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AUTONOMOUS VEHICLE HEAVEN OR HELL?

CREATING A TRANSPORTATION REVOLUTION THAT BENEFITS ALL

Authors

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About the Greenlining Institute

Founded in 1993, The Greenlining Institute envisions a nation where communities of color thrive and race is never a barrier to economic opportunity. Because people of color will be the majority of our population by 2044, America will prosper only if communities of color prosper. The Greenlining Institute advances economic opportunity and empowerment for people of color through advocacy, community and coalition building, research, and leadership development.

Environmental Equity

The Greenlining Institute's Environmental Equity program develops policies to improve public health and environmental quality for low-income communities and communities of color while bringing "green" dollars to these communities.

About the Authors

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Hana works on the development and implementation of policies leading to clean transportation and mobility investments that will benefit the health and wealth of low-income communities of color in California. She was the lead author of "Mobility Equity Framework: Making Transportation Work for People," a tool to maximize equity and community engagement in transportation planning and decision-making. She graduated magna cum laude from San Diego State University with a degree in Sustainability with a strong interest in environmental justice and equity. Hana has worked as a community organizer, advocating for climate change action and public transit policies in San Diego. She was a Climate Corps Fellow, a leadership development program that partners fellows with local organizations developing and implementing projects addressing climate change resiliency. Prior to Greenlining, Hana implemented innovative campaigns for Alameda County's Clean Commute Program, to promote long-term sustainable behavior changes.

Joel Espino *Environmental Equity Legal Counsel*
Joel works to reduce poverty and pollution in communities of color by advocating for accessible, affordable, and clean transportation choices and a diverse clean energy economy. He leads Greenlining's transportation equity work advocating to increase racial equity in transportation planning and investments; implementing the Charge Ahead California Initiative–a law that works to make electric vehicles (EV) accessible to low- and moderate-income Californians; and advocating for equitable EV charging infrastructure investments at the California Public Utilities Commission, the California Energy Commission, and within the Volkswagen Diesel Settlement. He is author of "Electric Vehicles for All: An Equity Toolkit"; lead author of "Electric Carsharing in Underserved Communities: Considerations for Program Success"; and co-author of "Delivering Opportunity: How Electric Buses and Trucks Can Create Jobs and Improve Public Health in California." Joel is always thinking of ways to make new mobility services and transportation investments more equitable and sustainable.

Alvaro S. Sanchez *Environmental Equity Director*
Alvaro is an urban planner with extensive experience crafting, implementing, and evaluating strategies that leverage private and public investments to deliver community benefits to impacted communities. Alvaro leads our work on SB 535 (de León) which directs at least one quarter of California's Greenhouse Gas Reduction Fund to disadvantaged communities. He also leads our neighborhood-scale sustainability initiative, a comprehensive and scalable approach to greenhouse gas reduction that leverages private

and public investment while improving underserved communities throughout California. Prior to joining Greenlining, Alvaro led Green For All's stormwater infrastructure strategy. As a member of the State and Local Initiatives team, he led the organization's strategies for connecting impacted communities to economic opportunity related to national stormwater infrastructure investments. He wrote several reports detailing the untapped opportunity of using green infrastructure as a cost-effective stormwater management tool that creates job and business opportunities for underserved communities. Several leading water and stormwater utilities throughout the country have used the framework he presented to deliver triple-bottom-line benefits. Alvaro has over nine years of experience working on economic development and land use issues throughout California and nationally. In 2011 he received a Master of Planning degree from the University of Southern California, where he focused on affordable housing and economic development. He is the President of the Board of Directors at Dolores Street Community Services, an immigration and community development organization in San Francisco. He also created the Triple Bottom Line Hub, a social media platform that celebrates projects that deliver triple-bottom-line benefits.

Editorial

Bruce Mirken *Media Relations Director, The Greenlining Institute*

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Randall Winston *Executive Director of California's Strategic Growth Council*
Clarrissa Cabansagan *Senior Community Planner at TransForm*
Jamie Dean *Program Director at the 11th Hour Project*
Erika Rincón Whitcomb *Senior Associate at PolicyLink*
Bahram Fazeli *Director of Research & Policy at Communities for a Better Environment*
Gil Tal *Research Director at UC Davis Institute of Transportation Studies, PH&EV Center*
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The opinions expressed herein do not necessarily reflect those of the organization that funded the work or the individuals who reviewed it. The Greenlining Institute bears sole responsibility for the report's contents.

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EXECUTIVE SUMMARY

- Three transportation revolutions—electrification, vehicle sharing, and autonomous (self-driving) vehicles—are poised to transform our entire transportation system, impacting everything from how people move and the shape of our communities to the livelihoods of millions now employed in driving jobs.

- This technology has many potential benefits, leading some to imagine a "heaven" scenario: reduced smog, less traffic, less space needed for parking, increased ease of mobility. Still, profound questions remain about whether this new transportation technology will improve the lives of marginalized groups like people of color, the poor, the elderly, and people with disabilities—who are often poorly served by our current transportation infrastructure—or whether it will leave them even worse off.

- If left up to the free market without adequate regulation, we can expect a "hell" scenario dominated by personally-owned autonomous vehicles that are only accessible to those who can afford them, while further congesting our streets and polluting our air, leaving others to cope with worse traffic, longer commutes and under-resourced public transit.

- This report seeks to chart a path away from personally-owned autonomous vehicles and instead establish a vision and a path towards a "heaven" scenario that improves mobility for all people, reduces air pollution, and increases economic opportunities, particularly for marginalized populations. In a "heaven" future, all people will have access to fleets of autonomous vehicles that are electric and shared, known as FAVES, that replace the need for personal vehicle ownership. In this equitable and sustainable vision, we must continue to prioritize walking, biking, and public transit—still the healthiest, most sustainable alternatives—over FAVES and all other autonomous vehicles, to the maximum extent possible. To get there, we must put marginalized people first, reclaim our streets for people and not cars, and utilize this autonomous vehicle revolution as a tool to address the transportation, environment, and economic injustices of the past.

- This transportation technology is moving fast, and therefore it is critical to push forward policy interventions that prioritize the well-being and future of marginalized people and our environment.

- Specific policy interventions that can help bring about this "heaven" scenario include:

    - Autonomous vehicles must operate primarily in the form of FAVES to the maximum extent possible, to promote sustainable and equitable outcomes.

    - Single-occupancy autonomous vehicles owned either by individuals or companies must be strongly disincentivized to reduce air pollution, greenhouse gas emissions, and vehicle miles traveled. Examples include progressive, equitable road pricing or similar fees on single-occupancy autonomous vehicles.

    - FAVES and all other forms of autonomous vehicles should increase affordable, accessible, efficient, safe, and reliable mobility for all people, while supporting and enhancing walking, biking, and public transit.

    - FAVES and all other forms of autonomous vehicles must provide fair labor practices, retraining programs, and a Just Transition[1] for workers displaced by self-driving technology.

METHODOLOGY

To collect the information necessary to develop the framework, The Greenlining Institute conducted a literature review, developed surveys, and conducted expert interviews with relevant stakeholders to gain a robust understanding of the implications of electric, shared, and autonomous vehicles. The literature review included over 200 reports, and we conducted 30 expert interviews. We surveyed experts by employing a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis survey on electric, shared, and autonomous vehicles to assess the equity implications. We compared the results of the survey with the literature review findings and input from the technical advisory committee. Though we conducted a literature review, it is important to note that literature focusing on specific equity outcomes of this technology is very limited. More research is needed to paint a complete picture of the equity implications of FAVES and autonomous vehicles, as well as potential equity-focused policy interventions. In general, the assumed impacts of FAVES and autonomous vehicles contemplate the impact on the population as a whole—not the impact specifically on marginalized communities. We know that a world dominated by personally-owned autonomous vehicles would cause more disastrous impacts on equity and sustainability than FAVES would. However, given what we know about the free market and structural inequities within our social, political, and economic systems, FAVES would likely also increase economic inequality and place heavier burdens on low-income people of color while delivering less benefits to them, unless we proactively plan to address these issues. We used the equity indicators from Greenlining's "Mobility Equity Framework: Making Transportation Work for People" as the basis of our analysis.

We convened an eight-member Technical Advisory Committee, comprising of transportation experts in government, academia, philanthropy, community-based organizations, advocacy groups, and industry. Their critical input and feedback guided the development of our framework, and was collected across three convenings, surveys, and reviews of drafts. The committee members include:

Richard Marcantonio *Managing Attorney at Public Advocates Inc.*
Randall Winston *Executive Director of California's Strategic Growth Council*
Clarrissa Cabansagan *New Mobility Policy Director*
Jamie Dean *Program Director at the 11th Hour Project*
Erika Rincon Whitcomb *Senior Associate at PolicyLink*
Bahram Fazeli *Director of Research & Policy at Communities for a Better Environment*
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MOBILITY EQUITY DEFINITIONS AND PRINCIPLES

Mobility Equity: a transportation system that increases access to high quality mobility options, reduces air pollution, and enhances economic opportunity for marginalized populations such as low-income people, people of color, the elderly and people with disabilities.

To achieve mobility equity in transportation planning and investments, we must prioritize:

1. Social equity: Addressing past and current injustices by redistributing societal benefits, burdens, and resources in a way that lifts up marginalized communities who have been left behind.

2. Community power: The ability of marginalized communities to influence decisions in a way that addresses their needs and concerns.

HOW TO ENSURE THE AUTONOMOUS VEHICLE REVOLUTION BENEFITS ALL

Our transportation system is on the verge of a major overhaul. Many researchers, analysts, industry insiders, and public officials foresee that the "three transportation revolutions" will completely change how people move, how cities look and feel, and how our transportation system is shaped.[2] Social justice advocates must ask whether these revolutions will improve the lives of marginalized groups like people of color, the poor, the elderly, and people with disabilities. This report tackles that question using the principles of Greenlining's Mobility Equity Framework and makes recommendations on how to guide new mobility innovations to create transportation systems that are equitable, sustainable, and empower marginalized people.

Purpose

This report is a follow-up to our Mobility Equity Framework, which lays out a process for how to prioritize equity and community power in transportation planning and decision-making. The goals of the framework are 1) increasing access to high quality mobility options, 2) reducing air pollution and promoting public health, 3) enhancing economic opportunities in low-income communities of color. This report examines the equity implications of the three revolutions — electric, shared and autonomous vehicles — within the context of the Mobility Equity Framework and provides equity-focused policy recommendations for how electric, shared, and autonomous vehicles can establish fair outcomes for all people.

The Three Transportation Revolutions

The electric vehicle revolution is poised to clean up the tailpipes of our cars, buses, and trucks more and more every day. While the electrification of vehicles must be further accelerated, in the United States close to a million electric vehicles have been sold, with nearly half of those in California.[3] The shared mobility revolution provides more choices of ways to get around like bike-share, car-share, ride-hailing, and scooter-share. The shared mobility market is trending toward "Mobility as a Service" or "MaaS," in which all of these mobility options can be bundled into one service or product. Experts estimate MaaS's market value at $358 billion in the U.S. by 2025.[4] At the same time, companies around the world are investing in self-driving autonomous vehicles, with large players such as Uber, Google, Apple, and Tesla playing a prominent role. The self-driving technology company Waymo has already driven eight million autonomous vehicle miles on public roads, and 400 Phoenix residents are currently testing Waymo's app to hail rides from this driverless transportation service.

Together, electric vehicles, shared vehicles, and autonomous vehicles make up the three revolutions in transportation. Companies have poured billions of dollars into the development and deployment of these three revolutions, an amount that continues to increase. This will lead to cascading impacts across society—changing how people move around cities, impacting people with driving jobs, and potentially making it easier to shed our personal cars.

Transportation Equity Heaven or Hell?

For years, the public policy debate on autonomous vehicles has occurred through the often-cited "Heaven or Hell" scenario.[5] The fast-moving autonomous vehicle revolution has the potential to help fix some of our transportation problems—the so-called "heaven scenario"—or make them worse—the "hell scenario." In a "heaven" future, autonomous vehicles that are electric and shared replace most personal vehicles, reducing congestion and space required for parking, cutting pollution, and improving streets and accessibility for all. A "hell" future means more personally-owned autonomous vehicles clogging streets, more car-oriented land use, weakened public transit, and more sprawl.[6] We have grave concerns that this "hell" scenario of personal autonomous vehicles would be devastating for equity, the environment, and marginalized communities. It is all too easy to imagine a future in which the wealthy are whisked around in autonomous Teslas while low-income communities of color struggle with worse traffic and longer commutes while depending on overwhelmed, underfunded public transit systems. Unfortunately, this "hell" scenario of personal autonomous vehicles is a very real possibility—a strong likelihood without bold policy interventions. Therefore, this report focuses on steering autonomous vehicles away from the "hell" scenario and towards the "heaven" scenario where autonomous vehicles are both shared and electric.

> ***In a "heaven" future, autonomous vehicles that are electric and shared replace most personal vehicles, reducing congestion and space required for parking, cutting pollution, and improving streets and accessibility for all.***

So what gets us to "heaven"? The answer seems to hinge on whether and how we can combine the benefits of the three transportation revolutions. Most experts and researchers agree that to ensure autonomous vehicle technology contributes to a "heaven" future, that technology must converge with the revolutions of electrification and sharing. What would this look like? Fleets of autonomous vehicles that are electric and shared, or "FAVES." While the field is fraught with acronyms describing the merging of these transportation revolutions, we will use FAVES throughout this report to conduct and focus our analysis on the social equity opportunities and challenges. Based on our analysis, combining these technologies

into FAVES gives us the best opportunity to secure benefits like cleaner air, cost savings, and improved mobility for marginalized communities.[7]

While FAVES are likely to produce societal benefits, questions still remain as to whether this "heaven" scenario will benefit all. Social justice advocates must ask whether the coming change will work for marginalized people like the poor, people of color, people with disabilities, and the elderly. Will these revolutions help solve inequality and injustice and put our transportation system on an equitable, sustainable, and just path? Or will they reinforce the unequal structures in our society and make marginalized groups like people of color and the poor worse off?

Even FAVES—on their own—are not guaranteed to fairly distribute the transportation benefits and burdens across all communities, especially marginalized populations. We must prioritize and implement equity into how FAVES are designed, deployed, and regulated. While many impacts of FAVES on marginalized communities remain unclear, what is certain is that without interventions, autonomous vehicles—in an unregulated market—are very likely to only benefit some, reinforce inequality, and potentially make marginalized communities worse off.[8] Only equitably deploying FAVES in a manner that prioritizes and enhances walking, biking, and public transit can steer us towards an "equity heaven" in which marginalized people experience improved mobility, better health, and greater economic opportunity.[9] Such a future, we should note, will benefit our whole society in addition to marginalized communities.

> ***Without interventions, autonomous vehicles—in an unregulated market—are very likely to only benefit some, reinforce inequality, and potentially make marginalized communities worse off.***

This report's policy recommendations are intended to secure a path towards an "equity heaven" future. With the three transportation revolutions rapidly advancing, we must act now to lay the groundwork to safeguard our most marginalized people.

What Problems Must These Revolutions Fix?

1) Transportation and Environmental Injustices

The United States has a long, shameful history of discriminatory policies and practices like redlining, racial covenants, and unjust housing policies that specifically excluded communities of color from economic opportunities. The result was segregated communities, with Black and Brown communities pushed into areas with greater pollution and poorer environmental quality than Whites. This spatial segregation has also contributed to transportation injustices likes highway construction that divided inner-city communities of color, displacing residents, and destroying neighborhood economies. America's car-centric culture and infrastructure have also contributed to economic inequality. For example, the poorest 20 percent of Americans spend 40.2 percent of their income on transportation, mostly for private vehicle expenses, while the wealthiest 20 percent of Americans spend 13.1 percent.[10] Moreover, as cities rapidly redevelop and gentrify, rising housing costs are increasingly displacing low-income residents of color into the suburbs. As result, these populations have become more likely to live farther from social services and work, subjecting them to longer and less reliable commutes, negatively impacting their economic well-being and quality of life. These disproportionate burdens and benefits stem in part from marginalized communities' lack of representation at the decision-making table. Regional metropolitan planning organizations control the allocation of billions of dollars to transportation plans, yet the voting members of MPO boards often do not reflect their region's demographic diversity—often underrepresenting low-income communities, women and people of color.[11] If autonomous vehicles and their deployment are not designed with strong equity, sustainability, and community-driven principles, they will likely exacerbate these transportation injustices.

2) Growing Economic Inequality

The racial economic gap continues to widen and grow, as people of color are subjected to stagnating wages and higher rates of low-wage jobs and unemployment.[12] As a result, across the U.S full-time workers of color earn 23 percent less than their white counterparts, impacting their ability to build wealth, attain higher education, and purchase homes.[13] A lack of reliable transportation options prevents people from

accessing jobs, education, and other opportunities to escape poverty.[14] These existing economic injustices and structural barriers leave low-income people of color especially vulnerable in our quickly changing economy. As more and more jobs automate and require college degrees, marginalized people will not be prepared with the skills and education they need to keep up. The widespread deployment of autonomous vehicles in place of truck drivers, transit operators, and delivery service workers, would disproportionately harm certain ethnic groups. In 2012, the U.S. Bureau of Labor Statistics reported that 15 percent of Black people and 17 percent of Latinos people work in production, transportation, and material moving jobs, compared to only 12 percent of Whites.[15] Without measures to mitigate harmful impacts, autonomous vehicles replacing driving jobs would certainly exacerbate this growing economic inequality.

If autonomous vehicles and their deployment are not designed with strong equity, sustainability, and community-driven principles, they will likely exacerbate these transportation injustices.

3) Technology is Outpacing Regulation

New transportation technologies have been developing so quickly that, in many cases, regulation has not been able to keep up and adequately protect the public, especially in a manner that guarantees a fair distribution of benefits and burdens. Lessons and challenges from how the shared mobility industry (e.g. Uber, bike-share, scooter-share, etc.) has rolled out give us a strong indication of how personal autonomous vehicles and FAVES can perpetuate transportation disparities and drive deeper social and economic inequality. While some cities are beginning to brace themselves for major changes by developing principles and policies around new forms of mobility,[16] we believe that there is still much work to do to protect marginalized populations through regulations and policy interventions.

4) Congestion, Sprawl, and Auto Dependency

For too long, our transportation system has prioritized the movement of cars over people. Without smart, proactive regulations anchored in sustainability and equity, the advent of the autonomous vehicle will only further cement America's car culture and widen inequality. If single-occupancy, individually-owned autonomous vehicles become a mainstream mobility option in urban areas, this would likely increase traffic congestion, increase pollution, and make public transit less competitive, resulting in decreased quality, service, and ridership—all of which would disproportionately harm transit-dependent marginalized people first and worst.[17]

How Do We Make These Revolutions Work for People?

1) Put Marginalized People First

Equity must be a central focus in the research, development, and deployment of FAVES and other forms of autonomous vehicles to ensure that these emerging mobility services meet the needs of all marginalized groups. To produce meaningful equitable outcomes, all sectors pushing autonomous vehicles forward must embrace diversity, equity, and inclusion. Additionally, marginalized community members must have a seat and a voice at the decision-making tables across all sectors, whether that's the private sector, the public sector, or universities. For example, we need a fair and accurate representation of low-income people, communities of color, the elderly and people with disabilities on transportation decision-making bodies such as city, county and regional transportation boards and commissions. The people closest to the pain must be closest to the solutions. While this report has a major focus on capturing benefits for low-income communities of color due to The Greenlining Institute's mission of bringing opportunities to historically disenfranchised communities, we must also place a strong emphasis on the need to improve the mobility and lives of other marginalized populations, such as the elderly and people with disabilities. All marginalized populations must be good allies to one another as we face dramatic changes in our transportation system.

> ***We must seize this opportunity to create a transportation system that is rooted in people and promotes vibrant, healthy, and clean places for people to live, work and play.***

2) Reclaim our Streets for People, Not Cars

Momentum, research, and investments in autonomous vehicle technology present an enormous opportunity to reimagine and revolutionize mobility and the places where we live. We must seize this opportunity to

create a transportation system that is rooted in people and promotes vibrant, healthy, and clean places for people to live, work and play. To truly prioritize people over cars, FAVES and other forms of autonomous vehicles must support a vision of sustainability and equity that puts walking, biking, and transit first.

3) Practice Mobility Equity

FAVES and autonomous vehicle technology must support and contribute to creating a just and fair transportation system. Therefore, the development, deployment, and regulations around all forms of autonomous vehicles must be anchored in the three goals of mobility equity:

- Transportation equity: Increase access to high-quality mobility options for marginalized groups, such as low-income people, communities of color, the elderly and people with disabilities.
- Environmental equity: Reduce air pollution and improve health outcomes for marginalized people.
- Economic equity: Enhance economic opportunities for marginalized people.

To ensure these three mobility equity goals guide the development and deployment of autonomous vehicles, policymakers, transportation planners, and decision-makers can leverage our Mobility Equity Framework's equity indicators in the development of principles, regulations, and policies. At this point there's no stopping autonomous vehicles. However, we must direct the development and deployment of autonomous vehicles into the form of FAVES while supporting a walking, biking, and transit-first vision to the maximum extent possible. With strong policy interventions we can leverage this momentum as an opportunity to create a more equitable transportation system. In this report, we utilize the Mobility Equity Framework's 12 equity indicators provided below as the lens to examine the potential equity impacts of autonomous vehicles and FAVES across a wide variety of issue areas. Along with this analysis, we provide equity-focused policy recommendations intended to maximize the benefits and minimize the harms of this transportation technology on marginalized populations. Many of the policy recommendations are not specific to autonomous vehicles or FAVES, because this technology has such wide implications and its impacts are so closely tied to other fields (e.g. land use, job loss, internet access). Therefore, we recognized a need to discuss and make recommendations in other areas to provide a complete view of how autonomous vehicles will affect the lives of marginalized populations. The recommendations provided below are a high-level overview of the more exhaustive and detailed list of equity-focused policy recommendations that are presented in full detail in the "In-Depth Analysis of Equity Issues and Policy Recommendations" section of this report.

Equity Recommendations

GOAL #1: Increase Access to High Quality Mobility Options for Low-Income People of Color

1) Affordability

FAVES and other forms of autonomous vehicles must contribute to creating a transportation system that is affordable to all people, but particularly marginalized people.

- Impose progressive, equitable fees on personally-owned autonomous vehicles and direct the resulting revenue towards subsidizing trips of low-income people and towards financing community-driven

walking, biking, and transit projects in marginalized communities.

- Explore how public sector innovation in driverless buses and rail can use cost savings to reduce transit fares for low-income individuals (while requiring Just Transition processes and retraining programs for transit operators).

2) Accessibility

FAVES operators must eliminate physical, financial, technological, cultural, and language barriers that prevent marginalized populations from accessing their services.

- Ensure operators use best practices for creating equitable access, including collaborating with marginalized communities (e.g. low-income, people of color, the elderly, people with disabilities, English learners, etc.) in the design, implementation, and evaluation of their services.

- Expand low-income peoples' access to banking, smartphones, and high-speed internet or provide payment and internet alternatives.

3) Efficiency

FAVES and other forms of autonomous vehicles must support the shared and efficient use of vehicles, lanes, curbs, and land, while prioritizing and meeting the needs of marginalized communities.[18]

- Operators should "right-size" FAVES by using the appropriate vehicle size to meet the mobility need and ensure their operations prioritize sustainable transport like walking, biking, and public transit.

- Impose progressive, equitable fees on personally-owned autonomous vehicles to fund walking, biking, and transit projects.

- Ensure design and implementation of "smart city" infrastructure and Mobility-as-a-Service technologies use equity best practices like collaboration with communities who experience barriers to mobility.

4) Reliability

FAVES must enhance and prioritize the reliability of sustainable modes of transport like walking, biking, and public transit in marginalized communities and must help fill mobility gaps.

- Ensure FAVES provide round-the-clock service in and/or to areas poorly served by mass transit where residents work late-night shifts.

- Provide real-time arrival information of FAVES in multiple formats to ensure accessibility for non-English speakers and people with disabilities.

5) Safety

FAVES and other forms of autonomous vehicles must enhance personal and public safety for all people, but particularly for marginalized people.

- FAVES must prioritize the of safety of bicyclists, pedestrians, and passengers, and promote safer roadways particularly in low-income areas that experience disproportionate traffic-related injuries and

deaths.

- Use equity best practices like collaborating with marginalized communities in finding solutions to harassment, profiling, privacy, surveillance, and cyber security concerns with FAVES and their operations.

GOAL #2: Reduce Air Pollution in Low-Income Communities of Color

6) Clean Air & Positive Health Impacts

FAVES and other forms of autonomous vehicles must cut transportation-related pollution and promote healthy environments, particularly in marginalized communities.

- Prioritize active, healthy modes such as walking, biking, and zero-emission public transit in marginalized communities overburdened by air pollution, to the greatest extent possible.

- Require sustainable and ethical practices across the entire lifecycle of FAVES, including their manufacturing, energy sources, batteries, and disposal.

7) Reduction in Greenhouse Gas Emissions

FAVES and other forms of autonomous vehicles must decrease contributions to climate change.

- Require autonomous vehicles to be electric, promote sharing, and discourage private autonomous vehicle ownership, particularly in marginalized communities.

8) Reduction in Vehicle Miles Traveled

FAVES and other forms of autonomous vehicles must prioritize shared vehicles and efficient use of lanes and curbs in a manner that promotes dense land uses, particularly in marginalized communities.

- Create and implement equitable VMT fees on personally-owned autonomous vehicle that are waived/reduced for low-income individuals and use revenue to fund walking, biking, and transit projects with prioritization in marginalized communities.

- "Right-size" FAVES based on community needs and geographic context.

- Use equity best practices to create and implement anti-displacement measures and dense land use policies to protect against the displacement of marginalized communities.

GOAL #3: Enhance Economic Opportunities in Low-Income Communities of Color

9) Connectivity to Places of Employment, Education, Services, and Recreation

FAVES must be operated in an equitable manner to improve connectivity and mobility, particularly in marginalized communities underserved by transportation options.

- Integrate FAVES with Mobility-as-a-Service mobile apps to fill transportation gaps (for example, by providing "first and last mile" access to transit hubs) and incentivize the use of walking, biking, public transit, and high-occupancy FAVES among populations with barriers to mobility.

10) Transportation-Related Employment Opportunities

FAVES and autonomous vehicle companies must generate jobs and related training to mitigate the impact on workers displaced by driverless vehicles.

- Create policies and programs to prepare the workforce for an automated economy, expand the social safety net, and support displaced workers through retraining programs and Just Transition processes.
- Prioritize hiring low-income individuals and other populations with barriers to employment.
- Conduct job trends assessments and ensure that high-quality jobs are available at the end of re-training pipelines.

11) Fair Labor

FAVES and autonomous vehicles companies should improve job quality, workforce diversity, and promote equity and inclusion among low-income individuals and others with barriers to employment.

- Use equity best practices like strengthening protections for union organizing, develop and implement high-road[19] strategies and strong labor standards within the autonomous vehicle sector, and ensure high-road labor standards for independent contractors.

12) Inclusive Local Business & Economic Activity

FAVES and other autonomous vehicle companies must be operated in a manner that provides community benefits to marginalized communities.

- Use equity best practices like enhancing local economic development, contributing to anti-displacement measures, hiring local individuals with barriers to employment, and buying goods and services from small, minority-owned and women-owned businesses.
- Establish community/cooperatively-owned business models of FAVES and partner with clean energy co-ops, retail centers, affordable housing, and public transit agencies.

Every community has varying mobility needs based on local demographics and geography, which will require policy interventions for autonomous vehicles that are adapted and tailored to these specific needs. In urban areas, high-occupancy FAVES will likely be more appropriate as opposed to rural areas that may only need lower-occupancy FAVES. Regardless, all forms of autonomous vehicles must be analyzed based on equity outcomes in low-income communities of color and other marginalized populations. Furthermore, communities must be actively involved in the decision-making processes regarding the size, scale, and use of all forms of autonomous vehicles to ensure that these services meet communities' specific mobility needs.

Future Research Needs

Much more research is needed on FAVES and autonomous vehicles more broadly. However, in the context of equity impacts and autonomous vehicles, we have narrowed down these four main topics with particularly large research gaps that will require much deeper examination:

1. Equity Impacts of FAVES

Our literature review of the equity implications of the future of transportation illuminated the limited and siloed nature of current research on mobility, equity, and the three transportation revolutions. While it is predicted that autonomous vehicles will be deployed on a large scale, the self-driving technology is still under development, making it very difficult to draw clear conclusions around the equity impacts. Because this information is especially limited on the equity impacts of the three revolutions, more research will have to be completed to recommend more specific and detailed policies. We need additional research to inform governments on how to address the equity and sustainability implications of the future transportation technologies.

2. The Role of Cities and Transit Agencies

Across the country, only 38 percent of cities' long-range transportation plans mention autonomous vehicles, and only 30 percent mention the impact of Uber and Lyft.[20] If the public sector fails to innovate and be on the cutting edge of this quickly changing transportation landscape, personally-owned autonomous vehicles may draw riders off transit and cause a decline in transit quality and service—most harming low-income, transit-dependent folks. Much more research is needed around how cities and transit agencies can maximize the benefits of FAVES and autonomous vehicle technology, whether that's in the form of autonomously driven trains and buses, or as first and last mile connections to transit hubs. For the public sector to be a competitive player in the autonomous vehicle space, government must experiment with various regulatory levers, public-private partnerships, and equity pilot projects. It will be critical to understand how different sizes and scales of autonomous vehicles can meet community needs and fill transportation gaps across, urban, suburban, and rural areas.

If the public sector fails to innovate and be on the cutting edge of this quickly changing transportation landscape, personally-owned autonomous vehicles may draw riders off transit and cause a decline in transit quality and service—most harming low-income, transit-dependent folks.

There must also be a dedicated effort to analyze and evaluate pilot projects to measure the benefits and harms to marginalized communities. Cities and transit agencies who take advantage of these transportation innovations can leverage their permitting system and public-private partnerships to ensure maximal equity benefits, such as fair access and progressive pricing structures, targeted hiring practices, sustainability standards, and prioritizing pilot projects in low-income communities of color. Yet to produce these results, government and transit agencies must begin researching and developing policies and programs to assess how to utilize FAVES and autonomous vehicles to equitably improve their transportation systems. In addition, cities must require private companies to share data (while accounting for privacy concerns) to help inform the development of equitable policies.

3. Full Cycle Economics

As autonomous vehicles and FAVES continue to develop, we will need much more research and understanding to assess this technology's entire economic lifecycle and impact—from labor issues to how cities collect vehicle-related revenue. Many unanswered questions exist around which jobs and demographics are at risk of job loss due to automation, the types of jobs that will be created, and the anticipated timescale. Additionally, we need a continued evaluation of best practices to prepare our workforce for the changing economy, retrain displaced workers, and widen the social safety net. Research will also be needed to find new measures to make up for lost city and state revenues in parking fines and fees, gas tax revenue, and vehicle registration and licensing that may result from a widespread deployment of FAVES. Additionally, more research is needed to understand the detrimental economic equity impacts of the "hell" scenario of personally-owned autonomous vehicles, to provide support for directing our transportation system towards a future of FAVES.

Many unanswered questions exist around which jobs and demographics are at risk of job loss due to automation, the types of jobs that will be created, and the anticipated timescale.

4. Digital Redlining and Technological Development

Many disparities in access to shared mobility services result from a lack of technological access to smartphones and the internet—the digital divide, often exacerbated by policies sometimes called "digital redlining." While much of this is a result of high cost, internet providers are slower to upgrade infrastructure and internet speeds in low-income areas than in higher-income neighborhoods.[21] Without equity-focused policy interventions, these patterns will likely be replicated in the roll out of FAVES—and therefore more information and best practices are needed to counteract digital redlining. In addition, autonomous vehicles equipped with high-tech sensors and cameras may also pose a risk to people's privacy and security. This multitude of new information being collected on travel behavior could enable private companies or the government to target and further oppress marginalized communities. Much more research is also needed around how race interacts with the technological development of autonomous vehicles and artificial intelligence more broadly, to ensure that these technologies are designed to counteract biases and truly are accessible to all.

IN-DEPTH ANALYSIS OF EQUITY ISSUES AND POLICY SOLUTIONS

Introduction

Transportation is undergoing three revolutions: 1) vehicle electrification, 2) vehicle automation, and 3) a widespread sharing of vehicle trips (also known as the pooling of vehicle trips or shared mobility).[22] These innovations are generating lots of excitement and investment. Many car makers and technology companies are developing electric, shared, and autonomous vehicles, in addition to apps and services that allow people to share rides in new ways. Over 40 companies around the world now have autonomous vehicle technologies under development and are competing to build and deploy fully autonomous fleets of taxis within the next five years.[23] Over the past few years, these revolutions have been developing independently— and on our roads we see more all-electric vehicles like Teslas and Chevy Bolts, increasing shared vehicle trips through services like Uber and Chariot, and self-driving cars being tested on city streets from Pittsburgh to Tempe. While these innovations have been deploying at varying degrees, we will need bold policy inventions to guarantee that these three technologies will develop together to create vehicles that are electric, shared, and autonomous.

We focus on directing autonomous vehicles into the form of FAVES because research indicates that the combined benefits of these technologies—along with increases in walking, biking, and transit use—have the greatest potential to improve mobility and eliminate negative externalities of transportation such as pollution and costly car ownership.[24] Future scenarios where only one individual revolution becomes widespread (e.g. only electric vehicles, only the sharing of trips, or only the automation of vehicles), result in shortcomings in terms of social equity and sustainability. For example, vehicle electrification of personal vehicles can reduce energy, carbon emissions, and air pollution if powered by clean energy

sources. Yet vehicle electrification without vehicle sharing perpetuates increased vehicle miles traveled and car-dependency and thus likely leads to more congestion and sprawl in cities and suburbs. Widespread autonomous vehicle technology can improve road safety and efficiency and reduce operation costs, yet autonomous vehicles on their own will eliminate driving jobs and may induce more vehicle trips, adding to congestion and sprawl. Widespread sharing of cars and trips can reduce car ownership and can help ease congestion if the seats in those cars are efficiently used. Yet if vehicles and trips are not shared efficiently nor electric, vehicle miles traveled can increase, leading to more congestion and emissions—impacts likely to be felt most severely in low-income communities of color. For these reasons listed above, personally-owned autonomous vehicles that fail to be shared or electric cannot be allowed to dominate the market because of these disastrous consequences for equity and the environment. To the maximum extent possible, autonomous vehicles must be deployed in the form of FAVES.

Personally-owned autonomous vehicles that fail to be shared or electric cannot be allowed to dominate the market because of these disastrous consequences for equity and the environment. To the maximum extent possible, autonomous vehicles must be deployed in the form of FAVES.

FAVES may take many forms, depending on how they are regulated and incentivized. They can be deployed at different scales and the vehicles themselves can vary in size. For example, FAVES can be deployed in the form of high-occupancy transit or shuttles or can take the form of on-demand personal vehicles, like Uber and Lyft today. Ownership models may vary as well. FAVES may be owned and operated by private companies, public entities like transit agencies, a combination of the two, or owned by communities through cooperative models.

FAVES have great potential to provide improved, convenient, and affordable mobility that increases the safety and efficiency of our transportation system. However, we know that marginalized people, including people of color, the elderly, disabled and poor, will likely be locked out of the benefits that FAVES are expected to provide due to historical patterns of discrimination in transportation access and investments—coupled with the dynamics of who are likely to be early adopters of new technologies. In addition, FAVES services may fail to be accessible or suitable to the needs of all people, if the companies developing this technology are not diverse, equitable, and inclusive of marginalized people in their hiring practices. Therefore, we will need to adopt a wide range of equity-focused policy interventions to guarantee the benefits of FAVES reach all people.

In fact, even FAVES, if left unchecked, have the potential to deepen social inequities. We can look to existing shared mobility services like Uber, Lyft, car-share, and bike-share, as precursors. Some of these shared mobility services are infamous for their disproportionate use and access among White, educated, upwardly mobile individuals and lack of practices to provide fair physical, financial, technological, and cultural access to low-income people of color, the elderly, and people with disabilities. In the case of ride-hailing companies like Uber and Lyft, their business models provide independent contractor driver jobs that do not pay family-supporting wages,[25] do not provide employment benefits like health insurance or vacation and utilize bonus and incentive schemes that can be exploitive. Uber and Lyft have also made headlines as studies report that ride-hailing likely adds to congestion in urban areas and contributes to reduced transit ridership.[26] As a result, governments have been left scrambling to retroactively regulate the shared mobility industry. While personally-owned autonomous vehicles certainly would cause more inequitable and unsustainable outcomes than FAVES, the reality is that without policy interventions, even the benefits and burdens of FAVES will not be fairly distributed.

One of the largest threats of FAVES is the potential loss of driving jobs. Currently 4.1 million Americans make all or part of their living by driving buses, trains, trucks, taxis, etc.,[27] and many African-Americans, Latinos, and Native Americans rely on these jobs for wages.[28] Some of the most critical policy interventions we recommend in this report focus on mitigating the economic harms of FAVES on low-income people of color.

The reality is that without policy interventions, even the benefits and burdens of FAVES will not be fairly distributed.

To deliver the greatest equity outcomes, FAVES must also align with and support a transportation vision that prioritizes walking, biking, and mass public transit above single-occupancy vehicles. This vision can also be adapted to best suit the needs of suburban and rural communities—FAVES can provide better first and last mile access and replace gas- or diesel-powered buses that have low-utilization rates in less-dense areas. Additionally, we need a fundamental shift—to the maximum extent possible—towards dense, compact, connected, and equitable development that prioritizes people, not cars. To steer us towards that ideal scenario, we need transformational policy interventions that center equity and sustainability in transportation planning and decision-making.

To ensure these revolutions support a transportation vision that prioritizes walking, biking, and mass public transit over single-occupancy vehicles where feasible, we need bold policy interventions and fair business models that guarantee benefits in communities that need them most. We must plan and implement policy interventions now to ensure that FAVES contribute to a just and fair transportation system. Numerous researchers and practitioners have found many potential benefits of combining these technologies, but we have seen less of a focus on the implications for equity. In this report, we apply the principles and framework we established in "Mobility Equity Framework: Making Transportation Work for People" to the rapidly evolving three revolutions. We use the framework's 12 equity indicators to guide our equity-focused policy recommendations for how to shift us towards a FAVES future while maximizing benefits and minimizing harms of this innovation. While this topic can benefit from further research and scenario planning, we know that without equity-focused policy interventions guiding the development and deployment of FAVES, the benefits and burdens of this technology will likely not be equitably distributed. While the three revolutions represent exciting opportunities, the most urgent and critical transportation revolution we need is one that prioritizes sustainability and puts our neediest, most vulnerable individuals and communities in the driver's seat. Our transportation system must enhance mobility, health, economic opportunities, and quality of life for all people.

Equity-Focused Policy Recommendations

Identifying Community Needs

The equity-focused policy recommendations in this report reach beyond just FAVES and autonomous vehicles because of the wide-ranging implications of this transportation technology. The recommendations address a wide range of policy issues regarding mobility, environmental sustainability, health, and economic opportunities in low-income communities of color. It is important to note that these recommendations are not intended to be one-size-fits-all solutions. Every community varies greatly in terms of demographics, geography, and structural inequities, and therefore electric, shared, autonomous vehicles will present different opportunities and challenges based on the context.

To determine which equity-focused policy interventions are relevant, we must first learn the needs of a community through an inclusive, community-driven process. From start to finish, there must be a

dedicated process to meaningfully engage hard-to-reach stakeholders who encounter barriers to mobility, such as low-income people, the elderly, and people with disabilities. Meaningful community engagement requires a wide range of approaches and is resource-intensive. When transportation planning agencies lack the resources and expertise to do extensive outreach in hard-to-reach communities, this results in policies that fail to meet community needs, dilutes benefits, or even increases the likelihood of unintended, negative outcomes for vulnerable communities. A community mobility needs assessment should uncover which transportation modes or mobility options are appropriate for the community's specific needs and geographic context. We outline this process in the first step of our Mobility Equity Framework.

Depending on the context, local government, transit agencies, or community-trusted entities may want to convene stakeholders, including community members and leaders; community-based organizations; advocates for low-income residents, the elderly, and people with disabilities; business groups; and the mobility companies to inform the development of a clear set of principles. These principles must be rooted in community, equity, and sustainability, and outline standards that autonomous vehicles and other mobility technologies and services must follow. Before policies and regulations are established, it is critical to develop a clear vision of the mobility future that the community wants in order to hold autonomous mobility services accountable to those standards. For example, the San Francisco County Transportation Authority—in partnership with the San Francisco Municipal Transportation Agency—engaged stakeholders to develop 10 Guiding Principles that cover issues such as equitable access, sustainability, labor, data, transit, and collaboration.[29] They have since adopted these principles, which will "serve as a framework for evaluating these services and technologies, identifying ways to meet city goals, and shaping future areas of studies, policies, and programs."[30] The San Francisco County Transportation Authority has completed a final evaluation report of emerging mobility services which assesses how these services align with these 10 Guiding Principles. Following this, San Francisco's Municipal Transportation Agency utilized this evaluation tool to determine which scooter-share companies would receive permits for pilot programs based on their commitments to safety, equity, and other criteria. We are now upgrading our Mobility Equity Framework to recommend processes such as this as a best practice for community engagement and the evaluation of new mobility services.

In the following sections we use the 12 equity indicators from our Mobility Equity Framework to analyze how autonomous vehicles may potentially impact low-income people of color. Based on these 12 categories, we provide equity-focused policy recommendations outlining how to ensure the benefits and burdens of FAVES and autonomous vehicles are distributed fairly.

Mobility Equity Framework - 12 Equity Indicators

Goal #1
Increase Access to Mobility

1. Affordability
2. Accessibility
3. Efficiency
4. Reliability
5. Safety

Goal #2
Reduce Air Pollution

6. Clean Air and Positive Health Benefits
7. Reduction in Greenhouse Gases
8. Reduction in Vehicle Miles Traveled

Goal #3
Enhance Economic Opportunity

9. Connectivity to Places of Employment, Education, Services, & Recreation
10. Transportation-Related Employment Opportunities
11. Fair Labor Practices
12. Inclusive Local Business & Economic Activity

Goal #1 Increase Access to High Quality Mobility Options

Equity Indicators	Overview of Policy Recommendations
1. Affordability	**State / Local** • Ensure Healthy, Sustainable Mobility is the Cheapest Option • Require Equitable Fares for FAVES • Explore Public Sector Innovation **Federal** • Reduce Commute Costs
2. Accessibility	**State / Local** • Expand Physical Access • Expand Financial Access • Expand Technological Access • Expand Cultural Access • Engage Community in Addressing Access Barriers **Federal** • Expand Financial Access • Expand Technological Access • Expand Access for People with Disabilities
3. Efficiency	**State / Local** • Prioritize Walking, Biking, and Transit • Maximize High-Occupancy FAVES • Right-Size FAVES to Geographic Context and Trip Type • Ensure Technology Promotes Equity • Utilize Data
4. Reliability	**State / Local / Federal** • Ensure Dependability
5. Safety	**State / Local** • Safety of Autonomous Vehicle Technology • Safer Infrastructure • Safety of Vulnerable Passengers • Safety from Street and Police Harassment and Violence • Emergency Evacuations

GOAL #1: Increase Access to High-Quality Mobility Options for Low-Income People of Color

Historically, local, regional, and state transportation plans and investments across the country have failed to adequately address the mobility needs of low-income communities of color, resulting in racial and ethnic disparities in transportation-related burdens like pollution and benefits such as increased mobility. Additionally, communities of color have even been considered an obstacle to highway projects in the U.S., leading to displacement and the destruction of their neighborhoods. Today, transportation plans and investments that do not meaningfully address inequities within the system will continue to reinforce unequal land-use patterns that perpetuate racially segregated geographies and contribute to disproportionate health and economic impacts.

Due to these inequities, low-income people of color often have much less access to high-quality mobility options that are affordable, efficient, reliable or safe, than their White, wealthier counterparts. A lack of access to high-quality mobility options in turn limits the economic opportunities available to those who need them most. FAVES have the potential to increase access to high-quality mobility to all but only if they are guided by community, equity, and sustainability.

FAVES have the potential to increase access to high-quality mobility to all but only if they are guided by community, equity, and sustainability.

1. AFFORDABILITY

Affordability refers to the cost of transportation, yet what constitutes affordable will vary by location and transportation mode.

The poorest 20 percent of Americans spend 40.2 percent of their take-home pay on transportation (mostly for private vehicle expenses), while the wealthiest 20 percent of Americans only spend 13.1 percent.[31] Lower transportation costs can particularly benefit low-income people, and free up more disposable income to spend on other essential costs, such as housing and food.

In general, research on self-driving and electric vehicles finds that these technologies can lead to cheaper mobility because of cost-savings associated with not having to pay for operation, gas, and maintenance. FAVES in place of vehicle ownership can significantly reduce household transportation costs, but car shedding is increasingly difficult for low-income households who are being displaced out of transit-accessible urban areas due to skyrocketing housing costs. While actual FAVES vehicles will likely be more expensive than traditional vehicles because of the electric and autonomous self-driving technology, both costs are rapidly declining.[32] Researchers from Rethink Transportation estimate that the overall transportation costs associated with FAVES are likely 10 times less than those of individually owned and operated vehicles, saving the average American family more than $5,600 per year in transportation costs—or equivalent to a wage increase of 10 percent.[33]

While the lower costs associated with FAVES are generally a good thing, cheaper vehicle travel can potentially lead to some negative outcomes. For example, people may be incentivized to travel farther distances which could promote dispersed, unsustainable land use patterns. Another potential impact of travel costs of FAVES may be reduced public transit ridership and potential job loss. Some experts caution that FAVES becoming such a cheap mobility option could induce cities to switch from subsidizing public transit to subsidizing FAVES owned by private companies—especially for low-capacity local transit service.[34] Some argue that this competition for ridership may push more public transit agencies to invest in self-driving technology, as we've seen in the case of Florida's Jacksonville Transportation Authority.[35] Labor costs can account for as much as 80 percent of transit operating costs,[36] and with no need for drivers, transit agencies could potentially reduce transit fares significantly. While cheaper transit fares can benefit low-income individuals, this self-driving technology does not come without consequences to other populations. Eliminating transit operator jobs can greatly impact people of color occupying those positions, since people of color disproportionately depend on public sector jobs compared to White people[37] (more information on mitigating job loss in the following sections).

Other researchers predict that in dense urban areas, instead of replacing transit, FAVES will more likely act as feeders to major, high-capacity public transit routes.[38] While much speculation continues about whether FAVES will complement or compete with public transit, most researchers agree that more affordable transportation represents a major benefit of this technology. However, without equity-focused policy interventions, there is no guarantee that low-income households will be able to access the cost savings benefits of FAVES. This is especially true if FAVES are primarily operated by private companies, which typically target higher-income markets because of perceived risks related to lack of demand in low-income areas and increased liability and damage to assets.[39] These companies will therefore need to be required to provide fair pricing and access for low-income people.

FAVES can certainly help reduce overall household transportation costs, but FAVES must be integrated into a transportation vision focused on improving the quality of the transportation modes that low-income people rely heavily on: walking, biking, carpool, and transit.[40] We need robust investments to improve the quality of these more sustainable and affordable options and make them more attractive to individuals. In addition, there must be smart and fair pricing structures on personally-owned autonomous vehicles to incentivize people to choose healthier, more sustainable modes such as walking, biking, public

transit, and high-occupancy FAVES (like buses and shuttles) and discourage usage of low-occupancy vehicles.

Recommended Policy Interventions

FAVES and other forms of autonomous vehicles must contribute to creating a transportation system that is affordable to all people, but particularly marginalized people.

At the State and Local Level

Ensure Healthy, Sustainable Mobility is the Cheapest Option

- Charge personally-owned autonomous vehicles through road pricing which could include road tolls, cordons,[41] congestion charges, occupancy-based pricing, carbon pricing,[42] or other similar fees. Fee should be designed to discourage over-use of single-occupancy or personally-owned autonomous vehicles while ensuring that users pay to use public roads. The fees must be significant enough to encourage a large shift to vehicle sharing or other modes.
    - Require fees to be progressive instead of regressive, so as not to overburden low-income people.
    - Revenues generated from fees should subsidize FAVES trips for low-income individuals or should be invested in walking, biking, or transit operations and infrastructure.[43]
    - Require engagement of marginalized communities in the design, implementation, and evaluation of any road pricing mechanisms. Refer to Vancouver's best practices.[44]

Require Equitable Fares for FAVES

- Require private and public FAVES operators to provide free or discounted fares for low-income people in a manner that does not compete with more sustainable modes like walking, biking, and transit.
- Implement anti-monopoly policies and improve competition between FAVES companies.
- Impose price regulations to prevent unfair price discrimination between different consumers.

Explore Public Sector Innovation

- Examine whether and how public transit agencies deploying driverless buses and rail can keep their prices competitive with FAVES operated by the private sector.
    - Prioritize expansion of autonomously driven transit services in areas underserved by public transit.
    - Require a Just Transition framework and retraining programs for public transit operators who lose their jobs to automation (refer to detailed mitigation strategies under the "Transportation-Related Job Opportunities" section).

At the Federal Level

Reduce Commute Costs

- Provide pre-tax commuter benefits/incentives for low-income people who walk, bike, or ride in high-occupancy FAVES to get to work.

2. ACCESSIBILITY

Accessibility refers to peoples' ability to access FAVES. This means that they are physically accessible (available in neighborhood, accessible to people with disabilities and the elderly, accessible to people with various cultures/languages, and accessible without the need for banking, smartphones, or internet).

In the United States, cities, towns, and roads are largely built around the personal automobile, yet nearly 7.5 million households do not have access to a private automobile. And of those households, 700,000 also do not have access to public transit.[46] Unsurprisingly, those with poor access to transportation options are overwhelmingly low-income, people of color, the elderly, adolescents, people with disabilities or people in rural areas. For example, in 2015, only 6.51 percent of White households did not have access to a car, compared to 19.71 percent of Black households.[47] The mobility of the elderly and people with disabilities is also restricted due to inadequate transportation options and is further complicated by a lack of first mile and last mile connections from public transit hubs to peoples' destinations. The Surface Transportation Policy Project reports that half of non-driving seniors stay at home on any given day due to a lack of transportation options.[48] Adults with disabilities are twice as likely as those without disabilities to have insufficient transportation options.[49] Lack of accessible, affordable, integrated transportation options prevent the elderly and people with disabilities from fully participating in society and limits their opportunities. With a quickly aging population and 16 percent of Americans having difficulties in physical functioning,[50] society needs equitable mobility options that are accessible to all.

Barriers to mobility also represent an economic justice issue. According to a Harvard University study,

a person's commute time is the most significant factor in their chances of escaping poverty.[51] Not only does a lack of transportation options limit a person's access to jobs and education, it also impedes their access to healthcare, social services, and recreation—contributing to poor health outcomes and a lower quality of life.

Not only does a lack of transportation options limit a person's access to jobs and education, it also impedes their access to healthcare, social services, and recreation—contributing to poor health outcomes and a lower quality of life.

Low-income individuals, the elderly, adolescents, and people with disabilities can gain the most from FAVES because these groups tend to have the lowest mobility. However, without policy interventions, marginalized populations will most likely face similar barriers to accessing FAVES, based on the present-day barriers preventing marginalized people from accessing shared mobility services.[52] For example, most shared mobility services like Zipcar (car-sharing) and Uber/Lyft (ride-hailing) require a debit or credit card to use them. This poses a significant barrier to low-income and undocumented individuals who do not have access to credit or banking services. In the U.S., nine million adults are unbanked and 43 million adults are underbanked – most often low-income individuals or people of color.[53] Moreover, the Pew Research Center reported that "in low-income households, around three-in-ten adults do not own a smartphone and half do not have internet or a computer"[54]—largely due to high costs. The high costs and poor quality of internet service stems from having very few internet providers in the U.S.; this lack of competition fails to incentivize companies to lower their prices or improve their speeds.[55] While it is important that FAVES and other shared mobility services provide alternative options for individuals without smartphones or banking—we also need to improve access to high-speed internet and banking in these communities.

Shared mobility companies have also been criticized for failing to comply with the Americans with Disabilities Act. Uber has been hit with multiple lawsuits asserting that the company discriminates against blind and wheelchair-using passengers by not providing fair access to riders with disabilities.[56] Additionally, shared mobility companies simply "providing" ADA compliant services does not mean they provide equivalent services to disabled patrons. If companies define this as having a few ADA compliant vehicles yet users with disabilities still experience longer wait times and inadequate levels of service, this is not fair access. All users must have equal access times and quality of service.

In addition to physical, financial, and technological barriers, some shared mobility services do not provide equal access across race and ethnicity. For example, a study on Uber and Lyft services showed that Black passengers faced 35 percent longer wait times and were twice as likely to have their rides cancelled than White passengers. Unfortunately, the racial bias and discrimination apparently practiced by some Uber drivers will not simply end once drivers are made obsolete.

There is evidence that algorithms and artificial intelligence can perpetuate racism and sexism, because they learn and replicate society's biases in their own behavior.[59] For example, it has been documented that artificial intelligence has much more difficulty recognizing the faces of women and darker-skinned people than White males, because the algorithms are trained with data that contains images of more White men.[60] Waze, the navigation app used by many taxis and ride hailing drivers, has an algorithmic mapping feature that alerts users to high crime areas. While this feature is only available in some countries and undoubtedly can have certain benefits, critics argue that this can lead to inequitable access, the stigmatization of certain neighborhoods, and economic harm to businesses and property values. If the algorithms and artificial intelligence essential to FAVES are not designed to counteract biases and address downstream inequitable impacts, this could further widen existing racial disparities in who can easily access these mobility services. Moreover, FAVES operators would have little incentive to provide

equitable access to their services in low-income areas, because of perceived high risks and perceived limited financial returns. [61] This is especially true in low-income suburban and rural areas, given that shared mobility business models largely rely on density.

We need comprehensive solutions to ensure that low income people of color, the elderly, adolescents, and people with disabilities can access FAVES. The same solutions and best practices in helping all people overcome the financial, physical, cultural, language, and technological barriers to using shared mobility services must be replicated as FAVES become integrated into our transportation system.

Recommended Policy Interventions

FAVES operators must eliminate physical, financial, technological, cultural, and language barriers that prevent marginalized populations from accessing their services.

At the State or Local Level

Expand Physical Access

- Ensure FAVES' compliance with the equivalent service standard under the Americans with Disabilities Act.
    - Co-design these accessibility features with the disability community to meet their needs.
- Require FAVES operators to service areas underserved by public transportation options as a condition for using city roads.[62] The service must respond to requests with equal access times and quality of service to all users, regardless of location, income, disability, etc.
- Explore public-private partnerships between FAVES, local governments, and transit agencies to efficiently service high-cost, under-utilized public transit routes.[63]
- Ensure algorithms provide equal service coverage regardless of rider characteristics like race, income, disability, location, etc.
- Require public and private FAVES operators to ensure accessibility to all people by providing fully accessible vehicles, including wheelchair access, in the most integrated settings, compliance with ADA, anti-discrimination, and communication requirements, child seats, and other accommodations.

Expand Financial Access

- Require multiple payment options (e.g., cash, transit cards, PayNearMe) to ensure access for unbanked and under-banked individuals.

Expand Technological Access

- Require alternative options to book FAVES (e.g., telephone concierge service, SMS text access, etc.) that do not require a smartphone.[64]
- Provide free, high-speed Wi-Fi in public spaces, particularly in low-income areas underserved by transit. Wi-Fi must be fast enough to provide reliable service for mobile applications.

Expand Cultural Access

- Use equity best practices to develop engagement and educational programs that help low-income communities of color to familiarize themselves with FAVES technology and services.[65]

- Require operators to provide multiple language options on the website, mobile application, and customer support services in areas where languages other than English are prevalent.

Engage Community in Addressing Access Barriers

- Require community engagement in mobility planning and decision-making to ensure that the services are accessible to populations with barriers to mobility and meet community-identified needs[66] (e.g. Austin residents voting on bike-share dock locations.[67])

- Require operators to continuously assess and improve their level of service in communities that face barriers to access.[68]

At the Federal Level

Expand Financial Access

- Improve access to financial services for low and moderate-income people. For a detailed list of policy recommendations, refer to the "Banking the Poor: Policies to Bring Low-Income Americans Into the Financial Mainstream" by The Brookings Institute.[69]

Expand Technological Access

- Improve access to internet for low and moderate-income people by:

    - Encouraging increased competition between internet providers to lower prices and improve quality, especially in rural areas. For a detailed list of policy recommendations, refer to the article "Want Real Choice Broadband? Make These 3 Things Happen."[70]

    - Expanding the Federal Communications Commission's Lifeline program for internet access for low-income households.

Expand Access for People with Disabilities

- Require FAVES operators to collaborate with stakeholders from the disability community to mandate all shuttles and buses to be fully accessible and a proportion of passenger-vehicle sized FAVES to be fully accessible. For a detailed list of features, refer to the Fully Accessible Autonomous Vehicle Checklist by the Disability Rights Education & Defense Fund.[71]

    - Provide subsidies to fund accessible vehicles within fleets using the revenue collected from personally-owned autonomous vehicles.

3. EFFICIENCY

Efficiency refers to time spent in traffic, travel times, and wait times

America's auto-centric transportation system wastes valuable time and money, and especially impacts low-income communities of color who experience even longer commutes as they are increasingly priced

out of cities, away from opportunity and services. The average commuter in America spends 42 hours a year stuck in traffic,[72] and spends 17 hours a year looking for parking.[73] A report by the Centre for Economics and Business Research and INRIX, Inc. found that if gridlock persists, by 2030 Americans will have wasted $2.8 trillion in lost time and fuel.[74] Even more absurd, cars sit parked and unused for 95 percent of their owners' waking hours.[75] Everyone benefits from transportation options that decrease congestion, travel times, and the need for parking. The solution to increased efficiency is congestion pricing and greater mobility options—not more highway lanes.

> ***The solution to increased efficiency is congestion pricing and greater mobility options—not more highway lanes.***

Many practitioners and researchers find that FAVES will increase efficiencies in our transportation system, and it is estimated that the widespread sharing of vehicles could reduce vehicle ownership by up to 43 percent and increase travel per vehicle by up to 75 percent.[76] However, this increased travel per vehicle must be shared in order to avoid increased congestion due to single-occupancy autonomous vehicles crowding our roads. The sharing of vehicle trips may also be spurred by the rise of Mobility-as-a-Service, or MaaS, which is the concept of integrating the planning, booking, ticketing, and payment across all public and private transportation and mobility providers into a single mobile app. It can be customized to incentivize riders to choose modes that provide the greatest sustainability, health and equity benefits. Researchers anticipate that as fewer cars travel more miles, the number of passenger vehicles in the U.S. will drop from 247 million to 44 million—which would allow for the repurposing of many parking spaces and lots for other uses, ranging from bike or transit lanes to public spaces.[77] Vehicles that are in near-constant use will decrease the demand for parking, which would reduce parking congestion and costs.[78] Additionally, it is anticipated that the interconnected technology between autonomous vehicles and "smart city infrastructure" such as traffic signals and street lights, can improve traffic flows. Vehicles and infrastructure can be equipped with Wi-Fi, video cameras, and audio sensors, but along with this increased data-gathering comes rising fears of a surveillance state and privacy concerns.[79] We must have an open public discussion around which types of data will be collected and why, to prevent interference with people's civil liberties.

To optimize efficiency, FAVES should be deployed in many forms and be right-sized based on geography and the needs of the target community. Importantly, this dramatic drop in vehicle ownership will be more applicable to dense urban settings and may be less in suburban and rural settings.[80] However, policies should also seek to densify suburban and rural areas, with the goal of maximizing the areas where autonomous vehicles can be deployed in shared form. FAVES could shorten travel times for commuting, errands, or recreation and thus increase work productivity and the time available to spend with family and friends. For individuals who live far from job centers due to unsustainable and inequitable land use, FAVES have the potential to open doors to new economic opportunities by making longer commutes easier. The all-electric vanpool operator Green Commuter has already demonstrated this promise by connecting low- and middle-income workers in the Los Angeles region to a manufacturing company, an 86 mile roundtrip from their disadvantaged community. Although not ideal, these kinds of long-distance commutes will only become easier and safer once the autonomous technology is combined with electric and shared vehicles. However, long-distance commutes run counter to increased efficiency and must be avoided through road pricing mechanisms and dense land use development (specific recommendations under "Reduction in Vehicle Miles Traveled" section). To ensure all people experience increased efficiency, a range of policy interventions must be in place.

Recommended Policy Interventions

FAVES and other forms of autonomous vehicles must support the shared and efficient use of vehicles,

lanes, curbs, and land, while prioritizing and meeting the needs of marginalized communities.

At the State or Local Level

Prioritize Walking, Biking, and Transit

- Ensure that FAVES complement instead of compete with walking, biking, and public transit/mass mobility.
    - Ensure that personal and high-occupancy FAVES do not duplicate existing public transit routes through geo-fencing (setting geographic boundaries), and instead serve as feeders to public transit hubs.
    - Charge fees on FAVES that operate along transit routes.
    - Subsidize first and last mile trips of FAVES that pick up and drop off at transit stations.
    - Create transit-only lanes in high-density corridors.
    - Designate specific FAVES pick up and drop off zones through geo-fencing. This guarantees that they do not impede pedestrians, bike lanes, wheelchair accessible van spaces, curb ramps, public transit or emergency vehicles.

Maximize High-Occupancy FAVES

- Prioritize and maximize the use of high-occupancy FAVES where feasible by:
    - Implementing road pricing for privately-owned autonomous vehicles to encourage the sharing of vehicles and efficient use of street space. For specific strategies to implement in an equitable manner, refer to the road-pricing recommendations under the "Affordability" section.
    - Establishing dedicated lanes for high-occupancy FAVES that are prioritized along routes that primarily serve low-income areas underserved by transit. Dedicated lanes ensure faster trips for shared trips than solo driving and free up space for other forms of transportation like high-occupancy transit or bike lanes.[81]
    - Implementing scaled permit fees for FAVES operated by private companies. For example, a scaled permit fee that encourage shared rides and adjust to provide discounts or incentives based on desired outcomes, such as percentage of rides provided to low-income communities and percentage of rides that are shared.

Right-Size FAVES to Geographic Context and Trip Type

- Implement incentives or fees to encourage FAVES to be high-occupancy where feasible. Examples include:
    - High-occupancy FAVES that fill transportation gaps in urban areas with poor transit coverage.
    - Micro-transit/shuttle FAVES that serve as feeders to public transit hubs in the suburbs.
    - Vanpooling/ridesharing FAVES in rural areas, such as Green Raiteros and Van y Vienen.[82]

- Right-size FAVES based on the specific trip types (first and last mile connections, daily commuting, shopping/errands, recreation, etc.)

- Implement incentives or fees to encourage industry to develop more autonomous buses and shuttles, as opposed to lower-occupancy vehicles.

Ensure Technology Promotes Equity

- Develop programs that partner Mobility as a Service mobile apps with FAVES operators, cities, transit agencies, affordable housing developments, major employers, etc. to improve efficiency while addressing equity and sustainability outcomes.[83]

    - Engage populations with barriers to mobility such as low-income people, the elderly, and people with disabilities in the design of Mobility as a Service, and find solutions to physical, financial, technological, and cultural barriers. Work with the disability community to ensure apps are accessible to people who are blind or low vision, Deaf or hard of hearing, or who have cognitive disabilities, and ensure websites/apps meet Web Content Accessibility Guidelines 2.0.[84]

    - Expand access to smartphones, cellular network, Wi-Fi, and electrical outlets in public transit stations and vehicles, with a priority in low-income areas that have transportation gaps.

    - Integrate multiple payment and booking methods for those without access to banking or smartphones, such as with LA Metro's "TAPforce."[86]

- Ensure that "smart city" infrastructure and the expanding "Internet of Things" (a network of connected vehicles, devices and other items that are embedded with software and sensors) improve efficiency while addressing equity and sustainability outcomes.

    - Ensure that this technology and data are publicly available and accessible to all communities, especially in those with barriers to mobility.

    - Experiment with how this technology can directly benefit low-income people, the elderly, and people with disabilities.

    - Engage communities in discussion around what types of data will be collected and how it will be used, to address privacy, surveillance, and hacking concerns.[87]

Utilize Data

- Require FAVES operators to share their data with public agencies to help understand the full scope of impacts. Data should be standardized to allow regulators to continuously improve FAVES efficiency, pollution reduction, safety, and equitable access in marginalized communities. Refer to SCAG's Future Communities Initiative for detailed policy recommendations for managing data and new technologies.[89]

4. RELIABILITY

Reliability refers to the consistency, variability, and predictability of travel times and wait times

Unreliable transportation particularly impacts transit-dependent individuals, who face inconsistent travel times and limited hours of service. Dependable mobility is critical to getting to school and work on time,

not having to wait for late buses, or not having to deal with broken-down cars. For low-income service workers who need late-night transit service to connect to second and third shift jobs, this lack of reliable transportation risks their employment and economic stability.[90] Other factors that diminish reliability include congestion, inefficient driver practices, poor vehicle maintenance, and inadequate enforcement of rules and regulations.[91]

Researchers and practitioners generally find that the connected technology of FAVES can increase reliable mobility across our transportation system. Connected FAVES will be able to communicate with one another "like a giant urban brain—that could mean more reliable service, like being able to assess ridership trends in real time and deploy extra buses during a particularly busy hour."[92] With no need for drivers, this also means that FAVES can operate more frequently and around the clock, connecting low-income service workers to late-night jobs. The safety features and connectivity between vehicles can also reduce delays following traffic crashes and eliminate stop-and-go traffic caused by human drivers.[93] The increased reliability of FAVES may also decrease travel times and improve connectivity to jobs and other destinations. Prioritizing high-occupancy FAVES that operate in the form of transit can help to change the perception that public transit is unreliable, potentially increasing ridership.

To the extent FAVES can enhance reliability, we must put policy interventions in place to guarantee that low-income people of color and other populations with barriers to mobility benefit from more dependable transportation options.

Recommended Policy Interventions

FAVES must enhance and prioritize the reliability of sustainable modes of transport like walking, biking, and public transit in marginalized communities, and fill mobility gaps.

At the Federal, State, or Local Level

Ensure Dependability

- Prioritize high-occupancy FAVES in low-income neighborhoods in dense urban areas, to further reduce congestion and increase reliable travel times, especially in areas poorly served by mass transit.

- Require round-the-clock FAVES service in low-income areas where residents are more likely to work late-night shifts, and areas poorly served by mass transit.

- Require real-time FAVES arrival information to be distributed in multiple formats, including audio, visual, and multiple language formats, to ensure accessibility for non-English speakers and people with disabilities.[94]

- To the extent that public-private partnerships are formed between transit agencies and FAVES companies, require these partnerships to be prioritized in low-income areas poorly served by mass transit.

5. SAFETY

Safety refers to collision rates and severity as well as personal safety issues such as harassment, profiling, etc.

A safe environment is necessary for a high-quality transportation system, yet we know that different racial and income groups experience very different levels of transportation safety. Low-income communities of color experience pedestrian fatalities at twice the rate of wealthier census tracts due to poor infrastructure, poor lighting, and a lack of enforcement of traffic law.[95] FAVES present an opportunity to improve safety regarding the disproportionate rates of vehicle-related injuries and deaths in vulnerable communities.

In general, researchers and practitioners predict that FAVES can reduce car crashes, potentially one of the greatest benefits. While some may still find the concept of a self-driving vehicle to be alarming, human driver error is responsible for 94 percent of traffic collisions.[96] However there are still major safety concerns around autonomous vehicles, especially in light of a self-driving Uber killing a pedestrian in Arizona. This tragic incident is a call for additional safety regulations, data reporting, and testing. Once this technology is ready for the roads, we anticipate that the widespread introduction of FAVES will bring benefits that range from reduced crashes and hospital visits to increased walking and biking due to safer conditions and less cars being on the road. Another potential safety benefit is the opportunity for FAVES to be utilized in emergency evacuations in the face of increasing natural disasters.

However, the safety of marginalized people has wider implications outside of just vehicle safety and includes harassment, street safety, and police profiling. Transportation safety does not exist in a vacuum. In addition to vehicle-related fatalities, policies must also address the safety concerns of marginalized populations in other aspects of their lives. In 2016, nine U.S. metropolitan areas experienced a 20 percent

increase over the prior year in hate crimes and harassment related to race, gender, religion, and sexual orientation.[97] These incidents commonly occur in public spaces and on public transit. In the case of FAVES, vulnerable populations such as women, children, people with disabilities, or other marginalized groups may feel unsafe sharing a confined space with strangers without a designated third-party safety attendant. Individuals' experiences with unsafe transportation can also be heightened by violent crime rates in a neighborhood, and residents may feel unsafe while waiting for FAVES. For Black and Brown communities, over-policing, racial profiling, and surveillance is a major safety concern. Without police reform, these issues may carry over to how law is enforced within the context of the widespread use of FAVES. While police and the law are deployed to "uphold safety," this typically operates for the benefit of the privileged at the expense of marginalized populations. The organization The Untokening argues that "safety is different for different people and should be defined by those most economic and legally vulnerable."[98]

Transportation safety does not exist in a vacuum. In addition to vehicle-related fatalities, policies must also address the safety concerns of marginalized populations in other aspects of their lives.

To fulfill the expectations of improved safety, a variety of issues must be addressed in the development of FAVES technology. For example, autonomous vehicles currently face safety challenges when operating under severe weather and complicated driving environments. Additionally, new safety issues may arise, such as cyber-attacks by hackers that could force autonomous vehicles to crash. Policy interventions must comprehensively address a wide range of safety issues, including car crashes, harassment, street violence, police profiling, emergency evacuations, and cybersecurity.

Recommended Policy Interventions

FAVES and other forms of autonomous vehicles must enhance personal and public safety for all people, but particularly for marginalized people.

At the State or Local Level

Safety of Autonomous Vehicle Technology

- Prioritize, ensure, and enforce the safety of bicyclists, pedestrians, and roadways, in areas with high traffic-related injuries and deaths.[99]
    - Designate appropriate speed limits on all forms of autonomous vehicles based on the geographic context and the safety of pedestrians and bicyclists, once the technology has demonstrated its safety.
    - Require data collection from FAVES operators and personally-owned autonomous vehicles to continuously improve safety.[100]

Safer Infrastructure

- Increase the safety of our general transportation infrastructure using methods such as: pick up and drop off zones, signal timing that gives leads to pedestrians and bicyclists, complete streets (safe

access for all users), improved lighting, curb ramps, audible pedestrian signals, ADA accessible bus stops and transit facilities, and well-maintained sidewalks, street crossings, and bike lanes.

    - Prioritize safe infrastructure improvements on a needs basis in low-income areas that experience disproportionately high traffic-related collision and fatality rates.[101]

Safety of Vulnerable Passengers

- Protect, prioritize, and enforce the safety of vulnerable populations such as women, children, people with disabilities, or other marginalized groups who may face harassment and violence in FAVES.

    - Install security measures in FAVES and surrounding the pick-up and drop-off zones, such as better lighting, emergency calling features, video recording devices, or staff personnel to monitor.

    - Designate specific FAVES for vulnerable populations, like Mexico City's female-only buses and taxi fleets.[102]

Safety from Street and Police Harassment and Violence

While these recommendations are not specific to FAVES, they are relevant to improving safety for marginalized communities.

- Follow safety strategies listed in "Using Safe Routes to School to Combat the Threat of Violence."[103]

- Follow recommendations from "4 Ideas that Could Begin to Reform the Criminal Justice System and Improve Police-Community Relations."[104]

Emergency Evacuations

- Create policies, plans, and/or regulations that coordinate a standardized response by FAVES to assist in evacuations in the event of natural disasters or other emergencies. Prioritize assistance in areas most vulnerable to disasters and where residents have the lowest mobility.

At the Federal Level

- Closely follow FAVES technological development and testing to ensure they are safe to deploy before permitting widespread use.

- Continue research and development of cyber security protection methods for autonomous vehicles.[105]

- Create public-private partnerships between the Federal Emergency Management Agency and FAVES operators, like the Federal National Ambulance Contract that responds to disasters, acts of terrorism, or other emergencies.[106]

GOAL #2: Reduce Air Pollution in Low-Income Communities of Color

Because low-income people of color suffer the most from air pollution and the impacts of climate change, they also stand to benefit the most from FAVES and a more environmentally sustainable transportation system. However, we cannot assume that autonomous vehicles are guaranteed to be electric, powered by clean energy sources, or that their production will not cause negative social and environmental externalities. We need a wide range of policy interventions to secure equitable sustainability outcomes.

We also must be clear that electric vehicles are not the sole answer for creating a sustainable transportation system. We still need massive investments in walking, biking, and electric public transit in order to decrease vehicle emissions while increasing physical activity and making communities more livable. In addition to regulating the emissions of autonomous vehicles, we must also reject sprawling land use in favor of compact, high-density development.

Goal #2 Reduce Air Pollution

Equity Indicators	Overview of Policy Recommendations
6. Clean Air and Positive Health Benefits	**State / Local** • Ensure Autonomous Vehicles Maximize Pollution Reduction • Enhance and Promote Healthy, Sustainable Mobility • Assure Autonomous Vehicle Development Utilizes Ethical and Sustainable Practices **Federal** • Clean Air • Establish Manufacturer Accountability
7. Reduction in Greenhouse Gasses	**State / Local / Federal** • FAVES and Other Forms of Autonomous Vehicles Must Decrease Contributions to Climate Change
8. Reduction in Vehicle Miles Traveled	**State / Local / Federal** • Establish Smart, Equitable Land Use • Right-Size Fleets • Enact Equitable VMT Fees

6. CLEAN AIR & POSITIVE HEALTH IMPACTS

Clean air and positive health impacts refers to quantities of air pollutants (PM, NOx) reduction and level of physical activity.

Low-income people of color are disproportionately exposed to vehicle smog that produces toxic pollution and greenhouse gas emissions.[107] Greater exposure to transportation pollution in communities of color is tied to decades of segregation and structural racism in land-use decisions and government policy, which has resulted in low-income communities of color living near busy roads, freeways, ports, and other freight corridors at higher rates than wealthier communities and Whites. For example, in California, approximately 90 percent of people living in the poorest, most polluted areas are people of color. This disproportionate exposure leads to higher rates of asthma, cancer, and other pollution-related illnesses, increased health costs and more missed school and work days for people of color.[108]

In general, experts predict that autonomous vehicles will reduce tailpipe emissions because of improved traffic flows and efficiency, and electric and shared autonomous vehicles can further maximize the air quality benefits.[109] One report estimates that FAVES will reduce emissions by over 90 percent, assuming a complete transition to clean and renewable energy.[110] To reach the greatest reduction in air pollution and associated health costs, regulations must require autonomous vehicle operators to be fully electrified and maximize the use of seats through ridesharing (also known as "pooling").[111]

While low-income communities of color would benefit from cleaner air associated with the electric and

shared aspect of FAVES, we must also consider the mining, production, and waste practices related to electric vehicle batteries. Reports about exploitative child labor practices and pollution hazards to communities near mining sites raise concerns, especially since most of these reports take place in poor countries and further impact already vulnerable populations.[112] Additionally, materials needed for batteries, like cobalt and lithium, exist in finite quantities, making investments in efforts to recycle batteries and recover these metals necessary for sustainability. To ensure a Just Transition to electric vehicles, we need ethical, sustainable, and responsible sourcing on a lifecycle basis.

When it comes to the potential physical activity benefits associated with FAVES, the research is unclear, especially since we do not know how FAVES will impact rates of biking and walking. Depending on which transportation modes are prioritized, operation of FAVES could either make biking and walking safer, with more allocated street space—resulting in an increased use of active transportation—or FAVES could further spur automobile dependency.[113] People of color have much lower rates of physical activity than Whites, as a result of residential segregation that reduces access to recreational amenities, parks, and other spaces designated for exercise.[114] To guarantee increased physical activity in low-income communities of color requires increased investments in safe biking, walking, and recreational infrastructure in coordination with FAVES. Assuming there is a simultaneous surge in rates of walking, biking, and transit usage, this could also improve the mental health of people by increasing social contact and connections, and by decreasing driving-related stress (e.g. traffic, car crashes, etc.).[115] Policy interventions to promote clean air and physical activity must be approached in a variety of ways: from vehicle electrification to active transportation investments to dense land use to holding manufacturers accountable to the full lifecycle production of all forms of autonomous vehicles.

Depending on which transportation modes are prioritized, operation of FAVES could either make biking and walking safer, with more allocated street space—resulting in an increased use of active transportation—or FAVES could further spur automobile dependency.

Recommended Policy Interventions

FAVES and other forms of autonomous vehicles must cut transportation-related pollution and promote healthy environments, particularly in marginalized communities.

At the State and Local Level

Ensure Autonomous Vehicles Maximize Pollution Reduction

- Require all forms of autonomous vehicles to be electric, promote sharing, and discourage private autonomous vehicle ownership. Electrification and sharing are critical factors in maximizing emissions reductions.[116]

- Provide widespread electric vehicle charging facilities, with a priority in low-income areas with high levels of pollution.

    - Partner with affordable housing developments.

- Engage and educate impacted communities in determining where to install charging stations, to foster

community buy-in and support.

Enhance and Promote Healthy, Sustainable Mobility

- Prioritize funding to FAVES projects that promote walking, biking, and zero-emission public transit in areas underserved by transit. Some examples include:
    - Implement policies or projects that incentivize FAVES to enhance the quality and use of walking, biking, and transit infrastructure to encourage higher rates of active transportation and promote use of most sustainable modes.
    - Establish high-occupancy vehicle lanes that only allow shared FAVES and not single-occupancy FAVES.
- Implement road-pricing for privately-owned autonomous vehicles and reinvest the revenue back into walking, biking, and zero-emission public transit. For specific strategies to implement in an equitable manner, refer to the road-pricing recommendations under the "Affordability" section.
- Promote dense land use policies that are conducive to walking, biking, and public transit investments (more detailed recommendation on dense land use in "Reduction in Vehicle Miles Traveled" section.)

Assure Autonomous Vehicle Development Utilizes Ethical and Sustainable Practices

- Require ethical and sustainable standards and practices in the production of autonomous vehicles and component parts like batteries, especially given the likelihood that already vulnerable communities will be worse off due to unethical and unsustainable practices.

At the Federal Level

Clean Air

- Develop more aggressive federal air quality standards and mandate compliance by all states. Clean air standards send an important signal to vehicle manufacturers and legislators.
- Protect states' rights to set air quality standards higher than federal mandates.

Establish Manufacturer Accountability

- Require autonomous vehicles manufacturers to ethically source materials from places that have worker protections.
- Hold vehicle manufacturers accountable for the entire lifecycle of all materials, including the collection and recycling of depleted lithium-ion batteries.

7. REDUCTION IN GREENHOUSE GASES

Greenhouse gas emissions refers to carbon dioxide, methane, ozone, fluorocarbons, etc.

International efforts are underway to curtail greenhouse gas emissions to lessen the impact of our already changing climate. However, low-income communities of color live in areas more susceptible

to natural disasters and often have limited resources and transportation options, making them much more vulnerable to the impacts of climate change. In addition, a UC Berkeley study found that "the poorest third of U.S. counties will likely lose up to 20 percent of their incomes if climate change continues unmitigated."[117] The authors state that this may lead to the greatest transfer ever of wealth from the poor to the rich in U.S. history. The Economic Case for Climate Action in the United States reports that "$360 billion a year, on average, in economic losses, damages and health costs are estimated by the next decade—or about half of the expected growth of the economy."[118]

A UC Berkeley study found that the poorest third of U.S. counties will likely lose up to 20 percent of their incomes if climate change continues unmitigated.

The transportation sector contributes to the largest proportion of greenhouse gas emissions in the U.S. at 28.5 percent.[119] Powering all forms of autonomous vehicles with renewable energy sources represents an enormous opportunity to curb transportation's contribution to climate change. Not only would this minimize the impact on low-income households, but also the financial costs of climate change. Because many of the policy interventions to reduce greenhouse gas emissions duplicate the policy interventions for clean air and positive health benefits, refer to the previous section for equity-focused policy recommendations to reduce greenhouse gas emissions. In general, however, we recommend that:

FAVES and other forms of autonomous vehicles must decrease contributions to climate change.

8. REDUCTION IN VEHICLE MILES TRAVELED (VMT)

Vehicle miles traveled refers to travel levels of vehicles, which are influenced by the density of development and land use.

In 2016, it was reported that vehicle miles traveled in the U.S. increased to 3.2 trillion, a seven-fold increase since 1950—increasing far faster than our population, which only doubled during the same period.[120] High VMT is correlated to low-density land use and a lack of alternative transportation options such as walking, biking and public transit.[121] Wealthy households have the highest rates of VMT, while low-income households that live in denser areas with alternative transportation options have the lowest VMT rates.[122]

Following the format of our Mobility Equity Framework, we selected "reduction in VMT" as an equity indicator because of the need to reduce transportation-related air pollution and unsustainable land-use patterns. However, due to the electric and shared component of FAVES, VMT has a more nuanced meaning as a measure in this context. Higher electric VMT is not inherently bad for equity, because this could mean that people who previously had limited transportation options (low-income people, youth, the elderly, people with disabilities, etc.) have increased access to mobility and thus increased access to jobs, healthcare, education services, and other destinations. However, we must always pay close attention to increases in VMT, which can potentially lead to inequitable development. Analyses of VMT patterns must account for the type and use of VMT by user vehicle-occupancy, and the context of dense or sprawled land use.

How FAVES impact VMT will depend on the types and sizes most widely used, how they are used, and other city planning and land-use factors. If FAVES take a mostly shared, high-occupancy form like buses, they can likely reduce VMT by 37 percent—especially when combined with high-density infill development.[123] On the other hand, if personal, single-occupancy vehicles become the dominant type of FAVES and the preferred method of travel, VMT would likely increase by two to three trillion miles over the next 30 years.[124] The ease and comfort of cheap, single-rider, door-to-door FAVES may spur increased travel demand. This could influence more people to live farther from where they work, further encouraging unsustainable urban sprawl.[125] Sprawling land-use requires increased vehicle use, and therefore is an equity red flag for people of color who are less likely to own cars.[126]

The ease and comfort of cheap, single-rider, door-to-door FAVES may spur increased travel demand. This could influence more people to live farther from where they work, further encouraging unsustainable urban sprawl.

Due to the potential variations in FAVES vehicle types and deployment scenarios, VMT levels may increase in some areas and decrease in others. Analyses of VMT patterns must account for the type and use of VMT by destination and population, and the context of dense or sprawled land use. Because not all forms of VMT are created equal— electric and shared VMT is certainly preferred to single-occupancy VMT of super-commuters from suburbs to city centers, though this might not be the case in rural, less dense areas. Despite the fact that electric VMT is free of tailpipe emissions, to promote sustainability and connectivity to jobs we must prioritize dense land use planning practices to the maximum extent possible.

We need policy interventions to ensure that autonomous vehicles do not contribute to sprawling land use patterns and increasing traffic congestion. However, equity components must be built into these policy interventions to avoid burdens on low-income people. For example, VMT fees that charge based

on distance traveled have been observed as regressive and harmful to low-income people, if not carefully designed with equity in mind.[127] This is especially critical given the increasing numbers of low-income people being displaced into the suburbs and farther from job centers due to high urban housing costs. We must leverage policy interventions regarding the roll out of autonomous vehicles to reduce VMT, foster sustainable growth patterns, transportation equity, and increase economic opportunities for low-income people of color.

Recommended Policy Interventions

FAVES and other forms of autonomous vehicles must prioritize shared vehicles and efficient use of lanes and curbs in a manner that promotes dense land uses, particularly in marginalized communities.

At the Federal, State or Local Level

Establish Smart, Equitable Land Use

- Require the operation of FAVES to align and support equitable, inclusive, compact development in low-income communities of color through policies such as zoning for dense development, elimination of parking requirements, anti-displacement measures, urban growth boundaries, and financial incentives promoting infill and mixed-use development.[128]

- Prioritize funding FAVES projects that promote transit and active transportation modes such as walking and biking (see "Clean Air and Public Health" section for examples.)

- Promote and prioritize building transit-oriented development and mobility hubs in low-income areas that are equipped with FAVES, charging stations, and other sustainable mobility options.

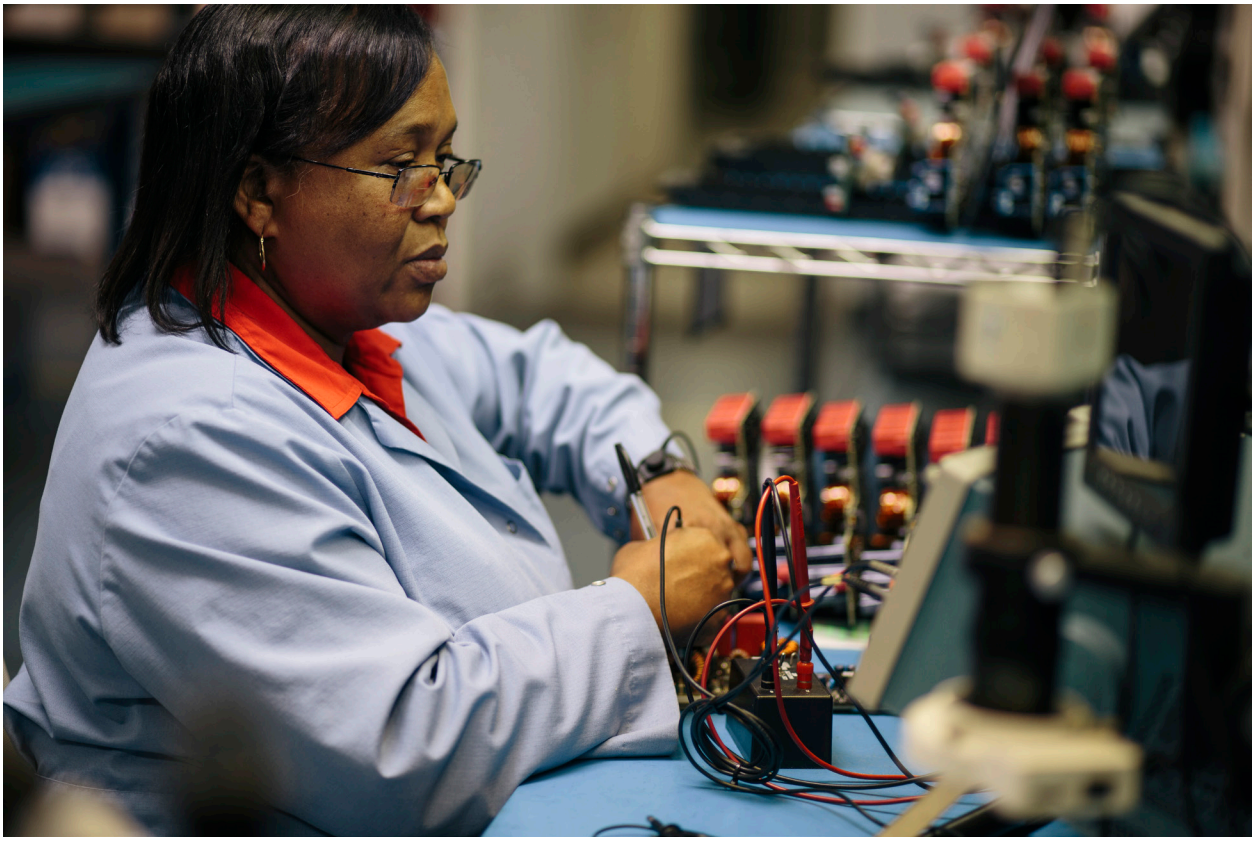
Right-Size Fleets

- Ensure that FAVES are "right-sized" to satisfy community needs in geographically different marginalized communities. See more details on right-sizing under the "Efficiency" section.

Enact Equitable VMT Fees

- Require all forms of autonomous vehicles to pay variable fees for vehicle miles traveled, with higher fees for lower-occupancy vehicles. Fees for FAVES serving low-income individuals should be waived or reduced. Revenue collected should be invested in walking, biking, or public transit infrastructure.[129]

    - Create policies that incentivize and/or subsidize VMT fees for FAVES operating as high occupancy public transit in low-income areas, especially during congested time periods.[130]



GOAL #3: Enhance Economic Opportunities in Low-Income Communities of Color

The National Equity Atlas describes the growing racial wealth gap in the U.S., and how "rising inequity disproportionately affects workers of color, who are concentrated in low-wage jobs that provide few opportunities for economic security or upward mobility."[131] As a result, people of color earn lower wages and suffer from higher rates of unemployment compared to their White counterparts. This makes low-income people of color even more susceptible to our quickly changing economy.

In addition to the transportation sector, automation has the potential to impact sectors such as the service industry, retail, and even finance—and the impacts of automation will disproportionately affect people of color. A report by the McKinsey Global Institute found that Latinos face the highest potential of job loss due to automation, "at close to 60 percent, followed by Blacks at 50 percent, Asians at almost 40 percent, and Whites at roughly 25 percent."[132] Other groups that will also be likely left behind in this economic transition to automation include individuals returning home from incarceration, single custodial parents, people with disabilities, individuals lacking a high school diploma or GED, or other populations facing barriers to employment. Some experts believe automation is not inherently bad, because in some cases, robots will replace jobs that are difficult, dangerous, or unhealthy for humans, like roofing, welding or agriculture—sectors that employ large numbers of people of color.[133] Others hope that with the elimination of these undesirable sectors, displaced workers can be retrained in new occupations, such as in the caring economy in the form of personal and health aides for our aging population.[134]

In this age of the gig economy, we need fair labor practices that provide workers with wages, benefits, and a work environment that ensures worker dignity and promotes a high quality of life.

We know jobs will be eliminated due to automation. We also know that new types of jobs will be created due to automation. However, a skills gap will impact who can access these new jobs. Thus, we must put strong social safety nets and transition programs in place for displaced workers so that they can access regular income while they transition to other careers or opportunities. Additionally, retraining programs must ensure that there will be jobs available at the end of the pipeline. For displaced workers who are older and likely to have difficulty transitioning to another career, we need bold funding and programs for early retirement. In addition, in this age of the gig economy, we need fair labor practices that provide workers with wages, benefits, and a work environment that ensures worker dignity and promotes a high quality of life. Furthermore, our transportation system must enhance mobility for all people to guarantee increased access to economic opportunities. It will not be an easy transition, and we will need a wide array of equity-focused policy interventions to ensure that low-income communities of color are not left behind in this technological revolution.

Goal #3 Enhance Economic Opportunities

Equity Indicators	Overview of Policy Recommendations
9. Connectivity to Places of Employment, Education, Services & Recreation	**State / Local** • Enhance Mobility • Develop Equitable Technology **Federal** • Coordinate Medicaid funding/reimbursement
10. Transportation-Related Employment Opportunities	**State / Local** • Support Displaced Workers • Accelerate Targeted Hiring • Prepare Workforce • Expand Social Safety Net **Federal** • Prepare Workforce • Expand Social Safety Net
11. Fair Labor Practices	**State / Local** • Promote Workforce Diversity, Equity, and Inclusion • Improve Job Quality **Federal** • Develop Higher Labor Standards for Independent Contractors in FAVES
12. Inclusive Local Business & Economic Activity	**State / Local** • Foster Local Economic Development • Promote Local Workforce Diversity, Equity, and Inclusion • Prevent Displacement **Federal** • Spur Economic Development

9. CONNECTIVITY TO PLACES OF EMPLOYMENT, EDUCATION, SERVICES, & RECREATION

Connectivity refers to the ease of access and proximity to destinations.

With urbanism taking hold and higher-income people flocking to urban centers in growing numbers, low-income people of color are being priced out into the suburbs in search of a more affordable housing costs. This suburbanization of poverty is devastating for the fight against inequality as it limits access to job centers, social services, and other critical destinations. In fact, 61 percent of high-poverty tracts and 55 percent of communities of color have experienced declines in job proximity between 2000 and 2012—and these tracts are increasingly expanding in the suburbs.[135] Additionally, our quickly aging population means that "by 2030, nearly 20 percent of Americans will be 65 or older,"[136] increasing the demand for alternative transportation options to access medical care, retail, and other services. To illustrate how a lack of transportation options impacts people with barriers to mobility, a report from The American Association of People with Disabilities found that 500,000 people with disabilities never leave their homes because they have no transportation options.[137]

The good news is that autonomous vehicle technology has the potential to unlock mobility for entire populations who cannot legally or safely drive today, such as children, seniors, people with certain types of disabilities, and undocumented individuals. For residents of rural areas who lack connectivity to destinations, FAVES may also serve as a bridge to economic opportunities. This means they will have greater overall connectivity to all types of destinations—increasing their mobility, job opportunities, shopping, recreation, health, and social interactions.[138] In urban areas, however, we must ensure that FAVES operated by private companies do not replace public transit, and instead enhance the quality and use of transit, such as by serving as feeders to transit hubs. Companies like Transdev are already transporting 3,000 passengers a day in autonomous shuttles as a first and last mile solution from public transit hubs to various destinations.[139]

With the appropriate incentives and regulations, FAVES have great potential to ensure that people with barriers to mobility are more connected to opportunities, services, and recreation. Because of the ease and comfort of FAVES, low-income people of color and people with disabilities may also be able to travel farther to reach a wider range of job opportunities. For low-income families who have already been pushed to the fringes of urban areas, FAVES may be a necessary and viable option to connect them to jobs and other destinations. While longer distances and commutes to jobs are certainly not ideal, FAVES can help bridge a mobility gap until equitable and sustainable land uses take hold. FAVES will not increase connectivity to destinations on their own—we need bold and robust policy interventions that target and prioritize the mobility needs of marginalized communities.

Recommended Policy Interventions

FAVES must be operated in an equitable manner to improve connectivity and mobility, particularly in marginalized communities underserved by transportation options.

At the State or Local Level

Enhance Mobility

- Expand and modernize fixed-route public transit along high-demand corridors in low-income communities to increase frequency, speed, and efficiency. Designate dedicated lanes (subway, rail, bus-only, etc.) for public transit/high-occupancy FAVES.[140]

- Improve street and sidewalk infrastructure to increase access to pathways to transit stops for the elderly and people with disabilities.[141]

    - Support development of FAVES that have a flexible-route service, where demand is not high enough for fixed-route transit service.

- Use FAVES to enhance mobility for marginalized populations:

    - FAVES should enhance the use and quality of mass public transit by addressing first and last mile gaps to connect transit hubs to other destinations.

    - FAVES should enhance connectivity to health centers, local business hubs, schools, community centers, and religious centers and other destinations frequented by populations with barriers to mobility, in a manner that does not negatively impact the use or quality of mass transit.

Develop Equitable Technology

- Develop programs that partner Mobility as a Service providers with FAVES operators, cities, transit agencies, affordable housing developments, health centers, major employers, etc.,[142] to promote connectivity within and to areas with transportation gaps. For more information on how to develop and implement programs in an equitable manner, refer to the "Efficiency" section.

At the Federal Level

- Coordinate Medicaid funding/reimbursement for eligible recipients to use FAVES to access health care, as well as health care workers who provide home care.

10. TRANSPORTATION-RELATED EMPLOYMENT OPPORTUNITIES

Transportation-related job opportunities refers to the direct and indirect employment throughout the construction, operation, and maintenance of transportation projects, modes, or mobility services.

Researchers and experts overwhelmingly cite job loss as one of the most concerning negative impacts of the automation of vehicles. In 2015, The U.S. Department of Commerce reported that 15.5 million U.S. workers, or about one in nine, are employed in occupations that could be affected by autonomous vehicle technology.[143] These jobs include truck drivers, transit operators, delivery service workers, as well as other on-the-job drivers including construction workers, repair personnel and installers. People of color will be disproportionately impacted if these jobs automate. In 2012, the U.S. Bureau of Labor Statistics reported that 15 percent of Black people and 17 percent of Latinos work in production, transportation, and material moving jobs, compared to only 12 percent of Whites.[144] Automation replacing human labor is hardly a new phenomenon. Agriculture and manufacturing have lost jobs to automation and technology,[145] however this new wave of employment losses after 2020 could exceed previous job loss during economic transitions by two or three times and will most impact low- to moderate-income workers.[146] Great uncertainty remains around the exact timeframe of the deployment of autonomous vehicle technology, and therefore this job loss could occur gradually over decades. However, an urgent need exists now to secure policy interventions to lessen this predictable impact on already vulnerable populations.

Automation and artificial intelligence are transforming work as we know it, increasing efficiency and productivity while decreasing costs. There is no doubt that new jobs to develop, monitor and maintain automated technologies will emerge. And many believe that automated technology taking on dull or

dangerous work gives our society an opportunity to redesign jobs to capitalize on uniquely human skills, such as interpersonal communication, problem-solving, and strategic thinking.[147] Some hope that this economic transition will be an opportunity to emphasize more jobs as caregivers for elders, children, people with disabilities, and other vulnerable populations.[148] Regardless of which new jobs will be created as a result of automation, we can predict there will be a significant skills gap in who can access these jobs. The future of work is trending toward middle-skill and high-skill work that requires some formal training and education. As a result, low-income people of color, who disproportionately face multiple barriers to training and education, will be increasingly locked out of these opportunities. The private and the public sectors must both fund and coordinate efforts to enhance K-12 education in low-income areas, upskill the existing workforce for our changing economy, and create a strong social safety net for workers displaced by technological change.

The future of work is trending toward middle-skill and high-skill work that requires some formal training and education. As a result, low-income people of color, who disproportionately face multiple barriers to training and education, will be increasingly locked out of these opportunities.

While there is much speculation on how automation will impact transportation-related jobs, the types of policy interventions we choose will ultimately decide whether autonomous vehicles will promote a just and equitable economy. Government must play a large role in assessing which jobs are at risk, which new occupations will be in demand, expanding the social safety net, initiating programs to close skills gaps, and ensuring jobs exist at the end of re-training pipelines. Both the public and private sectors must work together to provide solutions for transportation workers who are most vulnerable to job loss due to automation. To be most effective, these policy interventions must be supported at the federal, state, regional, and local levels.

A JUST TRANSITION

Facing mounting pressure from environmental groups and California's push towards a clean economy, the Diablo Canyon nuclear power plant was facing a closure of its facility in the coming years. The utility owner, Pacific Gas & Electric, and the IBEW Local 1245 labor union negotiated a Just Transition process for the plant's 1,200 employees and 200 subcontractors. Instead of a sudden shut down, this deal would keep the plant open for up to nine years, while providing retention programs, severance allowances, retraining programs, and a long pre-layoff notice to workers. PG&E also replaced the power from the nuclear plant with an array of clean energy and energy efficiency investments. Additionally, PG&E agreed to reimburse the community with $85 million for lost property tax revenues. Labor unions hold this up as model of a Just Transition process that resulted in the fair treatment of workers and creation of new jobs in the clean energy sector.

Recommended Policy Interventions

FAVES and autonomous vehicle companies must generate jobs and related training to mitigate the impact on workers displaced by driverless vehicles.

At the State or Local Level

Support Displaced Workers

- Establish retraining programs to help workers displaced by autonomous vehicles access other jobs, such as in the manufacturing, monitoring, operation, and maintenance of autonomous vehicles or in other jobs in emerging industries. This could include charging fees to autonomous vehicles companies, with the funds used for creating transition funds and retraining programs for displaced workers.
    - Retraining programs must ensure that there will be jobs available at the end of the pipeline. Provide income support to displaced workers as they are retrained.
    - Provide income support to displaced workers as they are retrained.
- Require autonomous vehicles companies whose operations will result in high levels of job loss to use the Just Transition framework to negotiate transitions to other occupations.[149]

Accelerate Targeted Hiring

- Encourage autonomous vehicle companies to use targeted hire practices to provide high-quality jobs to low-income individuals and individuals with barriers to employment (e.g. people of color, women, veterans, formerly incarcerated, single custodial parents, individuals lacking a high school diploma or GED, etc.) in the design, construction, operation, and maintenance of FAVES and related infrastructure. Examples include:
    - A tax credit or subsidy to companies who create local high-quality jobs, training opportunities, and career pathways for individuals with barriers to employment. These incentives must be accompanied by reporting requirements for recruitment and placement metrics and the identification of a government entity responsible for monitoring companies' compliance.
    - Prioritize operating permits to companies that have robust recruiting and hiring policies targeting low-income communities of color, provide high-quality jobs, have robust minority-owned business procurement goals (e.g. supplier diversity), and partner with or provide support to workforce development programs aimed at low-income communities of color.

Prepare Workforce

- Conduct assessments of occupations at risk from autonomous vehicles and assessments of emerging job trends.
- Increase funding for community colleges, technical colleges, apprenticeship programs, and other institutions that provide education for low-income students and those with barriers to employment[150] to gain access to future transportation-related jobs.
- Invest in skills-development programs aimed at training members of low-income communities (particularly those with barriers to employment) to fill emerging employment needs in the heavy-duty electric vehicle industry and related transportation-electrification fields.

Expand Social Safety Net

- Modernize unemployment insurance by expanding access for low-wage women and non-standard workers, developing income security, reforming its financing model, and fixing state administration to ensure fair access such as translation services for immigrant workers. These reforms are critical

to improving access to unemployment insurance, because only 37 percent of unemployed workers received UI benefits in 2007.[151] For a complete list of detailed policy recommendations to modernize unemployment insurance, refer to the National Employment Law Project's Changing Workforce, Changing Economy report.[152]

- Leverage best practices from Trade Adjustment Assistance (TAA) programs created to address job loss related to technological change. For a detailed list of policy recommendations related to TAA, refer to "Mounting a Response to Technological Unemployment."

At the Federal Level

Prepare Workforce

- Increase funding to community colleges, technical colleges, apprenticeship programs, and other institutions that provide education for low-income students, people with disabilities, individuals lacking a high school diploma or GED, and other groups with barriers to employment[153] to gain access to high-quality jobs in transportation and emerging mobility technologies and services such as FAVES.

- Provide incentives for the private sector to create education and professional development programs to upskill and retrain existing employees to avoid displacement.

Expand Social Safety Net

- Expand Trade Adjustment Assistance (TAA) to apply to job loss related to technology and automation such as autonomous vehicles. For a detailed list of policy recommendations to achieve this, refer to "Mounting a Response to Technological Unemployment."

- Increase funding for programs that provide funding for a social safety net for displaced workers, including retraining grants, income support, reemployment services, Supplemental Nutrition Assistance Program, Temporary Assistance for Needy Families, unemployment insurance, paid retraining, and protection of health benefits.[154]

- Consolidate social safety net programs listed above into a singular streamlined Universal Dislocated Worker Benefit that is easier to access and is adaptable to various threats to employment.[155]

- Expand funding to existing pilot projects for Universal Basic Income, Cash Transfers, and Negative Income Taxes for workers displaced by automation.[156]

- Initiate funding to create pilot projects for Federal Job Guarantee[157] programs for workers displaced by autonomous vehicles. Such a program would allow communities to determine their employment priorities, such as infrastructure projects, caregiving, building housing, or other job categories.

11. FAIR LABOR

Fair labor refers to fair wages, basic employment benefits and protections throughout the construction, operation, and maintenance of transportation projects, modes, or mobility services.

Today, labor practices in the transportation sector vary greatly from public transit operators, which are typically unionized, to independent contract drivers of private ride-hailing companies such as Uber and Lyft. Compared to the private sector, the public sector has granted more equitable opportunities for women and people of color, in addition to access to unions, fair wages, and employment benefits and protections.[158] Independent contractors infamously do not share those same benefits, and do not benefit from rules on minimum wage, overtime, and breaks.[159] In California, 50 percent of independent contractors are people of color and 38 percent are foreign born.[160] Uber and Lyft have fought to prevent their drivers from unionizing, and after deducting the companies' cut, gas, insurance, maintenance and depreciation, drivers often end up making less than minimum wage.[161] The working conditions of manufacturers such as Tesla have also been criticized for mandatory overtime, low wages, and high rates of workplace injuries.[162]

While it is likely that ride-hailing drivers will eventually be made obsolete by driverless FAVES, workers will be needed to design, build, maintain, and monitor FAVES. The labor practices for these future jobs will range greatly, depending on whether they are operated by the public sector or the private sector. The historical record of unfair labor practices within the private sector is a strong indication of how future labor trends will unfold, and lessons should be learned from ride-hailing companies' exploitative labor practices today. Without fair labor practices, low-income people of color employed in the transportation sector of the future will not be provided with opportunities and pathways to upward mobility. To prevent these unfair labor practices from being replicated in the future, equitable policy interventions to protect workers in the transportation sector must be enacted both in the public sector and the private sector.

COMMUNITY BENEFITS AGREEMENT

In 2018, the company BYD signed an agreement with Jobs to Move America and the SMART Local 105 labor union to become the first electric bus manufacturer to be represented by a union. The community benefits agreement will invest in pre-apprenticeship and training programs and commit to hiring women, people of color, veterans, previously-incarcerated, and other groups with barriers to employment. In addition, the company will provide transportation support for workers who do not have access to a car.

Recommended Policy Interventions

FAVES and autonomous vehicles companies should improve job quality, workforce diversity, and promote equity and inclusion among low-income individuals and others with barriers to employment.

At the State or Local Level

Promote Workforce Diversity, Equity, and Inclusion

- Encourage FAVES and other autonomous vehicle developers, manufacturers, and operators to provide:
    - Partnerships with workforce development organizations that focus on job training, apprenticeships, high school programs, etc., preferably in low-income communities of color.
    - Targeted hiring practices for women, people of color, veterans, people with disabilities, previously-incarcerated, single custodial parents, individuals lacking a high school diploma or GED, and other groups with barriers to employment.
    - Compliance with requirements to provide religious and disability accommodations for employees.
- Require programs, agreements, incentives, etc. to be accompanied by reporting and identify a government entity responsible for monitoring companies' compliance to diverse hiring commitments.

Improve Job Quality

- Require manufacturers and operators of FAVES and other forms of autonomous vehicles to provide high-quality jobs, prevailing wages, benefits, and employment protections for employees.[163] For example, this can be done through Project Labor Agreements, Community Benefit Agreements, or High-Road Agreements[164] that promote green projects and infrastructure.
- Develop higher standards to classify independent contractors, as in the ruling of California's Supreme Court.[165] While FAVES will have no drivers, operators may still utilize independent contractors for cleaning, maintenance, assisting passengers, monitoring, etc.
- Local governments and transit agencies should:
    - Support development of publicly, community, or cooperatively-owned FAVES to promote fairer

labor practices and higher-quality jobs.

  - Partner with private FAVES operators only when necessary, and prioritize those that offer prevailing wages and benefits, are unionized, promote equitable job training, and have targeted hiring practices.

- Conduct assessments of emerging job trends, to understand which policy tools will improve the quality of jobs.

At the Federal Level

- Develop higher labor standards for independent contractors in FAVES and the autonomous vehicle industry.

- Strengthen protections for union organizing to enable unions to partner with FAVES and autonomous vehicle-related employers to bargain for higher labor standards and community benefits.

12. INCLUSIVE LOCAL BUSINESS & ECONOMIC ACTIVITY

Inclusive local business and economic activity refers to local hire agreements, diverse business contracting, increased foot traffic to local business, new businesses created, increased property values, benefiting the local community without displacing residents, etc.

The design of transportation systems has cascading effects on local business and economic activity. Historically, the construction of freeways through urban cores displaced residents, businesses, and destroyed the local economies of communities of color. Today, this prioritization of cars is widely recognized as a major blunder in transportation planning. Many cities across the country now aim to reverse this by recognizing the merits of walking, biking, and transit investments.

Walking and biking benefit local economies by reducing transportation costs, raising property values, and increasing local business activity.[166] The American Public Transportation Association reports that "every dollar spent on public transportation generates four dollars in economic returns. Public transit drives the local economy and directly generates sales, revenue, and new private investment."[167] However, along with the demographic shifts of city centers and increasing investments in walking, biking, and public transit infrastructure, also come risks to vulnerable populations. Rising property values and new businesses attract new residents, priming these urban cores for gentrification and the displacement of low-income residents.

FAVES may harm local business and economic activity—depending on what form they take. The electric and autonomous features of FAVES mean that they would be less likely to be involved in car crashes and therefore would need less repairs and maintenance than cars today—potentially causing a drop in the demand of auto repair shops.[168] A significant drop in gas-powered vehicle ownership may cause a drastic reduction in the need for local gas stations.[169] This impact may hit people of color even harder than others as many are employed in these sectors[170] and will be at higher risk of economic displacement. In addition, companies producing and operating FAVES may outsource manufacturing and monitoring to countries with cheaper labor costs, thus eliminating local economic opportunities for this new sector.[171] In addition, the convenient door-to-door service of FAVES may reinforce automobile dependency in place of walking, biking, and transit, potentially harming local businesses due to reduced foot traffic.

To ensure positive outcomes on local businesses and economic activity, we must be more imaginative and explore alternative models of FAVES outside just the traditional private sector.

Yet FAVES could also increase local economic activity and spur transit-oriented development and connectivity to retail destinations, depending on how they are regulated. Some people are optimistic that the affordability and convenience of FAVES may lead to reduced car ownership and space devoted to cars. This would be an opportunity to convert parking spaces and parking lots into new business developments, public spaces, affordable housing, and other human-centered design features.[172] While much of the conversation revolves around FAVES operated by private companies, cooperatively-owned FAVES represent a potential strategy to increase local business and economic activity. Because of the shared ownership in profits and decision-making, cooperatively-owned FAVES can help build inclusive local economies that engage community members, such as in the example of the electric Saskatoon CarShare program in rural Canada.[173] Having a nonprofit status also would allow cooperatively-owned models to receive grants and easily collaborate with government, businesses, and transit agencies.[174] To ensure positive outcomes on local businesses and economic activity, we must be more imaginative and explore alternative models of FAVES outside just the traditional private sector. The introduction of FAVES operated by private companies can still be a means to establish a slew of community benefit agreements to address the needs of marginalized populations. However, we will need policy interventions to avoid harms and spur the growth of inclusive, equitable, and vibrant local economies.

Recommended Policy Interventions

FAVES must be operated in a manner that provides community benefits to marginalized communities.

At the State or Local Level

Foster Local Economic Development

- Require FAVES companies and operators to use local work and local goods and services related to their production, operation, and maintenance.
- Assist in the establishment of local, cooperatively-owned FAVES business models that have a strong interest in sustaining local business and creating inclusive and equitable local economies.
    - Form partnerships between FAVES and community clean energy co-ops, especially in rural areas—such as this zero-emission Canadian electric car-share program.[175]
    - Form partnerships between FAVES and local chambers of commerce, retail centers, affordable housing, and public transit agencies.
- Designate FAVES pick up and drop off zones along local business corridors in marginalized communities, including commercial areas, health centers, supermarkets, etc.
- Repurpose under-utilized parking lots and street parking to be converted into public space, sustainable transportation infrastructure, local businesses, affordable housing, and other community serving facilities (recreation centers, childcare centers, clinics, etc.)

Promote Local Workforce Diversity, Equity, and Inclusion

- Place a high priority on FAVES projects that have robust recruiting and hiring policies targeting low-income communities of color, provide high-quality jobs, have robust minority-owned business procurement goals (e.g., supplier diversity), and partner with or provide support to local workforce development programs aimed at low-income communities of color.

    - Require programs, agreements, incentives, etc. to be accompanied by reporting requirements and identify a government entity responsible for monitoring companies' compliance.

Prevent Displacement

- FAVES and other forms of autonomous vehicles must be operated in a manner that supports and complements anti-displacement measures to the maximum extent possible.

At the Federal Level

Spur Economic Development

- Increase funding for the Economic Development Administration to invest in regions experiencing decline in employment and that are vulnerable to automation.

    - If increased funding is available, Federal assistance could come in the form of planning and economic adjustment assistance, Community Development Block Grants, Community Service Grants, etc.

CONCLUSION

The details regarding the size, scale, and use of autonomous vehicles are currently still to be determined, making it difficult to accurately compare equity outcomes against other modes like walking, biking, and public transit. Exactly how FAVES will roll out will largely depend on how we regulate them, in addition to how we disincentivize personally-owned autonomous vehicles. While the timeline remains uncertain, it is not too soon to begin developing policies to create equitable outcomes for all people across the board. Yet before jumping to regulate, cities and transit agencies first need a clear vision, strong guidelines, and evaluation methods to assess all forms of autonomous vehicles. These guidelines can be used as leverage when approving permits or forming public-private partnerships. Government must boldly insist on positive, equitable outcomes for marginalized populations by negotiating with autonomous vehicle companies and operators for fair access and progressive pricing structures, local hiring practices, and other community benefits. Transit agencies themselves must also be innovative and adapt to keep up with this technology—or else they risk becoming less competitive, like the taxi. Publicly-owned autonomous vehicles that operate in the form of high-occupancy rail, buses, or shuttles hold great potential for ensuring fair access to all people, abiding by sustainability standards, and implementing a Just Transition process and retraining for displaced workers. Autonomous vehicles that operate primarily in the form of FAVES represent an opportunity to invest in safer and more efficient walking, biking, and transit infrastructure, to electrify vehicles, and to prepare our workforce for a more automated economy.

However, private or public autonomous vehicles meeting equity criteria will not by itself be enough to give the green light to this technology. Communities must be actively engaged in assessing their own mobility needs and deciding the size, scale, and use of autonomous vehicles that would address those needs. Only once the community needs have been determined can the appropriate equity-focused policy

interventions be implemented. FAVES and autonomous vehicles more broadly will vary greatly depending on the demographics and geography of each community, and therefore there will be no one-size-fits-all policy solutions. Pilot projects in marginalized communities must be tailored to their specific needs, tested, and assessed before any widespread adoption. Communities must be at the decision-making table regarding all aspects of autonomous vehicles, to self-determine what their "equity heaven" should look like and how to get there.

Communities must be at the decision-making table regarding all aspects of autonomous vehicles, to self-determine what their "equity heaven" should look like and how to get there.

Community decision-making power in combination with equity-focused policy interventions around the adoption of autonomous vehicles will ensure that all communities benefit from this technology. Under an ideal "equity heaven" scenario, autonomous vehicles in the form of FAVES present an opportunity to generate positive mobility and health outcomes for low-income communities of color and other marginalized groups. Similarly, we need a wide array of policy interventions to mitigate any potential negative outcomes of autonomous vehicles on the economic opportunities of low-income communities of color.

Whether in the context of autonomous vehicles, ride-hailing services, electric vehicles, or public transit, the same three steps of the Mobility Equity Framework must always be applied: (1) identifying current community mobility needs, (2) maximizing equity outcomes, and (3) elevating community decision-making power regarding any new transportation technologies. Following these three steps puts communities in charge of determining the size, scale, and use of autonomous vehicles. We need proactive, not reactive, policies to maximize the benefits and minimize the harms of autonomous vehicles on low-income communities of color and other marginalized populations.

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