for improving mobility and accessibility. More communication and engagement between state authorities, community-based organizations, and residents are needed.[79] For example, a UCLA study on the impacts of trucks in Southeast LA found that safety concerns were paramount for the community, given that residents saw truck collisions involving vulnerable community members, including children.[80] AV technology may be

75. Mollie D'Agostino, Paige Pellaton, and Brittany White, "Equitable Congestion Pricing" (Institute of Transportation Studies, University of California, 2020), https://escholarship.org/uc/item/17h3k4db.

76. Alan Jenn and Kelly L. Fleming, "Road User Charge Administration: Lessons Learned from Fuel Taxes," 2021, https://doi.org/10.7922/G2T43RDR.

77. Alan Jenn, "Assessing Alternatives to California's Electric Vehicle Registration Fee," December 1, 2018, https://escholarship.org/uc/item/62f72449.

78. Anne Brown and Brian Taylor, "Bridging the Gap between Mobility Haves and Have-Nots," in Three Revolutions: (Island Press, 2018).

79. Thomas W. Sanchez, Rich Stolz, and Jacinta Ma, "Moving to Equity: Addressing Inequitable Effects of Transportation Policies on Minorities," Joint Report (Harvard University, 2003), https://civilrightsproject.ucla.edu/research/metro-and-regional-inequalities/transportation/moving-to-equity-addressing-inequitable-effects-of-transportation-policies-on-minorities/sanchez-moving-to-equity-transportation-policies.pdf.

80. Genevieve Giuliano, Maged Dessouky, Sue Dexter, Jiawen Fang, Shichun Hu, Marshall Miller, "Heavy-Duty Trucks: The Challenge of Getting to Zero," Transportation Research Part D: Transport and Environment 93, no. 2021 (2021): 1361–9209, https://doi.org/10.1016/j.trd.2021.102742.

able to improve safety outcomes and address some factors that higher rates of traffic violence in certain demographic groups. However, the infrastructure inequities in the built environment are a larger issue that will require policy solutions beyond the scope of AVs.

With respect to disability access there are also important efforts worth mentioning. In California, some lawmakers have given this issue of AVs and disability access some thought. A proposed policy on disability access and workforce consideration is SB 336, which proposed to require transit operators to ensure that AV transit vehicles are staffed with at least one employee trained in "passenger safety, passenger communication, assisting the disabled and elderly, and emergency response and preparedness."

Outside of California there are also efforts to expand AV access for people with disabilities. For example, May Mobility, operating in the Midwest and Southeast, has a wheelchair-accessible vehicle in service, with safety drivers accompanying each trip (the vehicles are not fully ADA compliant). Notably, May Mobility is among 10 semi-finalists chosen to participate in a USDOT Inclusive Design Challenge[81] to investigate design solutions for making AVs accessible for people with disabilities. The team will have a series of design charettes that culminate in Summer 2022 addressing design questions, such as how people with physical, sensory, and cognitive disabilities can locate, enter, and interact with an AV.

Early research shows that statewide policy can proactively steer AVs toward net social and environmental gains. If unregulated, AVs can increase congestion, urban sprawl, transportation emissions, and overall vehicle miles traveled.[82, 83] By setting strategic policy mechanisms today, the state can set guiding principles to ensure the safe, equitable, and sustainable adoption of SAVs without hindering technological innovation.

PROBLEM: THE WORKFORCE IMPACTS OF AVS ARE UNDETERMINED

Workforce impact mitigation is a priority for the future of automation in the transportation sector. Hundreds of thousands of truck drivers nationwide and tens of thousands of passenger vehicle drivers can expect changes to aspects of their work in future decades.[84] While a new USDOT report projects that the transition for long-haul trucking will not happen overnight,[85] some workers may be rendered redundant. A transition plan may be able to minimize harms and policy will dictate these outcomes. This will be especially important for transit system operations. However, questions remain about how to ensure fair wages for monitoring AV systems. Policymakers can learn from automation in other industries to ensure a measured strategy. If policy can steer technological innovation in such a way that improves economic efficiencies, quality of work, and safety and environmental outcomes, there may be win-win policies that can arrive at benefits.

CONCLUSION

This compendium of model policies intends to provide a jumping-off point for further research and analysis to determine which of these options can most effectively meet the needs of Californians. The problems identified in this analysis are by no means exhaustive, but they reflect an interwoven cross-section of key problems associated with automation as they relate to the principles in the CalSTA Framework. The overlapping segments seen in Figure 1 (page 4) convey the key focus points

81. "May Mobility, Umtri Awarded Funding, Advance to Semi Finalist Round of USDOT Inclusive Design Challenge," May Mobility, January 7, 2021, https://maymobility.com/may-mobility-umtri-awarded-funding-advance-to-semi-finalist-round-of-usdot-inclusive-design-challenge/.

82. Caroline Rodier, Miguel Jaller, Elham Pourrahmani, Anmol Pahwa, Joschka Bischoff, Joel Freedman, "Automated Vehicles Are Expected to Increase Driving and Emissions Without Policy Intervention," 2020, https://doi.org/10.7922/G2G73BZW.

83. Lew Fulton, Jacob Mason, and Dominique Meroux, "Three Revolutions in Urban Transportation," 2017, https://itspubs.ucdavis.edu/publication_detail.php?id=2723.

84. Steve Viscelli, "Will Robotic Trucks Be 'Sweatshops on Wheels?'" Trucking Policy Fall 2020 (2020): 81–89. https://issues.org/robotic-autonomous-trucking-policy-sweatshops-viscelli/.

85. "Automated Vehicles - Comprehensive Plan" (U.S. Department of Transportation, n.d.), https://www.transportation.gov/sites/dot.gov/files/2021-01/USDOT_AVCP.pdf.

for the strategies identified in this analysis. Each of these problems align with one or more of the draft CalSTA Framework principles.

There are many policy strategies for the State to consider in order to ensure that AVs advance the principles in the CalSTA framework and respond to the problems we identify in this issue paper. In addition, if the State does not convene a meeting or form a working group of multiple stakeholders, it runs the risk of acting without adequate and balanced input.

SB 66 proposes such a working group, calling it the California Council on the Future of Transportation.[86] While the particulars of this bill are still in flux, the original text suggested convening agency leaders, representatives from diverse community-based organizations, academics, and the private sector in this Council. This convening is a critical next step in developing what will be an iterative set of policies to advance AVs while leading California toward a more sustainable and equitable transportation future.

The Commission should provide ongoing opportunities to receive and submit comment to the Legislature, and research from the Institute of Transportation Studies can help to inform this effort. The top-ten policy strategies outlined in this report and summarized as topics below can be a jumping-off point for some of the discussions and subcommittees assembled by the state.

- AVs and transit
- Personally owned AVs
- ZEV-AVs
- Rural/suburban AV issues
- Safety and security
- Workforce
- Booking and payment
- Disability access
- Data collection

86. "SB 66 California Council on the Future of Transportation: Advisory Committee: Autonomous Vehicle Technology.," Title II Government § Chapter 1.5 (commencing with Section 13985) of Part 4.5 of Division 3 (n.d.), 66.