

# Federal Highway Administration

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## National Dialogue on Highway Automation: June 26-27, 2018 Policy and Planning Workshop Summary

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16. Abstract  The Federal Highway Administration (FHWA) initiated the National Dialogue on Highway Automation (National Dialogue) workshop series. The National Dialogue was a series of meetings held across the country to facilitate information-sharing and to engage the transportation community in a conversation focused on how to safely and efficiently integrate automated vehicles into the road network. This document summarizes the key themes discussed among participants from the June 2018 National Dialogue workshop held in Philadelphia, Pennsylvania.			
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# Overview

Automated vehicles (AVs) have the potential to transform the Nation's roadways. They could increase vehicle safety, improve transportation system efficiency, and enhance mobility for many people who may be unable to drive today. Although they offer a wide range of benefits, they may also introduce uncertainty for the agencies responsible for the planning, design, construction, operation, and maintenance of the Nation's roadway infrastructure.

In June 2018, the Federal Highway Administration (FHWA) initiated the National Dialogue on Highway Automation (National Dialogue), a series of meetings held across the country to facilitate information sharing and engage the transportation community in a conversation on how to safely and efficiently integrate automated vehicles into the road network. A diverse group of stakeholders provided input on key issues regarding automation. This input will help inform future and existing FHWA research, policies, and programs.

The National Dialogue series consisted of six national workshops, each held in a different location and focused on a unique topic: policy and planning, data and digital infrastructure, freight, operations, and infrastructure design and safety. The workshop series kicked off with an introductory webinar in May 2018. More information about the webinar and meetings is available on the FHWA National Dialogue on Highway Automation [website](#).<sup>1</sup>

## Workshop Objectives

The FHWA identified several objectives for the workshop series:

- Gain an understanding of potential impacts of automated vehicles on national highway infrastructure, safety, policy, operations, and planning.
- Prioritize actions to inform the integration of automation into existing FHWA programs and policies.
- Create models for sustained information sharing among public agencies and the private sector. Support newly developed partnerships among these organizations and define a clear path of communication among FHWA and automation stakeholders.
- Gather insights from infrastructure owners and operators and inform the development of possible technical guidance actions at the Federal level.
- Validate or provide direction into highway research priorities and roles among FHWA, national partner organizations, industry, and State and local governments.
- Develop an engaged national community or coalition on integrating automated vehicles into the roadway system, using inputs from States, local governments, industry, and associations, alongside FHWA and other Federal agencies.

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<sup>1</sup> <https://ops.fhwa.dot.gov/automationdialogue/index.htm>.

## **Policy and Planning Workshop**

The Policy and Planning Workshop was the second workshop of the National Dialogue series. This workshop, held June 26-27, 2018, in Philadelphia, Pennsylvania, focused on policy and planning for automated vehicles. Nearly 200 individuals from industry, government, academia, and associations participated.

This document summarizes key themes that participants raised throughout the breakout sessions. The views in this document reflect participants' inputs and do not represent official positions, policies, or statements on behalf of the FHWA or the U.S. Department of Transportation (USDOT).

# **Key Takeaways**

## **Safety Is the Greatest Priority**

Safety was identified as a top priority for most participants when referring to policy and planning issues for automated vehicles. They identified the importance of providing for the safety of all roadway users in the context of automation (e.g., safety of AVs, non-AVs, pedestrians, bicyclists, etc.). Developing clear safety standards for AV testing and operation on public roads was one approach participants discussed to address safety. Yet, they acknowledged that creating clear and consistent regulations could be a challenge for policymakers, as they will have to account for varying AV adoption rates and roadway designs. Participants suggested that FHWA work closely with the National Highway Traffic Safety Administration to coordinate changes in vehicle and infrastructure requirements to address safety and to establish safety requirements for AVs.

## **Funding Availability Could Impact AV Adoption**

Infrastructure investment is a key aspect of supporting AV adoption. State and local agencies face competing priorities for infrastructure investments and may need to consider the importance of funding availability and resources to support infrastructure improvements that could accelerate AV adoption and deployment. Some participants were unclear about the eligibilities for infrastructure upgrades or modifications specifically for AV operations within Federal funding programs (e.g., Federal-aid). They sought clarification of funding programs that are eligible sources for AV-related activities. Coordination with State and local agencies may be needed to clarify how local Transportation Improvement Programs (TIPs) and Statewide Transportation Improvement Programs (STIPs) can be used to support AVs.

## **Defining Roles and Goals at All Levels of Government Is Key**

Inconsistencies in the current patchwork of State laws can introduce challenges to overall policy

development for AVs. Participants discussed the need for a clear Federal vision to help guide policy nationally and at State and local levels. They suggested the USDOT as a natural leader to guide national policy development for automation. Development of a national roadmap describing goals, objectives, and milestones for different phases or stages of AV technology integration could help clarify plans for stakeholders. Several participants also suggested the USDOT clearly define areas of responsibility for each of its modal administrations around automation. The different roles of each modal agency on automation are not always clear to the broader transportation community and the public. In addition, it may be necessary to clarify authorities among Federal, State, and local governments as they work to implement varying AV policies.

### **Policymakers, Public Agencies, and the Public Seek Better Information on AVs**

Policymakers, public agencies, and the public have varying levels of understanding regarding AVs. In addition, there is notable misinformation around the current capabilities of an AV and what it can do. There is also some confusion around the timelines by which AVs will be widely available on the roadways. As a result, workshop participants discussed the need for more objective and clear information regarding AV technology and its potential implications for the roadway infrastructure. They expressed the need for infrastructure owners and operators, in particular, to develop an understanding of the implications of AVs on infrastructure planning needs and the overall transportation system. Elected officials were also identified as benefiting from education and knowledge about AVs to support the development of sound AV legislation. Many felt that greater transparency, clear communication, and consistent or standard terminology would ultimately support public acceptance of the AV technology.

### **Transportation Planning Processes May Evolve to Address AVs**

The transportation planning process may need to evolve to address automation and the uncertain impacts it could have on congestion, land use, mobility, and the surface transportation system. Greater ride-sharing, reduced parking requirements, increased sprawl, curb-space use, and changes in municipal revenues were all identified as potential impacts from AVs. Participants discussed how the transportation planning process should remain flexible and iterative to address these potential changes and its uncertainties. Data collection and information would be useful to support transportation planning as well as policy development for AVs. To support this, however, participants acknowledged that certain questions around what data is needed and how it should be managed, shared, or used will also need to be addressed.

## **Workshop Design**

The workshop began with an overview presentation describing the National Dialogue and USDOT activities in automation. The overview presentation is available on the FHWA National

Dialogue [website](#).<sup>2</sup>

The workshop was divided into four different sessions designed to gather input from stakeholders:

- *Breakout Session 1:* Small group discussions focused on identifying issues and challenges for policy and planning.
- *Breakout Session 2:* Small group discussions focused on opportunities, practices, and strategies to address policy and planning for automation.
- *Collaboration Corner:* Informal interactive session where participants provided input at multiple stations, each focused on a distinct topic.
- *Breakout Session 3:* Group discussion focused on developing an action plan for the transportation community on automation.

USDOT representatives facilitated breakout session discussions at individual tables. Participants had 10-15 minutes to read and think about the discussion questions on their own, followed by group discussion. Information regarding the agenda, breakout session questions, and participants is included in the appendices of this document.

## Breakout Session I: Policy and Planning Issues and Challenges

This section summarizes stakeholder discussion from the first breakout session. Questions asked during this discussion included the following:

- In your perspective, what is the biggest policy challenge for enabling automation on the roadways?
- What current legislation, regulations, and/or State programs constrain or enable AV operations, maintenance, or investment?
- What are the potential impacts of AVs to system users? What are the policy questions in this area?
- What is the most important issue facing the transportation planning community as it relates to AVs?
- What are the potential effects of AVs on transportation mode choice and travel behavior over time?
- How can planning prepare for the safe and efficient integration of AVs into the roadway system?

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<sup>2</sup> <https://ops.fhwa.dot.gov/automationdialogue/index.htm>.



## **Clarifying Roles at Federal, State, and Local Levels**

It is important to clearly define roles at the Federal, State, and local levels for promoting and supporting automation. Stakeholders want to know the direction, responsibilities, and authority of agencies at all levels of government as they relate to AVs. It is not clear that all stakeholders, such as ADS technology companies, understand the distinction between the various roles that Federal, State, local agencies, metropolitan planning organizations (MPOs), and other organizations play. There is a need for clarification and communication regarding government roles and activities in order to reduce confusion and support AV operations crossing jurisdictional lines.

## **Keeping Pace with Technology Development**

Participants discussed the tension between rapidly developing automation technologies and the slower pace of regulation. It may be difficult for legislation and regulation to keep pace with automation technology as it changes. As a result, flexibility and strategic planning are necessary to support agencies, elected officials, and policymakers in making informed decisions. More research and discussion may be needed to better understand and manage the uncertainty of AV impacts. Also, existing laws (e.g., local laws, ordinances) do not necessarily take AVs into account and may need to be updated in the future.

## **Funding and Planning for Future Infrastructure**

Improved condition of the roadway infrastructure is important for both human-driven and automated vehicles. As a result, there may be a need for greater discussion around Federal funding availability, flexibility, and requirements. Participants suggested more infrastructure funding and resources to support a State of Good Repair. There are significant policy questions around how to fund not only maintenance of the existing infrastructure, but also any new infrastructure that may be needed to support AVs. A major challenge is that it is not clear what infrastructure standards are required for AVs, so agencies face uncertainty in where to allocate their infrastructure funding, especially given competing budgetary priorities. In addition, there is a risk of investing in certain technologies or other roadway upgrades that could become obsolete in the future. Some participants pointed to callboxes as an example of a now obsolete technology, after widespread adoption of mobile phones. Overall, State and local agencies will need to consider the long-term viability of such investments as they make infrastructure investment decisions.

## **Preparing the Workforce for New Vehicles and Technology**

The introduction of AVs could potentially impact professional drivers and the greater transportation workforce. Workshop participants discussed the need to assess the skillset of the current workforce and to determine how skills and training may need to adapt in the future to address AVs. The existing transportation workforce, particularly within local or smaller transportation agencies, will need to consider building a level of expertise around automation and

related technologies as more of these vehicles operate on public roads. Additional study should also be conducted on impacts to professional drivers, including those within the transit and trucking industries.

### **Standardizing Terminology for AVs**

Currently, there is notable confusion and inconsistency in the terminology and definitions around AVs. The lack of clear definitions makes it difficult for planners and policymakers to have meaningful conversation around AVs and to support AV readiness. A lack of consistent definitions can contribute to misinformation and potentially decrease public trust in the technology and ultimately impact public acceptance. A standardized lexicon around AVs could also be important for a national policy framework for AVs and could support development of State-level policy. Having a consistent and clear way of speaking about AVs could help policymakers, planners, State and local agencies, and industry communicate with each other and with the public.

### **Clarifying Data Management and Access**

Data privacy and security were highlighted as important areas of concern for workshop participants. Participants discussed the need for more guidance or best practices around data collection, storage, and access. As AVs present the ability to collect and generate significant amounts of data regarding the roadway environment, stakeholders desire guidance on how to manage and use AV-related data. In addition, FHWA and other planning organizations may want to evaluate data needs to support future transportation planning processes. Participants recommended working closely with States, MPOs, and other local organizations in order to develop data collection specifications and strategies.

### **Understanding Impacts on Congestion and Transit**

Automated vehicles introduce a range of impacts on congestion, private vehicle ownership, mobility trends, and the use of transit. Several participants expressed concern that AVs could increase commuting distances, increase sprawl, and discourage the use of mass transit. There was also much discussion on how broader trends in ride-sharing and travel patterns could influence the use of AVs and even lead to negative impacts on congestion. Participants remarked that scenario planning would be an important tool to better understand how these multiple factors could come together in the future and the implications for transportation planning processes. Some suggested that enabling more interaction between the planning community and industry (those developing the AV technology) could help the planning community better understand potential future scenarios and inform future planning models.

### **Developing a Roadmap**

Throughout this breakout session, participants pointed to the FHWA and USDOT as having an

opportunity to set goals and develop a national roadmap on automation. The lack of a clear national direction contributes to the risk that simultaneous, but separate, projects relating to AVs are occurring and with potentially disparate end goals. A national roadmap could explain what each stage of AV technology deployment looks like, outline different milestones for AV integration onto the roadways, and provide a common framework with milestones for stakeholders to work toward. With concrete descriptions and objectives, stakeholders can begin working together more effectively to achieve the goals of each stage. Several participants noted that FHWA could coordinate the development of this roadmap in partnership with State and local agencies, industry, associations, and other stakeholders.

## Breakout Session II: Policy and Planning Opportunities

This section summarizes stakeholder discussion from the second breakout session. Questions asked during this discussion included:

- What types of scenario planning activities would be helpful in understanding modal interactions with AVs?
- How could AVs affect transportation funding and revenues? What are the challenges and opportunities?
- What challenges or opportunities do rural areas provide for AV implementation?
- What planning practices will help make confident decisions despite rapid technological evolution?
- What are the planning issues in relation to each of the National Dialogue focus areas (Digital Infrastructure and Data, Freight, Operations, Infrastructure Design, and Safety)?
- What questions have we missed that need to be discussed?

### Creating New Revenue Structures

During this session, the discussion emphasized how increasing AVs on the roadways could lead to decreases in government revenue from traditional funding sources and that new revenue models would need to be considered. For example, since AVs may be developed as electric vehicles (EVs), public agencies could see decreasing revenues from fuel taxes. As AVs will be programmed to consistently follow the rules of the road, law enforcement agencies could see lower municipal revenues from parking tickets and traffic violations (e.g., speeding tickets). Another example provided was a potential drop in sales tax revenue if vehicle purchases decrease due to a drop in private vehicle ownership. Given these potential scenarios, there may be a need to identify new potential revenue sources. One consideration discussed was the use of a vehicle miles traveled (VMT) based fee for AVs, while others pointed to the need for a more structural shift in transportation funding.

## **Increasing Mobility and Accessibility for All**

There could be some challenges in ensuring that the benefits of AV technologies reach all citizens, not only those who live in or near urban areas. Disadvantaged populations and rural communities may not be as likely to have opportunities to take advantage of AV technologies because their communities may not be a focus for private industry. In addition, some rural areas may have limited connectivity, gravel or unmarked roads, and other characteristics that could make it difficult for AVs to navigate. Yet, AVs could offer significant benefits in mobility by improving the first-mile and last-mile connection, expanding access to emergency services, and supporting efficient goods delivery. In addition, how these benefits could also lead to economic development opportunities was discussed. Finally, a few participants noted that rural communities could lead in automation, especially as AVs support agricultural and freight applications.

## **Leveraging the Existing Planning Process**

The transportation planning process may need to evolve to address AVs and the uncertainty that these new technologies introduce into transportation planning and investment prioritization. However, participants considered that the existing planning process represents a good foundation for moving forward and that remaining flexible throughout the planning process will be important as AV technologies continue to develop. There are uncertainties around how AVs will impact congestion, land use, travel patterns, freight, and the broader transportation system. Visualizing how road networks could change over time with different levels of automation capability and adoption rates was identified as useful to inform transportation planning and modeling. Overall, participants thought that more information and data would assist with managing uncertainty about AVs. Also, ongoing pilots and testing of AVs represent opportunities for learning and could help support collaboration among the planning community, industry, and public agencies.

## Continuing Iterative Public Engagement

Participants noted that stakeholder engagement should reflect an iterative and continuous process. Stakeholders expect the discussion points to evolve as AV technology develops and more information about its implications are known. It may be essential to gain the confidence and ‘buy-in’ of local communities and the public, as they continue to interface directly with the technology. In addition, other modal users, like transit users, bicyclists, and pedestrians, will need to share their concerns and expertise to create a transportation system that is safe and accessible for all road users. Finally, participants stated that FHWA may want to consider continuing its role as convener to encourage collaboration across different stakeholder groups.

# Collaboration Corner

## Format

The Collaboration Corner was an interactive session designed to gather input from stakeholders on a range of topics. It consisted of a career-fair-style setup with six stations for collecting different types of information from stakeholders. USDOT staff members were located at each station to encourage participation, clarify the exercise, engage in discussion, and ask follow-up questions. Information was collected at each station through two methods:

- **Post-it exercise**—Attendees used post-it notes to respond to a specific prompt, which was presented on a wall-hanging poster at each station. This was a public form of communication that allowed attendees to view and engage with submitted suggestions.
- **Suggestion box**—Participants wrote their questions, suggestions, or other input on an index card and placed it into a suggestion box. This was a more private form of communication that allowed attendees to provide information that they may not have been comfortable sharing in a public forum.

Stakeholders provided input on the following topics:

- **Communities and AVs:** How can communities prepare for and shape the impacts of AVs?
- **State and Local Issues:** What do organizations need to prepare for an automated future?
- **Developing Policy:** What new policies are needed and what existing policies need to be modified to enable the development, deployment, and adoption of AVs?
- **Research Needs:** What research needs to be conducted, and when and by whom?
- **Terminology:** What terms are frequently used when discussing AVs, and are these words useful or confusing?
- **Parking Lot:** What are additional questions or comments that don’t fit into the other categories?

The following section summarizes key themes and takeaways for each topic.

## Communities and AVs

This station focused on how AVs could affect communities and how communities can prepare for and shape these impacts. Input was solicited in five categories, each of which was represented on a separate flip chart at the station: (1) Environment and Air Quality, (2) Mobility and Congestion, (3) Freight and Economic Impacts, (4) Land Use, and (5) Multimodal Safety.

**Table 1 Participant Input: Communities and AVs**

Environment and Air Quality	
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• AVs could increase the number of vehicle miles traveled, leading to increased emissions.</li> <li>• Sprawl could increase as AVs enable people to travel further at all times of the day, potentially impacting water quality, natural habitats, and social isolation.</li> </ul>
<b>Strategies</b>	<ul style="list-style-type: none"> <li>• To mitigate the potential impact of greater emissions, encourage the use of alternative fuels and consider limits on hours of operation.</li> </ul>
Mobility and Congestion	
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• Congestion could increase or decrease depending on a number of factors, but the deployment of AVs could lead to a greater number of vehicles, both occupied and unoccupied, traveling greater distances on the road during a broader range of peak hours, potentially leading to multiple rush hours throughout the day.</li> <li>• Transit use could decrease or become obsolete, increasing the equity gap between those who can and cannot afford AVs.</li> </ul>
<b>Strategies</b>	<ul style="list-style-type: none"> <li>• Encourage more efficient use of AVs (e.g., to enable first or last mile connections with transit, to facilitate ride-sharing, etc.) through new revenue models, pricing mechanisms, or other incentives.</li> <li>• Proactively identify activities and policies in support of equity and mobility goals.</li> </ul>
Freight and Economic Impacts	
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• Automation will impact jobs in the trucking industry. Job retraining programs may be necessary to adapt drivers' skills to new technologies.</li> <li>• AVs could lead to new freight business models, and consideration will be needed for factors such as pickup or delivery and parking and idling as delivery options increase.</li> <li>• Impacts of automated freight could be unevenly distributed between urban and rural locations.</li> </ul>
<b>Strategies</b>	<ul style="list-style-type: none"> <li>• Explore opportunities for job retraining and workforce development.</li> </ul>

Land Use	
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• There are questions about the need for parking in different situations (e.g., stadiums, airports, driveways, etc.).</li> <li>• AVs will eventually lead to a decrease in private vehicle ownership and reduce the need for parking.</li> <li>• AVs may contribute to increased sprawl, which could result in both environmental and community impacts due to decreased density (e.g., stretching emergency services across greater distances).</li> </ul>
<b>Strategies</b>	<ul style="list-style-type: none"> <li>• Develop guidance for designating safe pickup and drop-off areas and developing adaptable or convertible parking structures.</li> <li>• Fiber-optic links are able to communicate information, such as surveillance of intersections and traffic signals, further and more quickly in transportation networks. Also, encourage the installation of fiber-optic technologies in all new construction projects to facilitate the creation of an intelligent transportation system.</li> </ul>
Multimodal Safety	
<b>Impacts</b>	<ul style="list-style-type: none"> <li>• Impacts on vulnerable road users are unclear.</li> </ul>
<b>Strategies</b>	<ul style="list-style-type: none"> <li>• Collaborate with the Federal Railroad Administration (FRA) about potential benefits from AV interaction with railroad infrastructure and potential challenges at grade crossings.</li> <li>• Design infrastructure to protect vulnerable road users, including improving signage and striping.</li> <li>• Educate drivers, the general public, the planning community, and others on AV operations and impacts.</li> </ul>

### State and Local Agency Needs

Participants were asked to provide input on what States and local agencies need to prepare for an automated future. Input was solicited in five categories, each of which was represented on a separate flip chart at the station: (1) Technical Assistance, (2) Information and Tools, (3) Guidance, (4) Workforce Training and Skills, and (5) Other. Participants used color-coded post-it notes to delineate between near-term (within 5 years) and long-term (beyond 5 years) needs.

**Table 2 Participant Input: State and Local Agency Needs**

Technical Assistance	
<b>Near-term Needs</b>	<ul style="list-style-type: none"> <li>Standards for data management and sharing.</li> <li>Guidance to support planning for mixed vehicle fleets.</li> <li>Increased funding to hire technical experts.</li> <li>Peer exchanges and training opportunities to support education on AV technology.</li> </ul>
<b>Long-term Needs</b>	<ul style="list-style-type: none"> <li>Development of a training curriculum for State DOTs and MPOs.</li> <li>Funding for pilot programs and demonstrations in different operating environments.</li> <li>Guidance for State and local agencies on cooperative automated vehicle (CAV) infrastructure implementation.</li> <li>Continuing education for drivers on rapidly changing technologies.</li> <li>Guidance on best practices for data collection and management.</li> </ul>
Information and Tools	
<b>Near-term Needs</b>	<ul style="list-style-type: none"> <li>Scenarios and performance measures that can be adapted to varying local contexts.</li> <li>Tools to support long-range planning.</li> <li>Comprehensive information about Federal funding sources and project eligibility for AVs.</li> <li>Comprehensive information about traffic codes, including State traffic and driving laws and regulations.</li> <li>Updated planning tools to add automation into local Transportation Improvement Programs and Statewide Transportation Improvement Programs, including better public access to these programs to increase understanding of projects.</li> <li>Standardization of evaluation tools and requirements.</li> </ul>
<b>Long-term Needs</b>	<ul style="list-style-type: none"> <li>Tools for evaluating land use impacts through scenario planning.</li> <li>Information about demographics and technology adoption.</li> <li>Strategies to planning for accessibility and inclusivity.</li> </ul>
Guidance	
<b>Near-term Needs</b>	<ul style="list-style-type: none"> <li>Lessons learned from early deployments to guide future deployment.</li> <li>Information that is applicable or adaptable to diverse contexts (e.g., population, geographic location).</li> <li>Policy guidance from FHWA.</li> </ul>



<b>Long-term Needs</b>	<ul style="list-style-type: none"> <li>• Clarification of responsibilities between different agencies.</li> <li>• Guidance for local law enforcement on implementing policies related to AVs.</li> <li>• Development of national standards.</li> </ul>
<b>Workforce Training and Skills</b>	
<b>Near-term Needs</b>	<ul style="list-style-type: none"> <li>• Strategies to manage the transition to automation.</li> <li>• Incorporation of transportation technology education into university programs.</li> <li>• Capacity building for installation and maintenance of systems.</li> <li>• Encouragement of more diverse job categories in public service (e.g., data analysts, computer scientists, etc.).</li> </ul>
<b>Long-term Needs</b>	<ul style="list-style-type: none"> <li>• Development of a culture of innovation.</li> <li>• Increased hiring of data scientists and cybersecurity experts, among others.</li> <li>• Workforce development and apprenticeship programs.</li> </ul>
<b>Other</b>	
<b>Near-term Needs</b>	<ul style="list-style-type: none"> <li>• Guidance on AVs and disaster and incident management.</li> <li>• Consistency in State traffic and motor vehicle laws.</li> </ul>
<b>Long-term Needs</b>	<ul style="list-style-type: none"> <li>• Funding source flexibility.</li> </ul>

## Developing Policy

Participants were asked to identify policies or policy issues that they felt were important in certain categories. They were asked to organize policies into those that could accelerate AVs, manage AV impacts or represent an existing barrier to enabling AVs. Input was solicited in five categories: (1) Multimodal Safety; (2) Mobility and Access for Users; (3) Infrastructure Investment and Funding; (4) Federal, State, and Local Roles.

**Table 3 Participant Input: Developing Policy**

<b>Multimodal Safety</b>	
<b>Accelerate AVs</b>	<ul style="list-style-type: none"> <li>• Requiring slower speeds to mitigate complex interactions between AVs and pedestrians or bicyclists could accelerate AVs.</li> </ul>
<b>Manage Impacts</b>	<ul style="list-style-type: none"> <li>• Policies that address right-of-way use, emissions standards, information security, liability, right to repair, and risk exposure tolerance could help manage AV impacts.</li> </ul>
<b>Existing Barriers</b>	<ul style="list-style-type: none"> <li>• AVs will need to be able to interface with emergency responders during traffic incidents.</li> <li>• Interactions at railroad at-grade crossings is a concern.</li> </ul>

## Mobility and Access for Users

<b>Accelerate AVs</b>	<ul style="list-style-type: none"><li>• Policies should address current non-licensed drivers to promote mobility for those with specific needs (e.g., elderly, low-income, people with disabilities, etc.).</li></ul>
<b>Manage Impacts</b>	<ul style="list-style-type: none"><li>• Policies could encourage equitable distribution of AV benefits.</li><li>• Policies could promote efficient use of AVs through pricing mechanisms.</li><li>• Agencies should consider how routing algorithms will be developed and applied to AVs.</li><li>• Policies should provide more clarity about AV deployment timelines.</li></ul>
<b>Existing Barriers</b>	<ul style="list-style-type: none"><li>• AVs could lead to unequal access to technology tools and benefits.</li></ul>

## Infrastructure Investment and Funding

<b>Accelerate AVs</b>	<ul style="list-style-type: none"><li>• Linking Federal funding to technology investment could accelerate AVs.</li><li>• Policies should improve infrastructure for both conventional vehicles and all levels of automated vehicles (not just Level 4 and 5).<sup>3</sup></li><li>• Policies could provide financial support for communities managing AV deployments to fund costs when partnering with AV technology companies.</li><li>• Policies could expand pilots on alternative funding methods, like VMT pilots, to prepare for the lack of traditional revenue sources as more AVs are deployed.</li></ul>
<b>Manage Impacts</b>	<ul style="list-style-type: none"><li>• Public agencies could evaluate new mechanisms for toll collection, payment, and enforcement.</li><li>• Public agencies may need to address equity and environmental justice issues to manage infrastructure investments that only benefit high-end vehicles.</li><li>• Policies could incentivize public-private partnerships.</li></ul>
<b>Existing Barriers</b>	<ul style="list-style-type: none"><li>• The current infrastructure funding system is insufficient.</li><li>• Prioritizing smart corridors for infrastructure investment could help overcome existing barriers.</li></ul>

## Federal, State, and Local Roles

<b>Accelerate AVs</b>	<ul style="list-style-type: none"><li>• Expediting standards for AVs and connected systems could be a government role.</li><li>• Enabling testing and deployment of AVs while continuing to ensure safety is a government role.</li><li>• Public agencies may need to change State laws to enable testing and deployment.</li></ul>
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<sup>3</sup> [https://www.sae.org/standards/content/j3016\\_201806/](https://www.sae.org/standards/content/j3016_201806/)

<b>Manage Impacts</b>	<ul style="list-style-type: none"> <li>• Public agencies could: <ul style="list-style-type: none"> <li>○ Develop guidance for law enforcement,</li> <li>○ Encourage public participation in the policy decision-making process,</li> <li>○ Define responsibilities for collecting and managing data,</li> <li>○ Develop training standards for drivers and operators, and</li> <li>○ Regulate safety-critical communications</li> </ul> </li> </ul>
<b>Are Existing Barriers</b>	<ul style="list-style-type: none"> <li>• Current rules prohibiting the use of proprietary products on program and highway projects could be an existing barrier.</li> <li>• State licensing and insurance requirements could be a barrier to AVs.</li> <li>• Out-of-date Manual on Uniform Traffic Control Devices (MUTCD) requirements could also be a barrier to AVs.</li> </ul>

### Research Needs

Participants were asked to identify what research should be conducted, by whom, and when. Research needs were solicited in three categories, each of which was represented on a separate flip-chart at the station: (1) Urgent (by 2020), (2) Medium-Term (by 2025), and (3) Long-Term (by 2030 or later). Participants used color-coded post-it notes to delineate between public and private sector research responsibilities.

**Table 4 Participant Input: Research Needs**

<b>Research Areas: Urgent (by 2020)</b>	
<b>Public Sector</b>	<ul style="list-style-type: none"> <li>• Public opinion and values</li> <li>• Impact on vulnerable road users</li> <li>• Timelines for automated vehicle adoption and fleet penetration</li> <li>• Challenges and implications of Level 3 automation<sup>4</sup></li> <li>• Certification standards</li> <li>• Societal impacts</li> <li>• Transit impacts</li> <li>• Accuracy of computer vision</li> </ul>
<b>Private Sector</b>	<ul style="list-style-type: none"> <li>• Work zone safety impacts</li> <li>• Human Machine Interface and public awareness</li> <li>• Liability</li> <li>• Roadway safety devices that serve both human and automated driving</li> <li>• Innovative payment methods</li> <li>• Pavement and bridge impacts</li> </ul>

<sup>4</sup> [https://www.sae.org/standards/content/j3016\\_201806/](https://www.sae.org/standards/content/j3016_201806/)

### Research Areas: Medium-Term (by 2025)

<b>Public Sector</b>	<ul style="list-style-type: none"><li>• Impact of AVs on traditional infrastructure investment</li><li>• Impact on rural communities</li><li>• Infrastructure and maintenance needs as traffic patterns change</li><li>• Areas where AV markets and technology cause economic disruption</li><li>• Impacts of AVs on tribal lands</li></ul>
<b>Private Sector</b>	<ul style="list-style-type: none"><li>• Household location and mode choice impacts</li><li>• Impacts on mobility for people with disabilities</li><li>• Opportunities and considerations for proprietary data sharing</li><li>• Use cases and business models for AVs</li></ul>

### Research Areas: Long-Term (by 2030 or later)

<b>Public Sector</b>	<ul style="list-style-type: none"><li>• Use of AVs for disaster or incident management</li><li>• Land use considerations as transportation infrastructure changes</li><li>• Impacts on driving skills when AV adoption is widespread</li><li>• Updates to the MUTCD</li></ul>
<b>Private Sector</b>	<ul style="list-style-type: none"><li>• Standardized model for redundant systems and testing</li><li>• Updates to Highway Capacity Manual</li></ul>

## Terminology

Participants shared common AV terminology and indicated which terms are helpful and which are confusing. They placed these terms along two axes to show how these terms are used. The vertical axis represented the frequency with which these terms are used, and the horizontal axis represented the level of confusion surrounding their use. The table below illustrates the terms placed into each quadrant. Some of the most confusing and frequently encountered terms included “autopilot,” “autonomous,” and “connectivity.” Participants were also unsure of the distinctions among pilots, testing, and full deployment or operation.

**Table 5 Participant Input: Terminology**

		Confusing ↔ Clear	
← Frequency →	<ul style="list-style-type: none"> <li>• Autopilot</li> <li>• Autonomous</li> <li>• Advanced Transportation and Congestion Management Technologies Demonstration</li> <li>• FHWA’s role</li> <li>• Operator vs. Driver</li> <li>• Sensor needs vs. High Definition mapping needs</li> <li>• State of good repair</li> <li>• Vehicle to Infrastructure (V2I)/Vehicle to Vehicle (V2V)</li> <li>• Dynamic mapping elements</li> <li>• Connectivity</li> <li>• Self-driving car</li> <li>• Digital infrastructure</li> <li>• Levels of automation</li> <li>• Level 4 Automation (needs subcategories)</li> </ul>	<ul style="list-style-type: none"> <li>• Original Equipment Manufacturers</li> <li>• Users</li> <li>• Roadside Unit</li> <li>• Market penetration of AVs different levels</li> <li>• Driverless</li> <li>• Connected vehicle</li> <li>• Robotaxi</li> <li>• Society of Automotive Engineers J3015</li> </ul>	
	<ul style="list-style-type: none"> <li>• Highway</li> <li>• Operational Design Domain</li> <li>• AASHTO Green Book</li> <li>• Manual for Uniform Traffic Control Devices</li> <li>• Traffic control</li> <li>• Level 1-5</li> <li>• Connected Automated Vehicle /Automated Vehicle</li> <li>• Mobility as a service (MaaS) vs. Mobility on demand</li> <li>• Shared mobility</li> </ul>	<ul style="list-style-type: none"> <li>• Fully autonomous</li> <li>• Partially automated</li> <li>• Driverless vehicle</li> <li>• Connected/Automated</li> <li>• Autonomous ≠ Connected</li> </ul>	

**Parking Lot**

Participants shared any remaining questions and comments that did not cleanly fit into the other topic areas. Topics included:

- Data ownership and management considerations
- Public health effects (e.g., more access to healthcare, but also potential increase in sedentary behaviors)
- Need for more diverse stakeholder engagement
- Comparison with international activities
- Consistency of standards and policies
- Accessibility and equity considerations

- Workforce development and capacity building
- Need for new organizational and institutional models
- Cybersecurity considerations

## Breakout Session III: Action Planning Discussion

This section summarizes feedback from stakeholders who participated in the final breakout session focused on developing an action plan for FHWA. Key suggestions from this discussion included:

- Develop a roadmap outlining clear goals and objectives for each stage of AV adoption. This could set a clear national direction around which stakeholders could coordinate.
- Define areas of responsibility for each of its modal administrations as they relate to AVs.
- Focus on infrastructure improvements that need to occur independently of AV deployment and that will have ancillary benefits for AVs.
- Develop scenario planning guidance for AVs. This guidance could address both urban and rural communities and account for public adoption occurring over phases.
- Establish an interdisciplinary advisory group on AVs. This group could represent a task force with all 50 States, private sector, and industry to create recommendations, share information, and support infrastructure needs.
- Encourage national and uniform implementation of AVs, particularly with regard to technology, funding, data, definitions (common language), policy, regulations, and standards.
- Fund, develop, and maintain in real time a public repository of lessons learned, data (raw and applied), metrics, research results, and case studies.
- Enable promulgation of traffic laws by States in a machine-readable format. Participants seemed to agree on the need to gain consensus around a data standard for sharing traffic laws to enable seamless AV operations.
- Publish more visible, agreed-upon principles for moving forward, especially as they relate to safety, mobility, environmental sustainability, and equity.
- Help State and local agencies fund automated vehicle pilots and their full scale developments.
- Develop best practices, education, and guidance, and provide information for State and local agencies because there are different levels of awareness across localities, elected officials, and the public.

# Conclusion

The National Dialogue on Highway Automation’s Launch Workshop revealed stakeholder’s diverse interests related to automated vehicles. Overall, stakeholders desired further discussion and information sharing around automation. The FHWA plans to use the input provided from the workshop series to help inform future policies, research, and programs. Additional information regarding the workshop series and related initiatives is available on the FHWA website.<sup>5</sup>

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<sup>5</sup> <https://ops.fhwa.dot.gov/automationdialogue/>

# Appendix A: Participants

Nearly 200 participants from 111 organizations attended the workshop.

3M	Advocates for Highway and Auto Safety	AECOM
Alliance of Automobile Manufacturers	Amazon	America Walks
American Association of Motor Vehicle Administrators (AAMVA)	American Association of State Highway and Transportation Officials (AASHTO)	American Automobile Association (AAA)
American Council for an Energy-Efficient Economy (ACEEE)	American Insurance Association (AIA)	American Motorcyclist Association (AMA)
American Road & Transportation Builders Association (ARTBA)	American Traffic Safety Services Association (ATSSA)	American Trucking Associations (ATA)
Arcadis	Argonne National Laboratory	Arizona Department of Transportation
AssetWorks	Association of Global Automakers	Association of Metropolitan Planning Organizations (AMPO)
Aurora	Battelle	Bloomberg Government
Bosch	Capital Area Metropolitan Planning Organization, Texas	Carnegie Mellon University
CDM Smith	Center for Urban Transportation Research (CUTR)	City of Altoona
City of Philadelphia	City of Pittsburgh	Colorado Department of Transportation
Columbia University	Connecticut Department of Transportation	Consortium for Science, Policy and Outcomes at Arizona State University
Delaware Department of Insurance	Delaware Valley Regional Planning Commission	EasyMile
Eno Center for Transportation	Environmental Law and Policy Center	Gannett Fleming
General Motors	George Mason University	HNTB Corporation
Honda Motor Company	I-95 Corridor Coalition	ICF
Intelligent Transportation Society of America (ITS America)	International Brotherhood of Teamsters	Jackie Group
KCI Technologies	Kimley-Horn	Koch Companies Services, LLC
League of American Bicyclists	Louisiana Department of Transportation and Development	Lumenor Consulting Group *
Macatawa Area Coordinating Council	Maryland Department of Transportation	Memphis Urban Area Metropolitan Planning Organization



Mercer Strategic Alliance	Merriweather Advisors, LLC	Metropolitan Transportation Authority
Michael Baker International	Minnesota Department of Transportation	Mobility e3
Motor & Equipment Manufacturers Association (MEMA)	Motorcycle Riders Foundation (MRF)	National Association for Regional Councils (NARC)
National Governors Association	National Safety Council	New Jersey Department of Transportation
New York Metropolitan Transportation Council	Nissan Motor Company	Norfolk Southern Railway
North Carolina Department of Transportation	North Central Texas Council of Governments	North Jersey Transportation Planning Authority
Northern Virginia Transportation Authority (NVTAA)	OmniAir Consortium	Owner-Operator Independent Drivers Association
PACCAR Inc.	Pennoni	Pennsylvania Department of Transportation
Pennsylvania Municipal League	Pennsylvania State Police	Pennsylvania State University
Pennsylvania Turnpike Commission	Phoenix Contact	Royal Truck & Equipment
Rutgers, The State University of New Jersey	S&ME, Inc.	Sam Schwartz Engineering
Savari	Securing America's Future Energy (SAFE)	Subaru
Texas Department of Transportation	Tongji University	Toyota Motor Corporation
Traffic Technology Services (TTS) *	TrafficCast International, Inc.	Transportation for Massachusetts (T4MA)
Transportation Research Board (TRB)	TuSimple	U.S. Department of Transportation
Union Pacific Railroad Company	University of California, Berkeley	VHB
Virginia Department of Transportation	Whitman, Requardt and Associates	WSP Global

# Appendix B: Workshop Agenda

Day 1: June 26, 2018

Time (ET)	Agenda Item	Name
12:30 PM	<b>Registration &amp; Sign-In</b>	
1:00 PM	<b>Opening Remarks</b>	<b>Mala Parker, Associate Administrator</b> FHWA Office of Policy and Governmental Affairs
1:10 PM	<b>National Dialogue Overview</b>	<b>Heather M. Rose</b> Senior Transportation Futures Policy Analyst FHWA Office of Transportation Policy Studies
1:25 PM	<b>Breakout Instructions</b>	<b>John Corbin</b> Connected and Automated Vehicles and Emerging Technologies Team FHWA Office of Transportation Management
1:30 PM	<b>Small Group Session 1: Policy and Planning Issues and Challenges</b> <ul style="list-style-type: none"> <li>Section 1: Policy Issues and Challenges</li> <li>Section 2: Transportation Planning Issues and Challenges</li> </ul>	All Participants
3:00 PM	<b>Break</b>	
3:15 PM	<b>Report Out</b>	All Participants
3:45 PM	<b>Collaboration Corner</b> Market Square Format: Participants rotate around to different stalls to provide input on various topics.	Topics: <ol style="list-style-type: none"> <li><b>Communities and AVs:</b> preparing the planning community</li> <li><b>State and Local Issues:</b> building capacity and guidance</li> <li><b>Developing Policy:</b> identifying issues and priorities</li> <li><b>Research Needs:</b> collecting research needs statements</li> <li><b>Terminology:</b> developing a lexicon around highway automation</li> <li><b>Parking Lot:</b> gathering input on topics not covered at other posts</li> </ol>
5:00 PM	<b>Wrap-Up and Preparation for Day 2</b>	<b>John Corbin</b> Connected and Automated Vehicles and Emerging Technologies Team FHWA Office of Transportation Management
5:30 PM	<b>End of Day 1</b>	

Day 2: June 27, 2018

Time (ET)	Agenda Item	Name
8:00 AM	<b>Registration &amp; Sign-In</b>	
8:30 AM	<b>Kick-Off Day 2</b> <ul style="list-style-type: none"> <li>Agenda Summary Day 2</li> <li>Summary of Day 1 Themes</li> </ul>	<b>Kenneth Petty, Director</b> FHWA Office of Planning
8:45 AM	<b>Introduction</b>	<b>Alicia Nolan, Division Administrator</b> FHWA Pennsylvania Division
9:00 AM	<b>Welcome Address</b>	<b>Leslie Richards, Secretary</b> Pennsylvania Department of Transportation
9:15 AM	<b>Preparing for Automated Vehicles: Policy and Planning Perspectives</b> Policy and Planning leaders discuss key topics related to highway automation, their roles, and their stakeholder perspectives.	Facilitated by <b>Kenneth Petty, Director</b> FHWA Office of Planning <ul style="list-style-type: none"> <li>Robert Grant, Head of Government Relations, Aurora</li> <li>Patricia Hendren, Executive Director, I-95 Corridor Coalition</li> <li>Bill Keyrouze, Technical Programs Director, AMPO</li> <li>Rick Schuettler, Executive Director, Pennsylvania Municipal League; representing National League of Cities</li> </ul>
10:15 AM	<b>Break</b>	
10:30 AM	<b>Instructions for Breakouts</b>	<b>Corbin Davis</b> FHWA Office of Planning
10:35 AM	<b>Breakout Session 2: Policy and Planning Opportunities</b> <ul style="list-style-type: none"> <li>Section 1: Policy Opportunities</li> <li>Section 2: Transportation Planning Opportunities</li> </ul>	All Participants
12:00 PM	<b>Lunch (not included)</b>	
1:30 PM	<b>Report Out</b>	All Participants
2:00 PM	<b>Keynote Speaker</b>	Introduction by <b>Martin C. Knopp, Associate Administrator</b> FHWA Office of Operations <b>Brandye Hendrickson, Acting Administrator</b> FHWA
2:15 PM	<b>Instructions</b>	<b>Corbin Davis</b> FHWA Office of Planning
2:20 PM	<b>Brainstorming: What's Next?</b> Each table develops recommendations.	All Participants
3:05 PM	<b>Report Out</b>	All Participants
3:50 PM	<b>Wrap-Up and Next Steps</b>	<b>Jeremy Raw</b> FHWA Office of Planning
4:00 PM	<b>Open Discussion</b>	All Participants
4:30 PM	<b>End</b>	

U.S. Department of Transportation  
Federal Highway Administration  
Office of Operations  
1200 New Jersey Avenue, SE  
Washington, DC 20590

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