

DRIVING TOWARDS DRIVERLESS:

A GUIDE FOR GOVERNMENT AGENCIES



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**PARSONS
BRINCKERHOFF**

DRIVING TOWARDS DRIVERLESS:

A GUIDE FOR GOVERNMENT AGENCIES

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What People Are Saying About Driverless Vehicles

“The state of autonomous vehicle technology seems likely to advance with or without legislative and agency actions at the federal level. However, the manner in which autonomous vehicle technologies progress and will eventually be implemented depends heavily on these efforts. Intelligent planning, meaningful vision, and regulatory action and reform are required.”

*Preparing a Nation for Autonomous Vehicles:
Opportunities, Barriers, and Policy Recommendations*
Eno Center for Transportation
October, 2013

“One thing is clear. The next five to 10 years are going to be the most disruptive we’ve ever seen in the history of personal transportation.”

Karl Brauer
Senior Analyst, Kelley Blue Book
July 18, 2015

“We don’t want to be part of the problem of integrating this technology into the marketplace ... we want to be part of the solution.”

Anthony Fox
Secretary, U.S. Department of Transportation
May 13, 2015

“We don’t actually think there is a regulatory block. [National Highway Traffic Safety Administration] is not a permission-granting organization ... [the NHTSA] could certainly reactively ban it, but we don’t think that they need to grant permission.”

Chris Urmson
Director
Google Self-Driving Car Project
January 12, 2015

“A lot of times ... the cities and the counties ... are developing long-range [transportation] plans, but they are always using today’s technology. The 20 top MPOs [metropolitan planning organizations] in the nation haven’t addressed autonomous vehicles and their impact on mobility in the future.”

Randell H. Iwasaki
Executive Director
Contra Costa Transportation Authority
May 20, 2015

“We will see more change in the industry in the next five to 10 years than we have in the last 50.”

Mary T. Barra
Chairman and CEO
General Motors Company
September 16, 2015

Preface

Driverless vehicles have the potential to change all aspects of mobility – from driver safety and insurance liability to car ownership and how Americans commute—and could disrupt both public and private transportation as we know it. As Google, Uber, the automobile industry and other organizations continue to make rapid technological advances in driverless cars, it is vital that federal, state and local governments establish policies, laws and regulations that account for this disruptive technology. Of utmost importance is finding a balance between guarding public safety while regulating insurance/liability and simultaneously encouraging investment in research and development of driverless vehicles and their implementation and integration into our transportation system.

Most research papers and news reports regarding driverless vehicles focus on the technological advancement or implications for society (e.g., improved safety and greater mobility for the elderly and disabled people). Some articles cite the importance of government regulation; however, very few provide targeted guidance on how government agencies should respond. Driverless vehicles will likely have a huge impact on our future; however, it is the government's actions (now and in the future) that will determine how they are integrated into society and if the impacts are largely positive or negative. The intent of this guide is to outline the role of government in the integration of driverless vehicles in society and present the information that local and regional governments need to inform planning and decision-making – now and in the future.

The intended audience for this guide includes:

- **State/regional/local government officials** interested in understanding the state of driverless vehicle technology and how government officials should be planning for driverless vehicles. This group includes representatives from municipalities, transit agencies, metropolitan planning organizations, air quality agencies, departments of transportation, departments of motor vehicles, departments of insurance, highway departments and departments of public works.
- **Federal government officials** interested in determining which driverless vehicle issues should be addressed at the federal versus state/local levels.
- **Transportation consultants** interested in supporting state, regional and local governments as driverless vehicle technology evolves.

- **Other driverless vehicle stakeholders** (automakers, technology developers, insurance brokers, transit advocates, safety advocates, privacy advocates, and the general public) who are interested in understanding government’s role in driverless vehicles and how they can best work together.

This guide does *not* address the following topics:

- Automated vehicle technology advancement.
- Automated vehicle standards, including manufacturing and data, communications.
- Connected vehicles.
- Licensing requirements.
- Privacy or cyber-security regulations.
- Insurance/liability policies.
- Ethical decision-making.

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Chapter 1: DRIVERLESS VEHICLES 101

Driverless Vehicles 101

This section presents an introduction to driverless vehicles – what they are and are not, the key players in their development, their status and potential implications on society.

What Driverless Vehicles Are and Are Not

Fully automated vehicles (AVs), also referred to as driverless cars or self-driving cars, are capable of sensing their environment and navigating roads without human input. They rely on technologies like GPS, Lidar and radar to read their surroundings and make intelligent decisions about the vehicle's direction and speed and interaction with other road users, including cyclists and pedestrians.

Both the [National Highway Traffic Safety Administration](#) (NHTSA) and [SAE International](#) have defined levels of vehicle automation, ranging from driver assistance for a single vehicle function to full automation with no driver required. The focus of this guide is on the highest level of automation: fully automated vehicles (or “driverless cars”). NHTSA's highest level of automation (level 4), also referred to as “full self-driving automation,” is defined as a vehicle “designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip.” SAE defines its highest level of automation (level 5) as the “full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver.”

The following provides a list of what driverless vehicles are not:

- **Function-Specific Automation** (NHTSA and SAE levels 1 and 2). Automation at this level involves one or more specific control functions (either independent or working in unison), such as cruise control and/or lane centering.
- **Limited Self-Driving Automation** (NHTSA and SAE level 3 and SAE level 4). Vehicles enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions. For level 3, the driver is expected to be available for occasional control, but with sufficient transition time. An example is the current Google car with a steering wheel and brakes available as back-up for the driver. For SAE level 4 automation, the system has the capability to restore the vehicle to a minimal risk condition, even if the human driver fails to respond to a request to intervene.

- **Personal Rapid Transit (PRT)** – Small automated vehicles that rely on fixed guideway.
- **Connected Vehicles** - Connected vehicle (CV) safety applications are designed to increase situational awareness and reduce or eliminate crashes through vehicle-to-infrastructure (V2I), vehicle-to-vehicle (V2V), and vehicle-to-pedestrian (V2P) data transmissions. Applications support advisories, warnings, and vehicle and/or infrastructure controls.¹



Connected vehicle technology is being developed concurrently with automated vehicle technology, although the relationship between the two is still being determined. A driverless vehicle uses technology that exists completely within the car; this technology can read standard traffic signs, identify bicyclists' hand signals, and sense pedestrians independent of wayside infrastructure. Connected vehicles, on the other hand, rely on broadcasted communications from other vehicles or the infrastructure (e.g., roadside signals). Connected vehicles could be automated, but that is not a necessity. Driverless vehicles may have connected vehicle features, but that's not essential. Industry observers have wide-ranging opinions on the likely future for these technologies. Specifically, some industry stakeholders see connected vehicles as an important step toward a driverless vehicle society. Some see connected vehicles as the end goal, while others believe driverless vehicles can be developed and fully integrated into society without any connected vehicle features. Additionally, many believe the benefits of these technologies cannot be realized without both in place.

Driverless Vehicle Impacts

The potential impact of driverless vehicles is vast, with both positive and negative implications. The extent of these impacts will largely be driven by government policy ([see chapter 5](#)); however, some potential positive impacts are:

- **Improved public safety.** This is the largest positive impact, with the potential elimination of 90 percent of automobile accidents that are caused by human error.²
- **Improved mobility for the elderly, disabled and youth.** A survey found that nearly 15 million people nationwide, six million of whom are disabled, have difficulties getting the transportation they need.³ Moreover, by 2030, one in five Americans will be over 65 years old.⁴
- **Improved traffic circulation.** Assuming a 90 percent market share of driverless (mostly shared) vehicles, freeway congestion could be reduced by 60 percent.⁵ Also, vehicles cruising the street looking for parking spots account for 30 percent of current city traffic. That could potentially be eliminated with shared driverless vehicles.
- **Reduced need for parking.** In one study, no matter which scenario was tested, self-driving fleets completely removed the need for on-street parking due to the level of increased ride sharing and vehicle sharing. Additionally, up to 80 percent of off-street parking could be removed, generating new opportunities for alternative uses of this space.⁶
- **Improved personal mobility options and reduced personal mobility costs.** Each new self-driving taxi added to the fleet eliminates the need for about 10 privately owned cars.⁷ Essentially, people's mobility options will be increased substantially, so the need to own a private vehicle will be less necessary (at least in most urban and suburban areas). Among other opportunities, driverless cars could provide first/last mile transit solutions.
- **Reduced emissions.** A self-driving, electric taxi in 2030 would produce 90 percent lower greenhouse gas emissions (GHG) than a 2014 gasoline-powered privately owned vehicle, and 63 to 82 percent fewer GHG emissions than a 2030 privately owned vehicle with a hybrid engine.⁸
- **Increased road capacity and throughput.** The ability to constantly monitor surrounding traffic and respond with finely tuned braking and acceleration adjustments should enable autonomous vehicles to travel safely at higher speeds and with reduced headway (space) between each vehicle. Research indicates that the platooning of autonomous vehicles could increase lane capacity (vehicles per lane per hour) by up to 500 percent.⁹

Potential negative impacts include the following:

- **Increased vehicle miles travelled (VMT).** One study showed that VMT per driverless vehicle is 20 percent higher than non-driverless vehicles in a society with minimal vehicle and ride sharing. Additional VMT increases may be realized from induced demand as travel costs and congestion fall.¹⁰
- **Increased urban sprawl.** Regardless of the mode of available transit, people tend to live an average of 25-30 minutes from where they work.¹¹ And it is predicted that driverless vehicles could travel up to 120 miles per hour on major highways.¹² For this reason, and the ability of people to engage in activities in their vehicles other than driving, it is likely that people will be willing to live even farther from where they work, which could result in reduced accessibility to public services, increased infrastructure requirements, reduced farmland and reduced natural land.
- **Job loss.** 915,000 people are employed in motor vehicle and parts manufacturing. Additionally, truck, bus, delivery, and taxi drivers account for nearly 6 million jobs.¹³ These jobs, and others, could potentially be impacted by vehicles that do not need drivers. However, this would likely happen gradually and it is anticipated that many new jobs would also be created with the introduction of autonomous vehicles.

Driverless Vehicles Time Line

Industry experts and stakeholders have widely varying opinions on when driverless vehicles will be available. Automakers and technology developers estimate that driverless vehicle technology will be publicly available in 2018-2020; however, there are other factors that will influence the driverless vehicle time line, including consumer acceptance and adoption, government regulation, privacy and security regulations and insurance industry adjustments.

Traditional automakers like Mercedes and Toyota already make vehicles equipped with systems that keep cars within their lanes, apply brakes when necessary or park themselves. Automakers plan to gradually automate more functions of driving until, perhaps by 2025, some cars will be fully capable of driving themselves.¹⁴

On the other hand, Google, Alibaba, Baidu and other technology companies are aggressively working on their own driverless vehicles, and could leapfrog the car industry in bringing them to market. Generally, however, researchers believe that driverless vehicles will not be ubiquitous on roadways until 2025 – 2040 (and some believe even later).



Driverless Vehicle “Players”

Google, Uber, most major automakers, and other organizations are investing significantly in the advancement of driverless technology. Additionally, many research institutions are partnering with automakers to provide research support, validation and testing sites. For example, a few universities are studying the ethical questions associated with driverless cars (i.e., how to determine who gets harmed versus saved in an unavoidable accident). The following table provides a partial list of the key players in the driverless vehicle space (focused on the United States). Note: This table is not comprehensive and the list of “key players” is constantly growing.

Key Driverless Vehicle Players	Organization Names (Examples)
Automakers	Nissan, Mercedes, Tesla, Daimler, Ford, Volvo, Audi
Technology Companies	Google, Uber, Apple, Alibaba, Baidu, Easy Mile, Navya
Research Institutions	Carnegie Mellon University Traffic21 Stanford University's Center for Automotive Research University of California, Berkeley's PATH Program University of Michigan Transportation Research Institute Virginia Tech Transportation Institute
Federal Government	United States Department of Transportation National Highway Traffic Safety Administration Federal Highway Administration Federal Transit Administration Federal Motor Carrier Safety Administration Intelligent Transportation Systems Joint Program Office
State Government	California Department of Motor Vehicles California Department of Transportation Michigan Department of Motor Vehicles Virginia Department of Transportation
Local and Regional Government	Contra Costa Transportation Authority (Bay Area, California) Tampa, Florida Ann Arbor, Michigan Los Angeles, California Austin, Texas

Chapter 2:

OUR DRIVERLESS VEHICLE FUTURE

Our Driverless Vehicle Future

This chapter introduces two extreme visions of how society could look in the long term as driverless vehicles become integrated into society. It also outlines a potential path for how society could evolve from today's manually operated cars to tomorrow's driverless vehicles. While envisioning this future may seem like a fantasy, it is important to visualize this futuristic world in order to understand the potential implications on our cities. Ultimately, envisioning a driverless vehicle future could help guide government agencies' decision-making in the near and long term ([see chapter 5](#)).



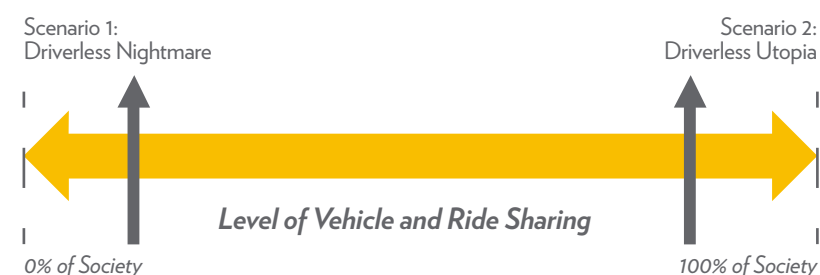
Potential Future Scenarios

It is unclear when society will fully adopt and integrate driverless vehicles; however, we will likely see increasing numbers of driverless vehicles in the 2025-2030 time frame. The graphic on page 8 presents two extreme options for what our society could become: a driverless “nightmare” or a driverless “utopia.”

These scenarios are highly dependent on the level of ride sharing and vehicle sharing that occurs, although there are other factors to consider as well. There are significant differences between ride sharing and vehicle sharing, as described below:

- **Vehicle sharing** refers to people owning a vehicle and sharing it rather than purchasing a vehicle with others. Since vehicles are empty 95 percent of the time,¹⁵ vehicle sharing maximizes the vehicle's potential while also minimizing the parking requirements associated with idle cars. The ease of vehicle sharing is greatly enhanced by driverless vehicles due to two factors:
 - 1) Technological advancements allow for sharing vehicles easily via a Smartphone app (similar to Airbnb or Uber); and
 - 2) Vehicles can be "delivered" without any person-time required as drivers are not needed.
- **Ride sharing** refers to vehicles that are occupied by more than one person. This refers to buses, car pools or van pools, or a mobility service (e.g., Lyft Line, Uberpool). Ride sharing can occur regardless of who owns the vehicle; the key is that vehicles on the road are shared, as this greatly increases each vehicle's utilization rate and reduces demand for parking in crowded urban areas. The benefits of ride sharing are expanded further when ride sharing enables dynamic trip matching for multiple passengers. The ease of ride sharing is greatly enhanced with driverless vehicle technology due to two factors:
 - 1) The perceived time loss or stress associated with picking up and dropping off other passengers will be minimized because people will not have to drive or navigate; and
 - 2) The cost of ride sharing services will likely decrease significantly as drivers will not be needed.

While the "nightmare" and "utopia" scenarios may present extreme options, this is intentional in order to present cogent visions for the future. These scenarios will, ultimately, allow for the development of planning activities and policy guidelines that support the preferred outcome. The reality will likely be a combination of the two scenarios, each of which is described in more detail below.



Scenario 1: Driverless Nightmare

Vision: People love the new freedom driverless vehicles afford them and they typically travel alone in their own (privately owned) vehicle because they do not want to sacrifice the time needed to share the ride. Moreover, people send their vehicles to run their errands and, when not in use, to park in a remote parking lot. Many have chosen to live far from their jobs, which increases urban sprawl and the overall level of travel due to the convenience of driverless vehicles. The significant increase in vehicle miles travelled results in increased traffic and road capacity needs. Shared trips are, for the most part, taken by low-income individuals who use ride sharing to supplement limited public transportation options.

Key Attributes:

- **Technology:** All vehicles operate only in driverless mode.
- **Mobility Options:**
 - o Cars are mostly privately owned, but even when people use mobility services, they do not share rides.
 - o Public transportation is limited. It is in place, for the most part, to support low-income individuals. It is highly subsidized and targeted at specific neighborhoods. Public transportation is, otherwise, unnecessary because people rely on their own vehicles.
- **Government Role:** The government allows the private sector to control and influence the mobility marketplace. Most government actions are reactive.
- **Key Impacts on Society:**
 - o Vehicle miles travelled (VMT) increases dramatically due to longer commuting distances (urban sprawl), lack of trip linking, more people using vehicles (e.g., elderly, disabled), and lack of ride sharing. This results in increased congestion and travel times.
 - o Government must increase road capacity due to the significant increase in VMT.
 - o Parking needs remain the same as the current day due to a similar private ownership model. (Parking spaces are relocated because cars can park themselves remotely.)
 - o Low-income people must live in the few neighborhoods that still have public transit in order to access their jobs.
 - o Irrespective of VMT increase, greenhouse gas (GHG) emissions are significantly reduced as many driverless vehicles will likely be electric.

Supporting Study:

- The International Transport Forum (ITF) conducted a study to examine the potential impacts of a fully shared, driverless fleet of vehicles in Lisbon, Portugal. A simulation model found that if 50 percent of car travel is by shared self-driving vehicles and the remainder by traditional human-piloted cars, total vehicle travel will increase between 30 percent and 90 percent. This was true regardless of the availability of high-capacity public transport.¹⁶

Scenario 2: Driverless Utopia

Vision: There are so many cost-effective and reliable transportation options available that people will not need to own their own cars (or they will own cars that they choose to share when they're not using them). Transit agencies (in partnership with private companies) are the main providers of the driverless shared vehicles. Privately owned cars are not necessary or desirable in urban and suburban settings. In rural settings, vehicle and ride sharing are the norm. Moreover, this high level of sharing has increased each vehicle's level of usage. Vehicles reach the end of their useful lives and are replaced sooner, thus allowing the earlier introduction of new vehicle technology.

Key Attributes:

- **Technology:** All vehicles operate only in driverless mode.
- **Mobility Options:**
 - o Public Transportation: high-speed rail, commuter rail and other long-distance rail options are fast, reliable and competitively priced with single or shared ride services. Driverless vehicles dynamically provide first-mile and last-mile solutions at lower cost than traditional transit service.
 - o Cars are mostly owned by businesses providing mobility services. Individuals may purchase their own car; but will likely share their vehicles when they're not using them.
 - o Use of alternative transportation increases due to safer roadways and more opportunities for bicycling and walking.
- **Government Role:** The government provides competitive public transportation options while regulating safety. Additionally, travel demand is proactively managed through the use of updated land use, parking and road pricing policies combined with taxation.
- **Key Impacts on Society:**
 - o VMT either stays the same as today or increases, but congestion and travel times are improved due to reduced vehicle headways, faster roadway speeds and fewer accidents.

- o Government policies discourage urban sprawl in order to keep commute times and VMT reasonable.
- o Road capacity needs decrease.
- o Parking needs decrease substantially due to the reduction in single-occupancy vehicle/privately owned cars.
- o Low-income individuals have excellent access to mobility options – both public transportation and other shared driverless rides.
- o Irrespective of VMT increase, GHG emissions are significantly reduced due to the high likelihood that many driverless vehicles will be electric.

Supporting Studies:

- The aforementioned ITF study found that shared driverless vehicles, combined with high-capacity public transportation, could remove 9 out of 10 cars in a mid-sized European city, but would increase VMT. Additionally, most on and off-street parking could be removed.¹⁷
- Based on a 2014 study completed at the Massachusetts Institute of Technology, data suggested that a shared-vehicle mobility solution in Singapore could meet the personal mobility needs of the entire population with a fleet whose size is approximately one-third of the total number of passenger vehicles currently in operation.¹⁸
- A Columbia University study modeled the impacts of shared driverless fleets on three environments: a mid-sized U.S. city (Ann Arbor, Michigan), a low-density suburban development (Babcock Ranch, Florida) and a large and densely populated urban area (Manhattan, New York). The study found that for the 120,000 residents of Ann Arbor who travel less than 70 miles a day, the shared fleet could provide near-instantaneous access to a vehicle on request with just 15 percent of the vehicles currently needed for these trips. However, overall travel would increase due to the need for repositioning vehicles. Similar findings emerged from the Babcock Ranch case study (3,000-4,000 vehicles for a projected population of 50,000 people). In the case of Manhattan, the study found that a fleet of 9,000 taxis could replace all of the trips taken today by more than 13,000 taxis with average waiting times of less than one minute (much lower than today).¹⁹

Scenarios Summary

The following table presents a summary of these scenarios, including their attributes and impacts. As mentioned earlier, these scenarios are purposely depicted as extremes in order to demonstrate the consequences for society. The future will probably fall somewhere in

between these scenarios. Regardless, the level of impact will largely be determined by government policy.

Impacts Summary of Driverless Vehicle Future Scenarios
(Changes from Today)

	<i>Driverless Nightmare</i>	<i>Driverless Utopia</i>
<i>Safety</i>	↑	↑
<i>VMT</i>	↑	↓
<i>GHG Emissions</i>	↓	↓
<i>Urban Sprawl</i>	↑	↓
<i>Parking Requirements</i>	No Change	↓
<i>Roadway Maintenance Requirements</i>	↓	↓
<i>Low-Income Mobility</i>	↓	↑

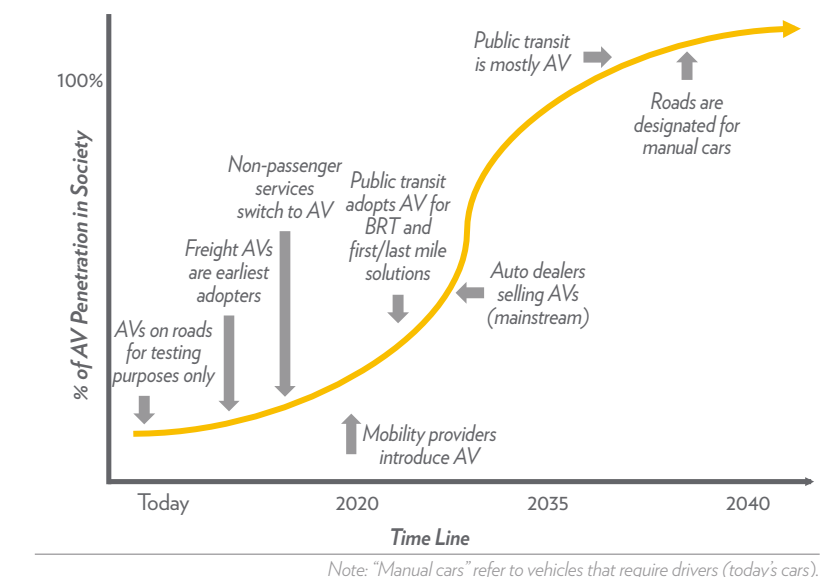
No matter the scenario, there are a few impacts that are likely in a future driverless vehicle society, including increased safety, increased VMT and decreased GHG emissions. Driverless vehicles eliminate the human factor, which, in all forecasts, will significantly reduce the number of vehicle accidents. VMT will likely increase as the cost of travel decreases and more people are able to drive. The experience for passengers in a vehicle will greatly improve, and vehicles will be able to complete trips without anyone in the car. Finally, GHG emissions will likely be significantly reduced due to the likelihood that many driverless vehicles will be electric.

Path to Driverless Vehicles

It is yet to be seen exactly how driverless vehicles will be integrated into society; however, it will likely be a gradual evolution that occurs over the next few decades. As the technology continues to be developed and tested, driverless vehicles will appear first on closed campuses (e.g., colleges and military bases) and then on highways, with freight vehicles appearing first. It is likely the mobility providers (e.g., Uber,

Lyft and automakers) and then public transit agencies will follow suit. Public transit agencies may see early opportunities to test driverless vehicles with bus rapid transit or other protected and fixed guideway services. Additionally, driverless vehicles may provide first/last-mile services to transit via driverless shuttles. In the short term, we may see driverless vehicles used in services that do not have passengers, such as street cleaning, parking enforcement, or delivery services. The following graphic illustrates how this concept may evolve over time.

As of January 2016, driverless vehicle testing is taking place on closed campuses in places like MCity (the University of Michigan's test site), Santa Clara University and the Contra Costa Transportation Authority's GoMentum test site. Additionally, driverless vehicles are being tested on highways in mixed traffic.



In the future, it is likely that the roll-out of driverless vehicles on highways will happen more quickly than on local roads due to the more predictable operating environment of highways, including consistent lane markings and signage and significantly fewer physical obstacles than local roads.

Over time, it may be viewed as less safe to have conventional manual vehicles on the roadways. In fact, during a transition period when both conventional and self-driving vehicles would be on the road, the risk for conventional vehicles could be elevated.²⁰ At some level of driverless vehicle proliferation, it's possible the government might certify or approve only certain lanes as acceptable for manual vehicles or ban manually operated vehicles outright ([see chapter 5](#)).

Chapter 3:

GOVERNMENT'S
CURRENT ROLE
IN DRIVERLESS
VEHICLES**Government's Current Role in Driverless Vehicles**

Currently, the government's role in the burgeoning driverless vehicle industry is limited. This chapter describes the government's role as of January 2016 at the federal, state and local levels in the United States.

Federal Government Role

At the federal level, the National Highway Traffic Safety Administration (NHTSA) is supporting some initial research in automated vehicles, human interactions with automated vehicles, and performance and safety requirements.²¹ The organization has also established a classification system for various levels of vehicle automation ([see chapter 1](#)). NHTSA issued policy guidance with recommendations (not requirements) for states that have authorized the operation of self-driving vehicles, including how to ensure safe operation of the cars throughout the testing phase.²² Many of the federal government's efforts have been focused on funding research and policy development on connected vehicles, including getting pilot programs off the ground.

State Government Role

At the state level, a wide variety of laws and regulations have been enacted or implemented. As of January 2016, California, Michigan, Florida, Nevada, Tennessee and Washington D.C. have enacted legislation allowing limited driverless vehicle testing on public roadways.²³ Related legislation is pending in many other states. The statutory language varies among the states and the focus of legislation varies among these topics:

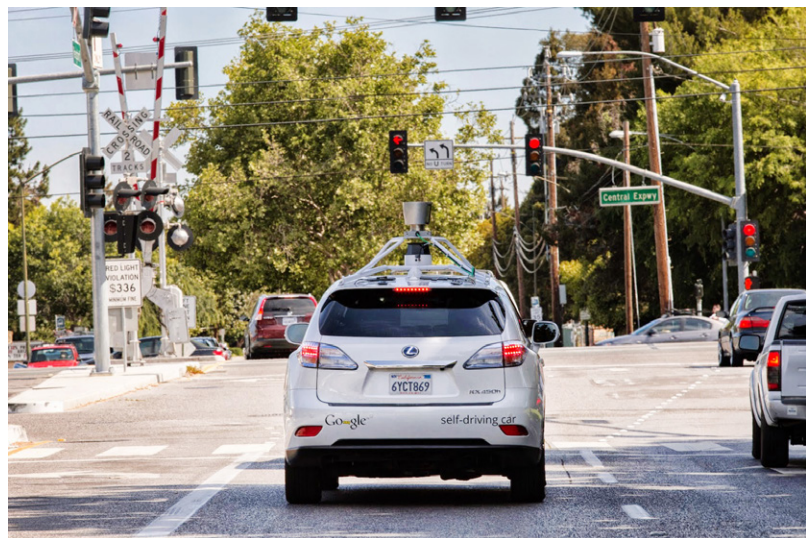
- The "drivers" (people sitting behind the steering wheel) need to be pre-approved and they need to have proof of training by the manufacturer;
- These "drivers" must also have the ability to take over control of the car (via a steering wheel, gas pedal, and brake pedal, at a minimum) at any time;
- Manufacturers are required to maintain some level of insurance coverage;
- Manufacturers need to show that their driverless vehicles have been tested and can safely comply with all applicable traffic laws;
- Driverless vehicles must store sensor data for a pre-established amount of time; and
- Some reporting (of incidents, at a minimum) is required.

Currently, there is little consistency or precedent on a safety and licensing framework among the existing and emerging legislation. Some states have opted against the creation of new regulations for driverless vehicle

testing or operation because of concern that previous laws have stunted research in those states that passed testing regulations.²⁴

Local Government Role

Local government involvement in the advancement of driverless vehicles is minimal. A few cities are making the news as driverless vehicles are being tested on their streets (notably Mountain View, California and Las Vegas, Nevada); however, the cities are not necessarily investing in the technology or actively forming partnerships with the technology developers.

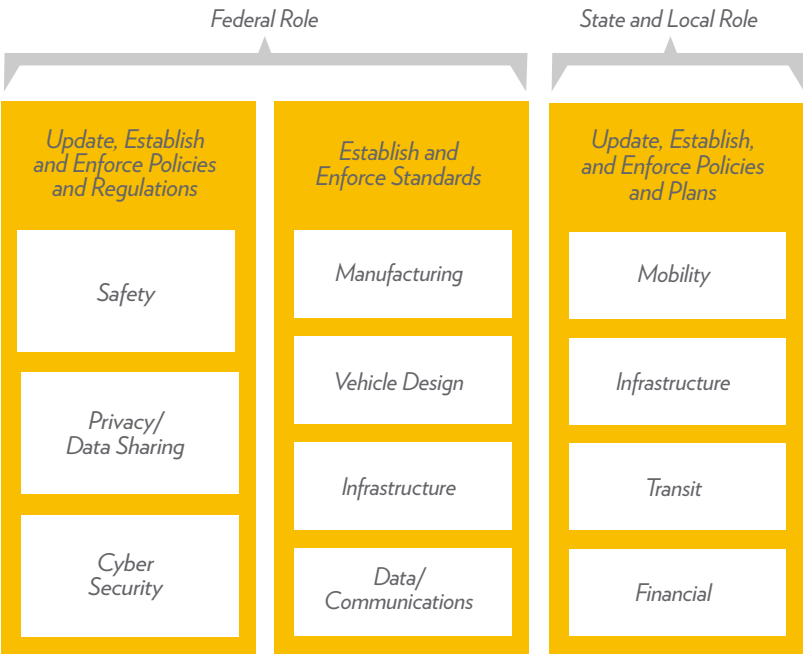


Chapter 4:
PROPOSED
GOVERNMENT
ROLE IN DRIVERLESS
VEHICLES

Proposed Government Role in Driverless Vehicles

The following section describes the aspects of driverless vehicles that will likely require government involvement now or in the future. As shown in the graphic below, the federal government will likely need to update, establish and enforce policies and regulations related to safety, privacy/ data sharing and cyber security, in addition to establishing and enforcing vehicle and safety standards. On the other hand, state and local governments will need to update, establish and enforce policies and plans for mobility, infrastructure, transit and financials. This will maintain the government’s role in protecting individuals’ safety and improving mobility around the country.

Proposed Government Role in Driverless Vehicles



Proposed Federal Government Role in Driverless Vehicles

It is crucial that the federal government proactively establish policies and regulations for driverless vehicles to ensure that passengers and bystanders are safe, but also because it is inefficient, costly and confusing for stakeholders to comply with multiple, disparate state laws. The following are issues that are most appropriately addressed at the national level:

- **Safety.** The federal government should lead the charge in establishing (or updating existing) safety standards for driverless vehicles, similar to those already in place by NHTSA. Specifically, the federal government could establish standards for manufacturing, vehicle design, infrastructure, and all aspects of data and communications – all with the intent of improving safety on our roadways.
- **Privacy/Data Sharing.** Because driverless vehicles will gather a large volume of data to operate most effectively, there are significant concerns about data ownership, collection and use. The federal government should, as it has with other data-rich industries, require that the driverless vehicle industry is secure and transparent with consumers about data ownership, storing, sharing and security breaches.
- **Cyber Security.** Driverless vehicles could be targets for terrorists, and an attack carries the risk of significant, coordinated traffic disruptions or collisions. The National Institute of Standards and Technology (NIST) is currently developing a framework to improve critical infrastructure cyber security.²⁵ It is vital that the government ensures that this encompasses the risks associated with driverless vehicles.

It should be noted that many of the issues described above are relevant for connected vehicles as well.

Proposed State, Regional and Local Government Role in Driverless Vehicles

Driverless vehicles have the potential to impact states and municipalities in a number of ways, with the greatest impact being significantly improved safety. Other potential effects include:

- Traffic congestion and tax revenues may increase or decrease;
- Current public transit options may need to become more competitive;
- Parking needs may decrease; and
- Roadway infrastructure may need to be adapted (to name a few).

Local governments will need to plan for these many changes and influence outcomes by enacting thoughtful policies.

Depending on the governance model of a particular region, various local entities will have jurisdiction over driverless vehicles. These local, regional and state governments could include transit agencies, metropolitan planning organizations, air quality districts, departments of transportation, highway departments, departments of motor vehicles, departments of insurance and departments of public works.

The following are a range of issues that are most appropriately addressed at the local level:

- **Mobility.** There are many factors that will influence the level of congestion within and around our cities. As described in [chapter 2](#), the level of ride sharing and the competitiveness of public transportation will be significant factors. Additional factors include: increased mobility options for the elderly, disabled and youth populations; people being willing to live farther from their jobs; and increased road capacity due to shorter headways between vehicles and reduced parking requirements.
- **Infrastructure.** Depending on the evolution of driverless vehicles (and connected vehicle technology as well), local infrastructure will need to keep pace. Specifically, local governments may need to update and reconfigure signage, speed limits, signal timing, roadways and parking spaces.
- **Transit.** As driverless vehicles become more popular, everything from service coverage to vehicle types to labor requirements stands to change. Transit agencies will need to rethink their services, labor needs and fee structure in order to stay competitive in the new transportation environment.
- **Financials.** The widespread use of driverless vehicles will have potentially significant financial consequences for local governments. Taxes, parking fees, speeding tickets, parking real estate and incident management are just a few of the revenues and costs likely to be impacted. Moreover, local government may need to identify new sources of revenue to pay for infrastructure.

In the near term, states are in a position to provide regulations regarding the testing and public use of driverless cars. States will also likely determine the licensing requirements associated with driverless cars. Researchers from the University of Michigan Transportation (UMTRI) suggest that self-driving vehicles should be subject to a license test.²⁶

The following chapter describes specific actions the state, regional, and local governments can take both now and in the future to proactively address the issues likely to arise from the proliferation of driverless vehicles in our society.

Chapter 5:

LOCAL, REGIONAL AND STATE RECOMMENDATIONS FOR ACTION

Local, Regional and State Recommendations for Action

As outlined in [chapter 1](#), driverless vehicles will have significant impacts on society. Local, regional and state governments need to start planning for these impacts now. In fact, governments need to consider the following planning and policy actions over the next decade, as the driverless vehicles roll-out is well within typical transportation planning time frames:

- Near-term planning activities.
- Medium- to long-term activities, including planning and infrastructure modifications.
- Policy development.

While short-term planning activities need not be excessively time consuming or labor intensive, policy development and medium- to long-term activities will require significantly more resources and political will. It should be noted that the anticipated benefits far outweigh the costs associated with these activities.

Near-Term Planning Activities

As described in [chapter 1](#), the next few years will likely be a time for continued development and testing of driverless technology. The recommendations outlined for the near term are focused on supporting the advancement of the technology and positioning the government to successfully plan for the future driverless vehicle society.

1. Stay Educated on Driverless Vehicle Progress

It is vital that local, regional and state governments become educated on the state of this constantly evolving disruptive technology. Government representatives should follow the development of driverless vehicles – both with respect to technology advancement and policy development, in the United States and internationally. While many aspects of the technology are being developed confidentially, there is plenty of publicly available information from which to learn. These are a few suggested approaches to monitoring these developments:

- Subscribe to *ITS America Smartbrief* and attend local and national ITS conferences.
- Follow the Transportation Research Board (TRB) Vehicle Highway Automation Committee.
- Subscribe to the Association for Unmanned Vehicle System's International (AUVSI) listserv and attend AUVSI conferences.
- Set up a weekly news alert for “driverless vehicles” and “driverless cars.”

- Follow blogs for emerging developments in driverless vehicles, such as my own [Driving Towards Driverless blog](#) or [Driverless Car Market Watch](#).

Other reports and websites can be found in the Additional Resources section at the end of this guide.

2. Incorporate Driverless Vehicles into City Goals

Driverless vehicles present an opportunity for state and local governments to meet many of their goals. Many cities are undertaking Vision Zero initiatives, setting greenhouse gas reduction goals, increasing transit cost-effectiveness goals, and aiming to enhance freight mobility. Government agencies may consider evaluating how driverless vehicles could directly impact long-range goals such as these. The USDOT report, [Benefits Estimation Framework for Automated Vehicle Operations](#), provides an approach for estimating the potential benefits associated with automated vehicles.

3. Establish Communications and/or Coalition with Driverless Vehicle Stakeholders

Ideally, government entities will become partners with this ever-growing community. Stakeholders to consider include local representatives from the “key players” listed in [chapter 1](#). Participation in a coalition can be a way to garner or provide valuable input as policies and plans are developed in future years.

4. Support Testing Activities

States will likely continue to be responsible for driverless vehicles’ licensing and testing requirements. This includes establishing the standard for who can “drive” (or be responsible for) a driverless vehicle, and how and where the vehicle must be tested. This guide does not have any specific recommendations for these requirements; however, consistency among states and collaboration with the technology developers is recommended.

Additionally, government entities might consider offering government-owned closed-campus land parcels as locations for technology developers’ testing. Examples include: college campuses (e.g., Santa Clara University), islands, and former military bases (e.g., GoMentum). This can support the advancement of the technology while also keeping government informed and connected to its private industry partners.

5. Establish Policies and Plans with Consideration for the Future

In addition to increasing awareness of driverless vehicle technology, local, regional and state governments should develop plans and policies with an eye to the future and a focus on safety. The ability to create plans and policies that are flexible and easily updated will be vital as technologies evolve and society’s needs change. For example, a transit

agency’s fleet management plan may specify vehicle needs for the next 30 years; however, it should also acknowledge the potential for a significant change in vehicle technologies and vehicle sizes. Additionally, plans for expanding roadways and parking may end up being unnecessary and these possibilities should be incorporated in agencies’ planning functions and vehicle procurement.

6. Encourage Open Data Sharing

As more information becomes available, the government is in a position to encourage the open sharing of data. While it is important to preserve people’s privacy, open, anonymized data can improve government decision-making and help the government to develop more informed policies and plans. Information on what open data is and why it’s important can be found on the website of [Government Technology](#).

Private companies may not be willing to share their data. In order to motivate these private companies, government may consider giving companies strong tax incentives for sharing data for the public good. Additionally, public and private companies will need to work together to identify models for data sharing in ways that respect personal privacy and security.

Medium to Long-Term Recommendations

The following recommendations present activities that will likely need to happen irrespective of which driverless vehicle scenario occurs. These include planning activities, infrastructure modifications and a few additional miscellaneous activities.

Planning Activities

The following activities represent short-range and long-range planning considerations that will continue to evolve over the next few decades. It will be important to reevaluate these activities as driverless vehicles become more pervasive.

1. Update travel demand model

As more information about driverless vehicles and their usage becomes available, travel demand models will need to be updated. Ideally the models should include updated information regarding who is traveling (i.e., elderly and disabled may travel more with access to driverless vehicles), where people are living and working, how many trips they are taking, how they value the time while traveling, what level of shared rides are occurring, and the vehicle ownership model. The models should also capture any changes associated with freight delivery. All of these factors are likely to impact travel behavior. Modeling these impacts will likely be refined as the technology is developed further; however, a research paper prepared by staff of the [Puget Sound Regional Council](#) describes one approach to updating an existing activity-based travel model.

2. Evaluate Road Capacity Needs

It is recommended that based on findings from the travel demand models, government agencies update long-range plans to consider whether driverless vehicles will result in increased or decreased congestion, and develop strategies to address increased congestion if warranted. Road congestion may increase or decrease depending on whether or not VMT increases or decreases and whether or not vehicle throughput is increased ([see chapter 2](#)).

3. Assess transit service delivery plans and fleet requirements

Transit agencies should seek to leverage driverless technology to maximize the cost-effectiveness of their service while ensuring equitable, fairly priced mobility options for everyone. As such, transit agencies will need to evaluate the full mobility eco-system (and how it has evolved in recent years with many private companies getting involved) to determine the appropriate level and location of transit services. Transit agencies might consider the following:

- Leverage private mobility companies to provide first/last mile solutions to longer-distance transit services.
- Transition the transit fleet to leverage driverless technology – potentially beginning with bus rapid transit and other services operating in protected guideways.
- Transition or subsidize paratransit services to private mobility companies.

Transit agencies will also need to reevaluate their fleet management plans in order to incorporate driverless vehicles in their fleets. This will have significant implications for labor requirements (and union agreements), maintenance facilities, maintenance workers and the safety and security of passengers. Note: This applies to public school bus systems as well.

4. Forecast financial implications

A cross-functional group of stakeholders and government officials should examine every line item of the budget to evaluate the potential financial implications of driverless vehicles. Examples of items to consider are:

- Parking revenues (or alternate revenues associated with land previously used for parking).
- Speed ticket violation fees.
- Tax revenues related to vehicle purchases, registration fees, and VMT.
- Health and life insurance costs.
- Transit agency costs and revenues.
- Incident management costs.

- Insurance costs.
- Government fleet transition to driverless vehicles.
- New enforcement activities.
- Unemployment insurance.

Note: Driverless vehicles could provide opportunities for municipal services to be delivered more cost-effectively as well.

Infrastructure Modifications

The following activities highlight the many infrastructure changes likely to be necessary over the next couple of decades. Many of these will not be determined until driverless vehicle technology is more fully developed and, in some cases, not until these vehicles are widely used on roadways. However, some may be necessary prerequisites for driverless vehicles to be able to operate efficiently and safely.

1. Update traffic signs and markings

Local governments should monitor and provide feedback on any updates to the Federal Highway Administration's [Manual on Uniform Traffic Control Devices](#) (MUTCD). This document provides information on changes to standards regarding how traffic signs, road surface markings, and signals are designed, installed and used.

2. Reduce lane width

Assuming lanes are marked appropriately, driverless vehicles will not require the traditional 10-12 foot lane widths on local roads or highways. Reducing the width of lanes might not be a necessity, but it could increase the capacity of roadways, provide added space for bike lanes, and/or improve walkability.

3. Alter speed limits

Driverless vehicles will travel at or below the speed limit specified on roads. In a fully driverless vehicle environment, it might be just as safe to have higher speed limits in some areas, especially highways, and speed limits in urban areas could also be adjusted to maximize safety benefits. It is likely that the methods for setting speed limits will change over time. Federal guidance regarding speed management safety can be found on the [FHWA website](#).

4. Adjust traffic signal locations and timing

A fully driverless vehicle society will likely introduce entirely new travel patterns. As a result, the local government might need to alter traffic signal locations and timing. In the future, traffic signals may be unnecessary or they may be highly adaptive to current traffic flow. This introduces new concerns regarding pedestrian and biker safety. Additionally, local governments may consider prioritizing pedestrians, cyclists, transit, and shared-occupancy vehicles at intersections.

5. *Eliminate/reduce parking and add more drop-off/pick-up locations*

As mentioned in [chapter 2](#), many parking spaces (both on-street and off-street) may be unnecessary due to the potential for reduced private vehicle ownership and the ability of driverless vehicles to park themselves in remote locations. On the other hand, parking spaces might still be necessary, but they could be relocated, potentially outside of city centers. For these reasons, more infrastructure for passenger pick-up and drop-off locations may be required. Additionally, parking space sizes could be reduced.

6. *Add electric vehicle charging infrastructure*

Most forecasts and studies assume that driverless vehicles will utilize electric-powered vehicles. This technology is still evolving; however, it is likely that public infrastructure, including parking spaces and pick-up/drop-off locations could better support mobility by providing electric charging stations. Moreover, “dynamic wireless power transfer” technology may provide mobile charging to vehicles via roadways while in motion.²⁷ The [U.S. Department of Energy’s website](#) has useful information about this technology.

7. *Develop new predictive models for pavement maintenance*

The timing for pavement maintenance may be quite different from today’s requirements. Level of roadway usage would significantly increase or decrease (depending on whether or not VMT increases or decreases) and driverless vehicles may be lighter and operate in a way that has less impact on the roadway.

8. *Designate/certify roads for driverless and/or manual operation*

Designating or certifying roads for driverless vehicles implies that the roadway owner (a government entity) would provide some framework for evaluating and confirming that a roadway is acceptable for a specified usage. It is debatable whether or not this will be needed. Some see designated roadways as inevitable since government agencies will assume some level of responsibility for the “driving public.” Others think that certifying roadways (whether for driverless or manually operated cars) would be too resource-intensive and would also result in a higher level of liability than would be reasonable. Examples of certification requirements may include:

- Clear markings or signage for the vehicles to read.
- Electronic communications/updates regarding speed limits.
- Appropriate signage regarding construction zones.
- Communications to other road users about the vehicle types allowed on that roadway.

Miscellaneous

The following activities do not fit into any of the previous categories. They include updating of enforcement and incident management functions of local government.

1. *Update enforcement function within government*

Existing enforcement activities, including the pursuit of speed limit evaders and drunk drivers, will likely be completely unnecessary in a driverless vehicle society. In fact, the enforcement requirements will likely shift to include the following types of activities:

- Certifying roadways and ensuring driverless vehicles are driving safely on these roadways.
- Ensuring the safety of transit passengers.
- Ensuring any managed roadways (Express Lanes, HOT lanes, etc.) are collecting appropriate revenues and that transit passengers pay fares.
- Ensuring data is shared appropriately.

2. *Update incident management function within government*

Currently, the government spends a significant amount on responding to accidents and even removing roadkill. While some level of vehicle accidents will be inevitable, the number of incidents is forecasted to decrease substantially. As such, the local government can reduce that function and potentially reduce costs.

3. *Incorporate driverless vehicle technology into government services*

The government provides many services and conducts many activities that could involve vehicles without passengers. These are potential early opportunities for the government to consider testing and incorporating driverless technology into their operations. Examples include street cleaning and parking enforcement.

4. *Update government workforce to match needs*

There is no question that, irrespective of which scenario ([from chapter 2](#)) occurs, the government’s role will need to change. As such, it will be necessary for the government at all levels to ensure that its workforce has the skills needed to fill various positions and functions that emerge as people change their travel behavior and patterns. While this is hard to predict at this point, it will be important to follow driverless technology developments around the world and invest in training throughout this time of significant change.

Policy Activities

As outlined in [chapter 2](#), driverless vehicles could create a “driverless utopia” or a “driverless nightmare.” This guide assumes that local, regional and state governments will want to take actions that encourage moving toward the “driverless utopia” scenario. The following activities represent policies that the government could put in place to influence how driverless vehicles can affect VMT, urban sprawl and/or parking requirements. These policies could be put in place at any time; however, the sooner they are in place, the sooner any potential negative impacts of driverless vehicles could be mitigated.

1. *Update roadway policies and infrastructure to manage the VMT impact*

Unless a ride-sharing model prevails, driverless vehicles will likely encourage people to increase their travel significantly. With the propagation of electric vehicles, the cost of fuel likely decreasing, and the expectation they will be productive while in their car, people may travel more often and for longer distances. For that reason, the following changes to roadways may help to dis-incentivize this potential increase in VMT by encouraging shared mobility models:

- Adopt or increase roadway tolls in general and/or specifically for single-occupancy vehicles.
- Add or designate more high-occupancy vehicle (HOV), high occupancy toll (HOT), and express lanes.
- Add congestion pricing in and around urban areas or downtown cores/central business districts.
- Develop policies for managing the likely need for more curb space for pickups/drop-offs, and provide priority access for high-occupancy vehicles.

2. *Adjust land use policies to reduce urban sprawl*

Driverless vehicles present the possibility of people being willing to live much farther away from their workplaces since their commute times may be newly productive. For that reason, it will be important for local governments that wish to reduce urban sprawl to establish specific policies to encourage high-density, walkable communities.

Examples include:

- Add more transit-oriented development and transit service, in order to allow better hubs for driverless vehicle pick up and navigation.
- Make pedestrian access to destinations (housing, schools, stores) faster and easier by minimizing the space allocated to parking lots and parking garages.

- Create policies and processes that encourage developers to build walkable communities.
- Create and enforce urban growth boundaries
- Develop policies that make greenfield development and septic-based development very expensive and onerous while, similarly, supporting infill development.
- Improve the quality of the schools in the urban core.

3. *Adjust the tax/fee structure to dis-incentivize car ownership and/or parking*

Driverless vehicles may result in an increase in single occupancy vehicle trips (and, ultimately, increased VMT). Taxes and fees can be increased or decreased to incentivize sharing rides and dis-incentivize private car ownership and single-occupancy vehicle rides. Examples of taxes that can do this include:

- Sales tax or vehicle license fee on private vehicle purchases.
- Tax on VMT.
- High fees for public parking and high taxes for private parking.
- Reduced (or even subsidized) costs and parking fees for shared ride services.
- Reduced (or even subsidized) costs for bike share, shuttles and other first/last mile solutions.
- Leverage driverless vehicle services for local “guaranteed ride home” programs so commuters feel confident they can get home regardless of how they got to work.²⁸

4. *Alter parking policies to reduce the need for private parking*

If people own driverless vehicles and rarely share them, parking needs will probably remain similar to today or increase commensurate with the population. On the other hand, increased ride sharing and vehicle sharing could significantly reduce or alter parking requirements. Parking policies can be established to minimize the land dedicated to parking and manage where parking spaces are located. Examples include:

- Eliminate minimum parking requirements in zoning laws and encourage more pick-up/drop-off locations at developments.
- Require developers to pay for the right to develop parking spaces and use that funding to pay for parking in designated (and possibly remote) locations.
- Establish a city-wide limit on parking spaces.
- Dedicate parking spaces for shared vehicles.

- Institute variable-priced parking to proactively manage how parking spaces are used.
- Establish policies requiring all new parking facilities to be designed and built to be adaptable (since they may not be needed for parking in the future). Key elements of adaptability are flat floors, comfortable floor-to-ceiling heights, and enough loading capacity to support another structural use.²⁹

Other examples of parking management policies can be found in [*Parking Best Practices: A Review of Zoning Regulation and Policies Pertaining to Parking*](#), produced by the New York City Department of City Planning.

5. Change transit pricing

As described earlier in this section, transit agencies will need to determine the appropriate level and location of transit service. For example, smaller transit vehicles with dynamic service may make public transit competitive with private vehicles and other mobility providers. In conjunction with this planning effort, it will be important to evaluate transit's "competition" and ensure that transit service is competitively priced and comparable in reliability, convenience and safety. Transit has always been subsidized and this will likely need to continue – especially if it is intended to support the low-income population and potentially low-ridership routes. Without reduced labor costs – including salaries, benefits and pensions – there is a real opportunity for transit agencies to become more competitive and financially sound through the use of driverless transit vehicles.

Chapter 6: CONCLUSION

Conclusion

Driverless vehicles are coming, with or without government involvement, and there is no question that they will have a significant impact on society. People may choose to live farther from their jobs, roads may become more congested, and public transportation may no longer exist. On the other hand, road safety may be drastically improved and current non-drivers may have new mobility options. The driverless vehicle could, literally, change how we approach all aspects of life.



PASCAL GOETGHELUCK/SCIENCE PHOTO LIBRARY

Simultaneously, the lines between public and private responsibilities with regard to mobility are blurring. Automakers are becoming service providers, the taxi business model is becoming obsolete, and ride-hailing companies are providing new mobility options. This has created new “competition” for public transit and, as such, is requiring the government to rethink its role in mobility. These changing perspectives, combined with the potential of driverless vehicles to transform all transportation sectors, creates a huge opportunity for local, regional, state and federal governments to use driverless vehicles to meet their transportation, land use and mobility goals.

With the coming of driverless vehicles, government at all levels in the United States has the opportunity to proactively establish goals and policies that can continue to support the driverless vehicle revolution while keeping the traveling public safe and mobile. If successful, the U.S. experience could be a model for other countries.

Glossary

Automated vehicles (AV) – Vehicles that use advanced technologies to assist a driver. Fully automated vehicles are driverless. See definitions in [chapter 1](#).

Driverless Vehicles – Vehicles that are designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. See definitions in [chapter 1](#).

Connected Vehicles (CV) - Connected vehicle safety applications are designed to increase situational awareness and reduce or eliminate crashes through vehicle-to-infrastructure (V2I), vehicle-to-vehicle (V2V), and vehicle-to-pedestrian (V2P) data transmissions.

Function-Specific Automation – The National Highway Traffic Safety Administration's (NHTSA) definition of the lowest level of automation. It involves one or more specific control functions (either independent or working in unison), such as self-parking assist or cruise control.

Global Positioning System (GPS) – One of the key technologies in driverless vehicles. GPS is a space-based navigation system that provides location and time information in all weather conditions.

Lidar – One of the key technologies in driverless vehicles is Lidar. It is a spinning light detection and ranging system that allows reflections from the spinning lasers to produce a point cloud. It can sense movement all around and is therefore fully aware of all objects on all sides and tracks them in real time.

Limited Self-Driving Automation – This is NHTSA's third level of automation. It refers to vehicles that enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions. The driver is expected to be available for occasional control, but with sufficient transition time.

Mobility Providers – Public and private organizations that are providing transportation services to the traveling public. These may include public transit agencies, transportation network companies (e.g., Uber and Lyft) and taxis.

National Highway Traffic Safety Administration - NHTSA is responsible for reducing deaths, injuries and economic losses resulting from motor vehicle crashes. This is accomplished by setting and enforcing safety performance standards for motor vehicles and motor vehicle equipment, and through grants to state and local governments to enable them to conduct effective local highway safety programs.

Personal Rapid Transit (PRT) – Small fully automated vehicles that rely on fixed guideway.

Vehicle Miles Traveled (VMT) – A measurement of distance traveled by vehicles across all roads. VMT is a metric used to study travel and traffic trends over time.

Notes

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- 3 http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/special_reports_and_issue_briefs/issue_briefs/number_03/html/entire.html, *July 1, 2015*
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Additional Resources

Reports

[Automated and Autonomous Driving: Regulation Under Uncertainty](#) by the Corporate Partnership Board

[Automated Vehicles: The Coming of the Next Disruptive Technology](#) by the Conference Board of Canada

[Autonomous Driving Regulatory Issues](#) by the Corporate Partnership Board

[Autonomous Vehicles: Self-Driving the New Auto Industry Paradigm](#) by Morgan Stanley

[Autonomous Vehicle Technology: A Guide for Policy Makers](#) by Rand Corporation

[City of the Future: Technology & Mobility](#) by the National League of Cities

[Dynamic Ridesharing and Optional Fleet Sizing for a System of Shared Autonomous Vehicles](#) by Daniel J. Fagant and Kara M. Kockelman of the University of Texas at Austin

[Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations](#) by the Eno Center for Transportation

[Re-Programming Mobility: The Digital Transformation of Transportation in the United States](#) by the New York University Wagner Rudin Center for Transportation Policy & Management

[Self-Driving Cars: The Next Revolution](#) by KPMG

[The Pathway to Autonomous Vehicles: A Detailed Review of Regulations for Automated Vehicle Technologies](#) by the London Department of Transport

[Toward a Systematic Approach to the Design and Evaluation of Automated Mobility-on-Demand Systems: A Case Study in Singapore](#) by Kevin Spieser, Kyle Treleaven, Rick Zhang, Emilio Frazzoli, Daniel Morton and Marco Pavone of the Massachusetts Institute of Technology

[Urban Mobility System Upgrade: How Shared Self-Driving Cars Could Change City Traffic](#) by the Corporate Partnership Board

[Using an Activity-Based Model to Explore Possible Impacts of Automated Vehicles](#) by Suzanne Childress, Brice Nichols, Billy Charlton and Stefan Coe of the Puget Sound Regional Council

Websites

[American Association of Motor Vehicle Administrators](#)

- AAMVA has established an Autonomous Vehicle Information Sharing Group to gather, organize and share information with the AAMVA community related to the development, design, testing, use and regulation of autonomous vehicles and other emerging vehicle technology.

[AutonomousTransportation.com](#) – Up-to-date news, articles, events, and publications regarding the autonomous transportation industry.

[Automated Driving: Legislative and Regulatory Action](#) - This web page tracks legislative and regulatory developments related to autonomous vehicles.

[AUVSI](#) - The Association for Unmanned Vehicle Systems International is a non-profit organization devoted exclusively to advancing the unmanned systems and robotics community.

[GreenTRIP \(Transform\)](#) - TransForm launched the GreenTRIP certification program to make communities healthier and more affordable places to live, work and get around.

[VRA](#) - Vehicle and Road Automation is a support action funded by the European Union to create a collaboration network of experts and stakeholders working on deployment of automated vehicles and related infrastructure.

Local Testing Sites

[GoMentum Station](#) - The Contra Costa Transportation Authority facilitates industry partnerships to conduct research, development, testing, validation, and commercialization of connected vehicle applications and driverless vehicle technologies.

[VTTI](#) – The Virginia Tech Transportation Institute is managing a full-scale, closed test-bed research facility for testing connected and autonomous vehicles.

[Florida Automated Vehicles](#) - This is the online home for the Florida Automated Vehicles program, led by the Florida Department of Transportation.

[University of Michigan Mobility Transformation Center](#) - The University of Michigan is joining with a team of industry, government and academic partners to establish a testing facility for the advancement of connected and autonomous vehicles.

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The William Barclay Parsons Fellowship was established in 1984 to perpetuate the ideals and achievements of the founder of Parsons Brinckerhoff. For the past 30 years, the Fellowship has been awarded annually to one or more individuals to advance the state of a practice and promote the firm’s technical excellence and prominence in a given field.

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