NEW JERSEY ADVANCED AUTONOMOUS VEHICLE TASK FORCE

FINAL REPORT

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Presented to:

Governor Phil Murphy
and
The New Jersey State Legislature

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EXECUTIVE SUMMARY

The New Jersey Advanced Autonomous Vehicle Task Force was established by the Senate and General Assembly of the State of New Jersey by joint resolution (P.L.2019, J.R.2) on March 18, 2019. [(1)] The purpose of the Task Force as defined in joint resolution was "…to conduct a study of advanced autonomous vehicles and to make recommendations on laws, rules, and regulations that this State may enact or adopt to safely integrate advanced autonomous vehicles on the State's highways, streets, and roads." The Task Force convened for the first time on September 5, 2019 and subsequently met six additional times during its tenure. Five subcommittees were established and each met at least two times.

KEY FINDINGS

- Automated Driving Systems (ADS) technologies have evolved significantly and advanced rapidly over the past five years. This has prompted policy makers and industry leaders worldwide to consider a future where fully autonomous vehicles (AVs) are commonplace if not ubiquitous.
- Highly autonomous vehicles (HAVs) have the potential to provide a range of benefits, including safety, mobility, efficiency, convenience, economic and other societal benefits. However, there are also potential negative impacts including uncertainty regarding how HAV deployment may impact land use patterns, public transit services, and workforce levels and skills requirements. With proper and careful deployment, these potentially negative impacts could become positive contributions to the quality of life in New Jersey by enabling more efficient use of land, providing enhanced affordable mobility to underserved communities, allowing affordable housing to become affordable living, and creating new job opportunities.
- There is a great deal of uncertainty surrounding AV technology development and adoption. One of the most important unanswered questions is whether AVs will be privately owned and operated for personal use; whether AVs will be shared as a new mobility service; or whether some combination of personal and shared use of AVs will emerge when HAVs are deployed widely. To realize the many potential positive benefits of AVs and to achieve high-quality affordable mobility that is within the reach of most New Jerseyans, the State should encourage driverless ridesharing.
- Federal guidance regarding AV regulation recommends that States focus on their traditional responsibilities related to vehicle licensing and registration, traffic laws and enforcement, and setting policy related to motor vehicle insurance and liability. Issues related to monitoring and regulating vehicle design and safety should remain the purview of the Federal government.
- The frameworks states have adopted to authorize the operation and testing of HAVs vary widely. Several states, including Arizona, California, Florida, Michigan, Nevada, Ohio, Pennsylvania, and Texas, which have active HAV testing taking place, represent leading approaches for enabling the safe testing of HAVs on public roadways.

- A review of relevant New Jersey statutes and regulations revealed few impediments to allowing the safe testing of HAVs on public roadways; however, as ADS technology continues to develop and New Jersey gains some experience with testing, statutes and regulations should be reviewed again to ensure consistency.
- New Jersey's existing vehicle licensing and registration processes are adequate to allow the titling, registration, and licensing of HAVs for testing purposes in the short term. Over the longer term, NJMVC should monitor HAV registrations and licensing and consider whether modifications to existing procedures are necessary.
- New Jersey's existing standard policy insurance requirements for different classes of vehicles (e.g., private passenger, commercial, omnibus, etc.) should be adequate for the purposes of insuring HAVs for testing and operation on public roadways in the short term. As more data becomes available for underwriting purposes, these requirements should be revisited.

RECOMMENDATIONS

The following Task Force recommendations, which are described in more detail in Section 5 of the report, are intended to be consistent with federal guidance and leading practices implemented in other states. They are designed to encourage the safe testing and deployment of HAVs in New Jersey by creating a welcoming policy environment that fosters collaboration, promotes public acceptance of automation, uses technology to improve the efficiency of the State's transportation system, and enhances the lives of New Jersey residents, workers and visitors by expanding travel options and making travel safer, easier and more affordable for all.

- **Establish a two-step permitting process to allow companies to test and then deploy HAVs on public roadways in New Jersey.**
    1) Designate the New Jersey Motor Vehicle Commission (NJMVC) as the lead agency responsible for approving and overseeing the testing and deployment of HAVs in New Jersey.
    2) Require that all testing of HAVs on public roadways in New Jersey be conducted with a safety driver present in the vehicle.
    3) Require all HAVs to be tested or deployed for operation on New Jersey public roadways to be registered and licensed under existing NJMVC processes.
    4) Require HAV Testers/Operators to show proof of insurance, surety bond, or self-insurance that meets the standard statutory requirements for the class of vehicle being tested/deployed.
    5) Require all HAVs to be tested or operated on public roadways in New Jersey to comply with all relevant Federal Motor Vehicle Safety Standards, or provide evidence that an exemption has been approved by NHTSA.

6) Require HAV Testers/Operators to certify that they have considered and implemented reasonable measures to help defend against, detect, and respond to cyber-attacks, unauthorized intrusions, or false vehicle control commands.

7) Authorize the Chief Administrator of NJMVC to immediately suspend or revoke any permissions to test or operate an HAV on New Jersey public roads in order to ensure public safety.

- **Offer prospective HAV Testers already approved to test HAVs in the states of Arizona, California, Ohio, Michigan, and Pennsylvania testing reciprocity.** Streamline the application process and offer prospective HAV Testers automatic approval once the testing permit application is deemed complete. Other states can be added to the list of reciprocity states at the discretion of the HAV Interagency Advisory Committee. Reciprocity is a novel approach that could set New Jersey apart and signal to HAV developers that the State is open for business while still providing state officials and local law enforcement the information they need to protect public safety. Once enabled, State officials should proactively work with counterparts in targeted states to formalize the reciprocity arrangements and work toward regionalizing HAV testing in key long-distance corridors and to cooperatively address any cross-jurisdictional challenges that might arise.

- **Establish an HAV Interagency Advisory Committee to monitor HAV testing and operation in New Jersey.** The advisory committee should consist of representatives from NJMVC, NJDOT, NJ TRANSIT, NJ Department of Banking and Insurance (NJDOBI), NJ State Police, the NJ Division of Highway Traffic Safety (NJDHTS), NJ Department of Human Services, the NJ Economic Development Authority (NJEDA), the NJ Department of Labor and Workforce Development, and such public and private stakeholders as deemed appropriate. Advisory committee responsibilities should include:

  1) review and comment on each HAV Testing Permit and HAV Deployment Certificate application;

  2) meet with HAV Testers and Operators on a quarterly basis or more often as necessary to monitor safety performance, discuss lessons learned, and address any issues and concerns related to testing and operations in New Jersey; and

  3) make recommendations as needed to the Governor and Legislature regarding policy, regulatory, and other matters pertaining to HAV testing and operation in New Jersey.

- **Create a single point of contact for companies wishing to test and deploy HAVs in New Jersey and proactively encourage HAV testing in the State.** For example, New Jersey could create a program similar to Ohio's that seeks to link municipalities interested in promoting HAV testing with companies that are seeking to test vehicles. Participation in the program should be completely voluntary. Priority should be given to identifying partnerships and pilot projects that solve important mobility and goods-movement challenges in New Jersey. Examples might include improving first/last mile connectivity to NJ TRANSIT fixed-route services to grow transit ridership; providing paratransit services for people with disabilities in a more customer-focused and cost-efficient manner; connecting low-income workers with job sites, making transit services and good movement more efficient; making port operations more efficient; and others. The program could be administered by the NJMVC or in partnership with the New Jersey Economic Development Authority or Choose NJ.

- **Prohibit local government jurisdictions and government agencies and authorities from enacting laws and regulations related to testing and deployment of ADS-equipped vehicles on public roadways in New Jersey.** HAV testing and deployment in New Jersey should be guided by State-level planning and policy direction. Preemption of local laws and regulations related to testing and deployment of ADS-equipped vehicles will help to reduce confusion. At the same time, every effort should be made to engage local leaders and law enforcement from the jurisdictions where HAV testing and operation will take place in the process of monitoring and evaluating testing efforts and safety performance.

- **Promote public acceptance of HAV technologies and use establish a stakeholder engagement framework to create a culture of HAV learning, collaboration, and problem solving in New Jersey.** One potential impediment to HAV development and adoption is lack of public acceptance. HAV technology is new and many people are either unfamiliar or skeptical of the technology. Steps can and should be taken to create opportunities for the general public and key constituencies, including traditionally transportation-disadvantaged communities to interact with the technology and learn the potential benefits and challenges associated with HAV deployment. Creating opportunities to "see and touch" the technology can help to break down unnecessary barriers to adoption related to fear and lack of trust in the technology. In addition, state officials should establish a stakeholder engagement framework to proactively investigate and address the full range of HAV testing and deployment issues that will need to be addressed over time. Important issues include: ensuring transportation-disadvantaged populations benefit from HAV deployment; promoting shared-use of HAVs; potential workforce impacts; and others. A series of stakeholder work groups should be constituted. These work groups can sponsor research, convene conferences, and facilitate discussion of important AV-related topics as they emerge.

These recommendations represent a starting point for creating a framework to advance the beneficial testing and use of HAVs in New Jersey. Ongoing work by the HAV Interagency Advisory Committee in collaboration with stakeholders will be required to continue to develop and execute a robust comprehensive program aimed at the broad deployment of HAVs that can provide affordable, high-quality mobility throughout New Jersey.

SECTION 1. BACKGROUND

REPORT OUTLINE

Section One of this report provides background on the Task Force and describes the Task Force mission, charge, and organization. Section Two provides an overview of automated vehicle technology, business models, and use cases. Section Three describes the status of automated vehicle laws, regulations, and guidance in the United States. Section Four presents a summary of issues and considerations related to automated vehicle testing, operation, and deployment. Section Five presents the Task Force's recommendations for enabling and encouraging the safe testing and operation of highly automated vehicles (HAVs) in New Jersey.

BACKGROUND

The New Jersey Advanced Autonomous Vehicle Task Force was established by the Senate and General Assembly of the State of New Jersey by joint resolution (P.L.2019, J.R.2) on March 18, 2019. (1) The Task Force, as established, was to include eleven members, including five public members appointed by the Governor; one public member appointed by the Governor upon recommendation of the President of the Senate; one public member appointed by the Governor upon recommendation of the Speaker of the Assembly; and four ex-officio members including: the Commissioner of Transportation or designee, the Chief Administrator of the New Jersey Motor Vehicle Commission or designee, the Director of the Division of Highway Traffic Safety in the Department of Law and Public Safety or designee; and a commissioner of the Board of Public Utilities selected by the Governor or designee. The public members were expected to have expertise in highway traffic safety, autonomous vehicle technology, automotive manufacturing, and automobile insurance. One public member was required to be a licensed professional engineer. Ultimately, six public members were appointed by the Governor.

According to the joint resolution, the Task Force was to be appointed and convened within 90 days after the law became effective. The Task Force was given 180 days after its initial meeting to issue a report to the Governor and Legislature. The law further stipulated that the Task Force was entitled to "…the assistance and services of the employees of any State board, bureau, commission, or agency as it may require," and that "The New Jersey Motor Vehicle Commission, the Department of Transportation, and the Alan M. Voorhees Transportation Center at Rutgers, the State University of New Jersey, shall assist the Task Force in the performance of its duties and provide the Task Force with studies, data, or other materials in the possession of those entities, to the extent that such are relevant to the purposes of the Task Force." (1)

TASK FORCE PURPOSE AND CHARGE

The purpose of the Task Force as defined in joint resolution was "…to conduct a study of advanced autonomous vehicles and to make recommendations on laws, rules, and regulations that this State may enact or adopt to safely integrate advanced autonomous vehicles on the State's highways, streets, and roads." According to the joint resolution, the study was to include but not be limited to an evaluation of:

- State laws that may unreasonably impede the testing and operation of autonomous vehicles on public roads in this State;
- State and Federal laws concerning advanced autonomous vehicles with a focus on licensing, registration, insurance, liability, law enforcement and accident reporting, land use, road and infrastructure design, public transit, and workforce changes; and
- Legislation and regulations in other states concerning advanced autonomous vehicles.

The Task Force was further charged with making recommendations on how New Jersey could "…safely integrate advanced autonomous vehicles on its highways, streets, and roads; any other information relevant to the subject of the report; and any draft legislation the Task Force deemed appropriate to implement the purposes of P.L.2019, J.R.2, which shall be consistent with federal law, regulations, and policy guidance." Finally, the Task Force was asked to make recommendations for "implementing advanced autonomous vehicle pilot programs to promote the safe testing and operation of advanced autonomous vehicles on public roads in this State." [1]

TASK FORCE ORGANIZATION

The Task Force convened for the first time on September 5, 2019. At the first meeting, New Jersey Motor Vehicle Commission (NJMVC) Chief Administrator Sue Fulton and New Jersey Department of Transportation (NJDOT) Commissioner Diane Gutierrez-Scaccetti were named co-chairs of the Task Force. At the October 8, 2019 Task Force meeting, Task Force members agreed to establish the following five subcommittees:

1. Licensing and Registration (Chair: Robert Porreca, NJMVC)
2. Law Enforcement (Chair: Eric Heitmann, NJ Division of Highway Traffic Safety)
3. Insurance and Liability (Chair: Nicole Brown, NJ Department of Banking and Insurance)
4. Infrastructure and Land Use (Chair: Sal Cowan, NJDOT)
5. Public Transit (Chair: Sal Cowan, NJDOT)

Task Force members and/or their designees volunteered to serve on one or more subcommittees based on their individual interests. As noted above, each subcommittee was chaired by a Task Force member or designee. Each subcommittee was charged with investigating and addressing the topics outlined in P.L.2019, J.R.2 and any other topics deemed appropriate by committee members. Including its first meeting, the full Task Force met seven times during its tenure. Each subcommittee met at least two times. A record of Task Force and subcommittee deliberations is attached to this report as Appendix 1.

SECTION 2. TERMS AND DEFINITIONS

Driving automation technology has been a part of motor vehicle design and manufacturing for decades (see Figure 1). Basic features like cruise control and antilock brakes are standard equipment in most modern passenger vehicles on the road today. More recently, automobile manufacturers have added a growing list of driver support features including: adaptive cruise control which adjusts the vehicle's speed based on the speed of the vehicles traveling in front of it; automatic forward-collision warning and braking; automatic parking; lane departure warning and lane-keeping assistance; blind spot monitoring; pedestrian detection and braking; adaptive lighting; dynamic driving assistance systems and others. [(4)] [(5)] These Advanced Driver Assistance Systems (ADAS), which rely on sensors, cameras, radar, LIDAR, and other technologies are intended to reduce crashes and collisions by "assisting" drivers to drive more safely. All of these features included in vehicles on the market today require the driver to remain attentive and to monitor the driving environment at all times.

Figure 1. Five Eras of Safety

Source: NHTSA

In contrast to ADAS, which require the driver to remain in control of the vehicle, Automated Driving Systems (ADS) are being designed to take over the driving task entirely, with no human intervention. In the past five years, ADS technologies have evolved significantly and advanced rapidly, prompting policy makers and industry leaders to consider a future where fully autonomous passenger and commercial vehicles are commonplace if not ubiquitous. This has led government agencies and standards-setting organizations to publish a range of guidance documents to promote uniformity in the use of ADS-related terminology, help manage the technology development process and encourage innovation while ensuring public safety. The remainder of this section provides an overview of automated driving systems, including key terms and definitions, emerging business models and potential use cases for the technology.

AUTOMATED VEHICLE (AV) TECHNOLOGY OVERVIEW AND KEY TERMS

The leading source of terms and definitions related to driving automation systems is SAE International (SAE), "a global association of more than 128,000 engineers and related technical experts in the aerospace, automotive and commercial-vehicle industries." Part of SAE International's mission is to develop “consensus-based standards that advance quality, safety and innovation” in the mobility industry. [6] This report adheres as much as possible to the terms and definitions set forth in SAE *J3016 Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* (June 2018). [7]

SAE defines an ***Automated Driving System*** **(ADS)** as “the hardware and software that are collectively capable of performing the entire ***dynamic driving task*** **(DDT)** on a sustained basis, regardless of whether it is limited to a specific ***operational design domain*** **(ODD)**.” According to SAE J3016, ADS is a term used specifically to describe a Level 3, 4, or 5 driving automation systems, which are described in more detail below. SAE defines the DDT as “all of the real-time operational and tactical functions required to operate a vehicle in on-road traffic, excluding the strategic functions such as trip scheduling and selection of destinations and waypoints, and including without limitation:

- Lateral vehicle motion control via steering (operational);
- Longitudinal vehicle motion control via acceleration and deceleration (operational);
- Monitoring the driving environment via object and event detection, recognition, classification, and response preparation (operational and tactical);
- Object and event response execution (operational and tactical);
- Maneuver planning (tactical); and
- Enhancing conspicuity via lighting, signaling and gesturing, etc. (tactical).” [7]

According to SAE, an ODD includes the “operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.” [7] The ODD defines where and under what conditions an ADS is capable of safely performing all or part of the DDT.

To promote better understanding and consistency regarding different levels of driving automation, SAE developed a six-level framework. As shown in Figure 2, ***Level 0*** vehicles require a human driver to perform all driving tasks with no automated features. ***Level 1*** automation includes vehicles controlled by a human driver under most circumstances with some driving assistance features available to control either lateral vehicle motion (e.g., steering) or longitudinal vehicle motion (e.g., acceleration or deceleration) under specified conditions but not both at the same time. ***Level 2*** automation allows a human driver to engage automated features that will control some aspects of the DDT such as acceleration, braking and steering at the same time; however, a human driver must remain engaged with the driving task and monitor the driving environment at all times. GM’s Super Cruise, Tesla’s Autopilot, Nissan’s ProPilot Assist, Volvo’s IntelliSafe, and others are examples of Level 2 partial automation applied to existing passenger cars.

Level 3 automated vehicles have an ADS capable of controlling all aspects of the DDT in a specified ODD when the ADS is engaged. A human driver must still be present to control the vehicle when the ADS is not engaged or when it is operating outside of its ODD and to act as a fallback driver if the ADS requests intervention. Level 3 ADS features are available in some General Motors products and several manufacturers, including Honda and BMW have announced plans to offer Level 3 traffic jam/highway "chauffeur" features on 2021 production year vehicles. In ***Level 4*** automation, the ADS is capable of performing all driving functions while operating in a specific ODD, with no expectation that human driver will be present to take back control of the vehicle if necessary. ***Level 5*** fully automated vehicles are expected to be capable of performing all driving functions under all conditions, with no human driver present. [7] Vehicles with Level 4 and 5 ADS are still in the development and testing stage.

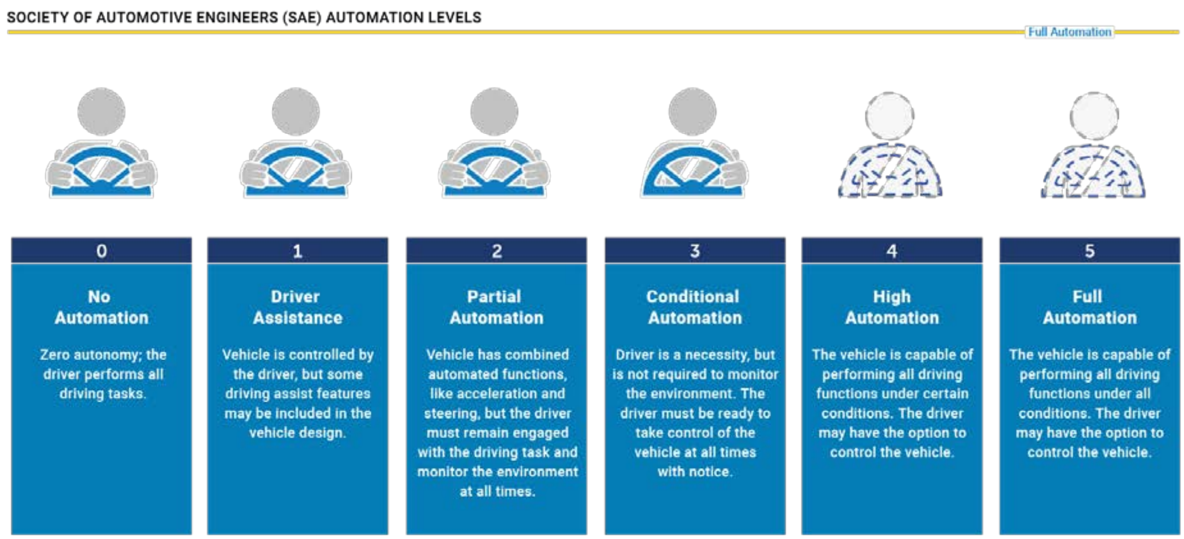

Figure 2. SAE Automation Levels

Two additional terms are important to understand. The ***DDT Fallback*** is "the response by the ADS user to either perform the DDT or achieve a ***minimal risk condition*** after occurrence of a DDT performance-relevant system failure(s) or upon exiting the ODD, or the response by an ADS to achieve minimal risk condition, given the same circumstances." It is important to keep in mind that the DDT and the DDT Fallback are "distinct functions, and the capability to perform one does not necessarily entail the ability to perform the other. Thus, a Level 3 ADS, which is capable of performing the entire DDT within its ODD, may not be capable of performing the DDT Fallback in all situations that require it and thus will issue a request to intervene to the DDT Fallback-ready user when necessary." [7]

SAE defines the minimal risk condition as "a condition to which a user or an ADS may bring a vehicle after performing the DDT Fallback in order to reduce the risk of a crash when a given trip cannot or should not be completed." A conventional driver is expected to achieve a minimal risk condition if necessary when operating a vehicle equipped with Level 1-2 features. At Level 3, if a DDT performance-relevant system failure occurs in the ADS or vehicle, a DDT Fallback-ready user is expected to achieve a minimal risk condition when s/he determines that it is necessary, or to otherwise perform the DDT if the vehicle is drivable and the ADS cannot perform the DDT. At Levels 4 and 5, the ADS is capable of automatically achieving a minimal risk condition when necessary. [7]

BENEFITS OF VEHICLE AUTOMATION

ADAS and ADS have the potential to provide a range of benefits, including safety, mobility, efficiency, convenience, economic, and other societal benefits. From a safety perspective, AVs have the potential to significantly reduce crashes, reduce injuries and save lives. Studies have shown that the vast majority of serious crashes result from human error. As NHTSA notes, "automated vehicles have the potential to remove human error from the crash equation, which will help protect drivers and passengers, as well as bicyclists and pedestrians." (8) A recent study estimated that AVs could reduce vehicle crashes by as much as 90 percent. (9)

Fewer crashes, injuries and deaths can provide economic benefits. For example, studies have estimated that crash-related injury and death cost the U.S. economy billions of dollars in lost workplace productivity. AVs have to potential to eliminate a significant portion of these costs (8) (9) (10) (11) AVs also have the potential to make time spent in vehicles more productive. (9) (12) McKinsey and Company estimated that "AVs could free as much as 50 minutes a day for users, who will be able to spend traveling time working, relaxing, or accessing entertainment," (9) rather than actively driving their vehicles.

In addition, AVs may enhance mobility for traditionally transportation-disadvantaged populations, such as young people not old enough to or that choose not to drive, older adults, people with disabilities, low-income households, and others that lack access to private vehicles or cannot drive for whatever reason. For example, a 2017 study conducted by the Ruderman Family Foundation estimated that the potential of AVs to mitigate transportation barriers for people with disabilities could "…enable new employment opportunities for approximately two million individuals with disabilities, and save $19 billion annually in healthcare expenditures from missed medical appointments." (10)

Finally, if a shared-use AV business model emerges as dominant (see next section), AVs could make travel more efficient, reduce overall vehicle miles traveled (VMT), and significantly reduce demand for parking and road space. In addition to freeing up significant land and building assets for repurposing, researchers estimate that AVs could reduce energy use and related emissions by as much as 80-90 percent from a combination of vehicle platooning, more efficient traffic flow and parking, ridesharing and other factors. (11) These benefits, however, could be negated if the dominant AV business model that emerges is privately owned vehicles operated for personal use. Some researchers even speculate that "…vehicle miles could increase dramatically due to a combination of factors including: increased use by those currently unable to drive, increased numbers of trips (both occupied and unoccupied), a shift away from public transit, additional VMT due to self-parking and self-fueling, and longer commutes." (11)

AV BUSINESS MODELS AND USE CASES

There is a great deal of uncertainty surrounding AV technology development and adoption. As noted in a recent article published by the McKinsey Center for Future Mobility, "No one knows today when the technology will be mature enough, when mass-market adoption might start, where it will start, whether customers will adopt it or how fast and large this adoption will be.” [13] One of the most important unanswered questions is whether AVs will be privately owned and operated for personal use, if a shared mobility model will become dominant, or if some combination of personal and shared use will emerge. Table 1 and the sections that follow summarize three potential AV business models and a range of potential use cases associated with AV transport of people and goods.

Table 1. Potential AV Business Models and Use Cases

Potential AV Business Models		Ownership	Operation	Use Cases (SAE Automation Level)
	Automated Private Vehicles	Individual	Personal use	• Highway chauffeur (L3) • Traffic jam chauffeur (L3) • Urban/suburban pilot defined area (L4) • Highway autopilot (L4) • Highway convoy (L4) • Full autopilot – anywhere operation (L5)
	Automated Shared Mobility Vehicles	Corporate or Public	Fleet, shared	• Bus platooning (L3) • Automated Robo-taxis (L4/L5) • First/last-mile connector (L4/L5) • Campus circulator (L4/L5) • Neighborhood circulator (L4/5) • On-demand micro-transit/paratransit (L4/L5) • Yard operations (L4/L5)
	Automated Freight Vehicles	Individual or Corporate	Single vehicle or fleet	• Truck platooning (L2/L3) • Highway chauffeur (L3) • Traffic jam chauffeur (L3) • HAV in confined areas (L4) • HAV hub-to-hub operation (L4) • HAV on open roads (L4) • Fully-automated freight vehicle (L5) • Automated package delivery (L4/5)

Source: Adapted in part from ERTRAC Connected Automated Driving Roadmap, Version 8, 08/13/2019

AUTOMATED PRIVATE PASSENGER VEHICLES

One AV business model that may emerge could extend current vehicle ownership patterns into the future. Like the dominant model today, AVs would be owned by individuals and operated for personal use. Auto manufacturers and technology companies would continue to develop and deploy AV technologies in the vehicles they produce and sell to the public. Existing Level 1 and 2 ADAS features would be augmented and enhanced over time to the point where ADS technology at Level 3 and above performs part or all of the dynamic driving task. Potential AV use cases include but are not limited to:

- ***Highway chauffeur (Level 3)*** – Conditional automated driving that involves ADS operation in a specified ODD, primarily on limited-access highways. The vehicle driver must activate the system but does not need to constantly monitor the driving environment. When enabled, the ADS performs all aspects of the DDT, including acceleration, braking, and lane changes. The vehicle driver is expected to achieve a minimal risk condition, when necessary. (14)

- ***Traffic jam chauffeur (Level 3)*** – Conditional automated driving when traffic back-ups occur on designated roadways. The vehicle driver must activate the system but does not need to constantly monitor the driving environment. When enabled, the ADS monitors slow moving traffic and performs all aspects of the DDT, including acceleration, braking, and lane changes as needed. The vehicle driver is expected to achieve a minimal risk condition, when necessary. (14)
- ***Highway autopilot (Level 4)*** – Highly automated driving on limited access highways, from entrance to exit on all lanes, including overtaking and lane change. The ADS user must activate the system but does not need to constantly monitor the driving environment. While the user can at all times override or switch off the system, the user need not be prepared to take over the DDT, so sleeping is allowed. The ADS has the capability of achieving a minimal risk condition, including leaving the highway and parking the vehicle safely. (14)
- ***Highway convoy (Level 4)*** – Electronically linked vehicles of varying types traveling on limited access highways or similar roads in the same lane traveling with minimum distance between vehicles. Depending on how the technology evolves, ad-hoc convoys could be created if vehicle to vehicle (V2V) communication is available with real-time performance monitoring that allows vehicles of different makes to participate in a convoy. The ADS user must activate the system but does not need to constantly monitor the driving environment during convoy operations. When enabled, the ADS can perform all aspects of the DDT, including acceleration, braking, and lane changes as needed. The Fallback-ready user or the ADS can achieve a minimal risk condition, when necessary. (14)
- ***Autopilot in defined area (Level 4)*** – Highly automated driving in mixed traffic on any roadway in a specified geographic area. The ADS can be switched off/overridden at any time if a driver is present. The Fallback-ready user or the ADS can achieve a minimal risk condition, when necessary. (14)
- ***Full autopilot (Level 5) –*** Fully automated driving from point A to B in any geography, on any roadway, under all conditions, without any input from the user. The ADS has the capability of achieving a minimal risk condition at any time. (14)

AUTOMATED SHARED MOBILITY VEHICLES

Another possibility is a shared mobility model characterized by private companies and/or public agencies operating and maintaining a varied fleet of AVs and selling mobility services to the public. Highly automated (Level 4-5) shared-use vehicles would operate in dedicated lanes and/or in mixed traffic. Depending on ADS capabilities and local use cases, services might be offered in designated areas, along specific routes, or with no limitations at all. There are examples of highly automated shared use vehicles in operation today in a variety of locations in the U.S., Europe and elsewhere. Examples include airport circulators and, more recently, low-speed automated shuttles operated in campus settings and in mixed traffic. Potential AV use cases include but are not limited to:

- ***Highly automated buses in mixed traffic or dedicated lanes (Level 3-4)*** – Highly automated transit buses and/or coaches operating in mixed traffic or in dedicated bus lanes together with non-automated buses at normal traffic speeds. Functions may include bus platooning, following and bus-stop automation for enhanced productivity, safety, traffic flow and network utilization. The ADS can be switched on and off/overridden at any time if a driver is present. The fallback-ready user or the ADS can achieve a minimal risk condition, when necessary. [14]
- ***Automated low-speed shuttles (Level 4)*** – Automated multi-passenger shuttles driving in designated lanes, on dedicated infrastructure such as a raised track, or in mixed traffic. Shuttles can be used individually or collectively as a system, along designated routes or in a designated area. Most applications today are limited to low speeds (< 25 mph) along specified routes; however, eventually automated shuttles may be capable of operating at higher speeds for longer distance travel or to match the speed of surrounding vehicles when operating in mixed traffic. Depending on the manufacturer, low-speed automated shuttles may or may not have steering wheels, accelerator pedals, and brake pedals. As such, for Level 4 vehicles a fallback driver is not required and user intervention is not anticipated. Automated shuttle fleet solutions may require backend infrastructures such as control centers, data processing support, and remote operation. The ADS has the capability of achieving a minimal risk condition at any time. Specific applications may include first/last-mile connectors, campus circulators, and neighborhood circulators. [14]
- ***Automated Robo-taxis (Level 4-5)*** – Highly automated vehicles providing for-hire, on-demand rides similar to the way traditional taxis and ride-hailing transportation network companies (TNCs) like Uber, Lyft, and others do today. Passengers call a vehicle using a mobile application or similar interface, request a destination, and the vehicle is dispatched to complete the trip. Similar to existing taxi and TNC services, individual rides might be solo or shared depending on origins, destinations, and demand. Applications may include micro-transit and paratransit services for people with disabilities. Level 4 vehicles would operate in a specified ODD with no driver present. Level 5 vehicles would operate driverless anywhere without restrictions in terms of geography, road type or condition. The ADS has the capability of achieving a minimal risk condition at any time.
- ***Storage/maintenance yard operations (Level 4-5)*** – ADS enabled transit buses or coaches operating in confined areas such as a bus storage and maintenance yard. Applications might include vehicle repositioning to enhance productivity and safety, before and after shifts and during routine vehicle maintenance procedures. The ADS can be switched on and off/overridden at any time if a driver is present. The Fallback-ready user or the ADS can achieve a minimal risk condition, when necessary.

AUTOMATED FREIGHT VEHICLES

A third emerging business model incorporates the use of highly automated vehicles (HAVs) in goods movement, logistics and package delivery. It shares similarities in terms of the technology development pathway with the automated private passenger vehicle model described above. Likewise, a number of the conditional automated driving use cases such as vehicle platooning/convoys, highway chauffeur, and traffic jam chauffeur can also be applied to commercial trucking. In addition, there are a number of potential logistics-specific use cases for AV vehicles in goods movement. These include but are not limited to:

- ***HAVs in confined areas (Level 4)*** – Highly automated freight transport vehicles driving in confined areas such as freight hubs, logistics terminal, and ports. Confined area operation would include the use of un-manned and remotely supervised vehicles, with or without a driver cabin. ADS-enabled vehicle operations would be remotely monitored and controlled if necessary. If remote operation failed, the on-board ADS would be capable of achieving a minimal risk condition. (14)
- ***HAVs in hub-to-hub operation (Level 4)*** – Highly automated freight transport vehicles driving hub-to-hub in designated corridors. Vehicles may or may not include a driver cabin. Hub-to-hub operation could also include longer transport corridors that connects hubs using designated open roads. Vehicles would operate without driver intervention according to pre-defined ODDs. The on-board ADS would be capable of achieving a minimal risk condition. (14)
- ***HAVs on Open Roads and/or Mixed Traffic (Level 4-5)*** – Fully automated freight vehicles driving from point A to B, on open roads, and in mixed traffic environments either in a specified ODD (level 4) or without restriction (level 5), without user intervention. The ADS has the capability of achieving a minimal risk condition at any time.
- ***Automated package delivery (Level 4)*** – Fully automated light-duty package delivery vehicles (< 10,001 pounds) operating in a specified ODD. These vehicles, sometimes called "last-mile robots" or "ground drones," would operate without a driver and may not include a driver cabin at all. Some vehicle designs are smaller than small passenger cars and are intended for neighborhood delivery of small packages and groceries. The on-board ADS would be capable of achieving a minimal risk condition.

AV TESTING AND OPERATIONS: CURRENT STATUS AND FUTURE DIRECTION

Vehicles equipped with SAE Level 0-2 autonomy are operating on the road today and becoming more commonplace each year. Private passenger vehicles with limited Level 3 automated features are currently available in some models with more planned for release in 2021. HAVs with Level 4 automation are currently being tested by a variety of companies in a number of states, including Arizona, California, Florida, Nevada, Ohio, Pennsylvania, Texas and others. For example, robo-taxis are being operated with and without safety drivers by high-profile companies including Waymo, Uber, GM/Cruise, and others. Low-speed shuttle demonstration projects have been undertaken throughout the United States and internationally. Low-speed shuttles are even being deployed into revenue service in the United States. Two recent examples include one service recently launched in Columbus, OH and another in Corpus Christi, TX. (15) In December 2019, the State of California authorized the testing and commercial use of light-duty autonomous delivery vehicles on public roadways. (16)

While significant progress has been made over the past five years, many uncertainties about HAV development cloud the future of how quickly adoption might occur. Mostly notably, the technical readiness of HAVs is still a work in progress. It is not yet clear when commercial release might occur. (17) Other uncertainties relate to the size of the price premium that may exist between HAVs and conventional vehicles when they are eventually introduced into the market and how consumer demand will respond based on its affordability and vehicle performance. The length of the phase-in period for full AV deployment in new car sales as well as the time frame required to turn over the conventional vehicle fleet is also uncertain.

Given these uncertainties, some believe that HAVs may be deployed first in the shared vehicle and freight business models explained above. These business models offer potential economic savings to operators that can deploy and manage fleets effectively. HAV penetration in the private vehicle market may take longer or may never take hold. Todd Litman, a mobility researcher at the Victoria Transport Policy Institute cautions "[i]f AVs follow previous vehicle technologies, it will take one to three decades for them to dominate new vehicle sales, and one or two more decades to dominate vehicle travel, and even at saturation a portion of vehicle travel may continue to be human operated." (17) Moreover, given potential cost premiums and personal preferences for control of the driving experience, it might take a government mandate for all new or operating vehicles to have AV technology. (17)

These uncertainties will have implications for future policy and planning for HAVs in New Jersey. It will be imperative for New Jersey to put in place an HAV governance structure that can monitor the testing phases of HAV development while also looking forward toward large-scale deployment. This future orientation will help state and local policy officials to put in place a policy framework that ensures readiness, invites innovation, and manages the transition to an HAV-dominated future, whenever that may occur.

SECTION 3. CURRENT LAWS

This section examines the status of advanced autonomous vehicle guidance, laws, and regulation in the United States at the federal and state levels. It also includes a review of New Jersey Statutes Annotated Title 39, the primary law affecting the regulation and operation of motor vehicles in New Jersey as it pertains to the testing and deployment of HAVs on public roadways in New Jersey.

FEDERAL LAWS AND GUIDANCE

The U.S. Department of Transportation (USDOT), through the National Highway Traffic Safety Administration (NHTSA), has primary jurisdiction over vehicle safety. The USDOT sets standards for vehicle performance and design features and has the authority to recall vehicles if a safety defect is detected. NHTSA is the federal agency charged with regulating safety standards in the auto industry and transportation. NHTSA issues the Federal Motor Vehicles Safety Standards (FMVSS) to implement laws passed by the U.S. Congress and which specify and regulate certain safety-related vehicle features. Manufacturers of motor vehicles and related equipment must comply with these standards to protect unreasonable risk of crashes from the design, construction or performance of motor vehicles. Historically, USDOT has been the primary funder for road and transit infrastructure projects, and a major contributor to transportation research and development.

In September 2016, NHTSA published its first policy document related to automated vehicles. The document, entitled Federal Automated Vehicle Policy: Accelerating the Next Revolution in Roadway Safety, was issued "…as agency guidance rather than rulemaking in order to speed the delivery of an initial regulatory framework and best practices to guide manufacturers and other entities in the safe design, development, testing, and deployment of HAVs." (2) The document addressed four key aspects of AV development and deployment: 1) Vehicle performance guidance for AVs; 2) the regulatory tools currently available to NHTSA to guide AV development; 3) new tools and authorities NHTSA may need to facilitate the safe introduction and deployment of HAVs; and 4) the role states should play in AV regulation.

The 2016 federal AV guidance included a model state policy that was developed in cooperation with the American Association of Motor Vehicle Administrators (AAMVA). The goal of the model state policy is to establish a consistent national framework to guide HAV development and deployment rather than a patchwork of incompatible state and local laws. The policy reinforces the traditional responsibilities States have for vehicle licensing and registration, traffic laws and enforcement, and setting policy related to motor vehicle insurance and liability and identifies where new issues related to HAV development, testing and deployment fit within the existing federal-state structure. (2) The policy acknowledges NHTSA's important role in monitoring and regulating vehicle design and safety and suggests that these areas should remain under the purview of the federal government, not state and local policy makers.

Since 2016, the USDOT and NHTSA have released three updates to the Federal AV policy. [(18), (3), (19)] Each was intended to refresh and build on the initial policy framework; reinforce federal and state responsibilities related to: HAV regulation; describe on-going and new HAV-related federal initiatives; and communicate best practices that states should consider. Each update also reaffirmed USDOT's reliance on a voluntary safety self-assessments by ADS developers; technology neutrality; and support for the development of voluntary technical standards for AVs. These reports have reflected and informed the national discussion on the appropriate scope of federal and state regulation of AVs.

The U.S. Congress has held hearings and considered legislation to signal the Federal role in ensuring safety in AV testing and deployment in response to issues raised by AV innovation, but ultimately without the successful passage of legislation. In the 115th Congress, the House passed H.R. 3388, the "Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution" (SELF DRIVE act) in September 2017. The related Senate Bill, "American Vision for Safer Transportation Through Advancement of Revolutionary Technologies" (AV START act) stalled in committee over concerns among some Senators that the bill failed to do enough to address consumer safety and cybersecurity issues.

The non-partisan Congressional Research Service (CRS) listed points of disagreement in the legislation of the 115th Congress, including:

- "The extent to which Congress should alter the traditional division of vehicle regulation, with the federal government being responsible for vehicle safety and states for driver-related aspects such as licensing and registration, as the roles of driver and vehicle merge.
- The number of autonomous vehicles that NHTSA should permit to be tested on highways by granting exemptions to federal safety standards, and which specific safety standards, such as those requiring steering wheels and brake pedals, can be relaxed to permit thorough testing.
- How much detail legislation should contain related to addressing cybersecurity threats, including whether federal standards should require vehicle technology that could report and stop hacking of critical vehicle software and how much information car buyers should be given about these issues.
- The extent to which vehicle owners, operators, manufacturers, insurers, and other parties have access to data that is generated by autonomous vehicles, and the rights of various parties to sell vehicle-related data to others." [(20)]

Comprehensive legislation on AVs to address standards for autonomous vehicles, cybersecurity, and other AV issues has not been introduced in the 116th Congress, although it has been reported that discussions on a bipartisan and bicameral bill are continuing. [(21)]

STATE LEGISLATION AND POLICIES

State governments traditionally have authority for regulating driver licensing, vehicle registration, insurance, vehicle inspections, and traffic laws to protect public safety. States also have a significant role in planning, funding, design, construction, operations and maintenance of transportation infrastructure. To date, there has been considerable variability in how states have handled these roles in the context of HAV testing and operation. [22] [20] According to the National Conference of State Legislatures (NCSL), 41 states and the District of Columbia have considered legislation related to AVs since 2012; 31 states and the District of Columbia have enacted legislation, and governors in 11 states have issued executive orders (EO). In five of the states where EOs were signed, legislation was also enacted. [23] Figure 3 presents a graphic depiction of the states where AV laws or EOs have been adopted.

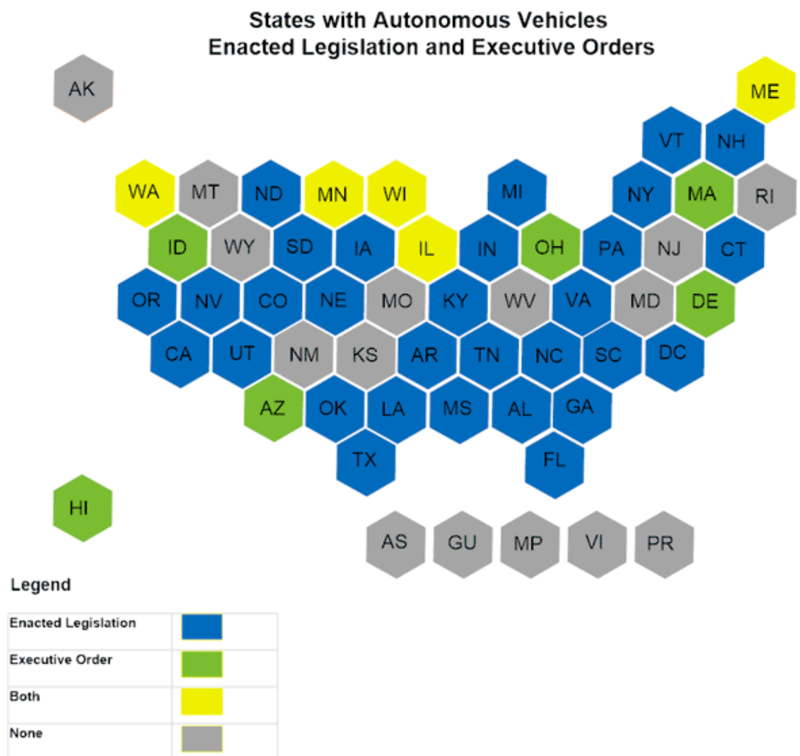

Figure 3. States with AV Enacted Legislation and Executive Orders

Source: National Conference of State Legislatures. Note: This image was downloaded from the NCSL website and does not reflect all legislation/EOs adopted in 2019 (e.g., New Jersey).

To inform Task Force deliberations, RU-VTC researchers conducted a high-level screening of all enacted legislation and EOs reposed on the NCSL database. A State-by-State Comparison Matrix is included in Appendix 2 for reference purposes. The screening provided a foundational understanding of how different states have addressed various AV-related topics. The following observations can be made:

- There is significant variation in the frameworks states have adopted to authorize the testing and operation of HAVs.
- Most states with adopted legislation or EOs address HAV definitions in some way, some more completely than others. Not all states use definitions that are consistent with SAE *J3016*

Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles. This is especially true for states that adopted legislation or an EO prior to 2017. States that have adopted legislation or and EO after 2017 are more likely to include standard terms and definitions.

- Vermont, New York and Pennsylvania specifically require that a “safety driver” be present in the vehicle during testing and operations. Others specifically authorize testing without a safety driver (CA, FL, IL, MA, MI, NH, OH, PA, WA) or are silent on whether a safety driver is required.
- Some states (AZ, CA, CO, GA, MI, NV, NY, OH, PA, DC) require entities wishing to test and operate HAVs on public roads to complete an application process.
- Some but not all state legislation/EOs require that the HAVs being tested meet all Federal motor vehicle safety standards.
- Some states require excess liability insurance coverage of $2m (AL, LA) or $5m (CA, CT, NV, NH, NY, VT). Michigan requires $10 million in excess liability. Others require HAV testers to provide proof of insurances in accordance with statutory minimum requirements but do not specify minimum coverage (FL, GA, MA, MI, DC). Still others are silent on insurance requirements.
- Only North Carolina specifically addresses titling and registration in their legislation. However, most states require HAVs to be properly registered and licensed prior to testing and operation on public roads. Nevada appears to be the only state that issues a special HAV license plate.
- Several states (AZ, CA, NY) require HAV testers to prepare and submit a law enforcement interaction plan.
- Most states don’t identify a specific agency for regulating and monitoring AV compliance. Those that do most often identify the State DOT as the responsible agency, some designate the Department of Motor Vehicles as the lead agency, and still others assign joint responsibilities among various agencies.
- Several states (CA, FL, MI, NV, NH, DC) specifically prohibit agencies and political subdivisions from passing HAV-related laws, regulations, taxes, fees etc.
- A number of states (AL, AK, CA, KY, LA, ND, OK, TN) have passed legislation that specifically addresses the use of AV technology to assist truck platooning.
- Only four states (FL, HI, NV, and PA) specifically authorize automated transit vehicle operation and testing.
- Cybersecurity was not specifically addressed in any state legislation or EO. However, California and Pennsylvania require prospective HAV testers to certify that they have taken reasonable measures to prevent cyberattacks as part of their HAV permitting process.

In addition to the high-level state-by-state screening, at the direction of Task Force members, RU-VTC prepared a series of case study tables that summarize the AV testing and operation enabling frameworks in place in Arizona, California, Florida, Michigan, Nevada, New York, Ohio, Pennsylvania, and

Texas (see Appendix 3). These states were selected because of their proximity to New Jersey or because they were thought to be leading case examples with active HAV testing taking place. The case study tables were used by the Task Force's subcommittees to inform their discussions and to help the subcommittees to formulate recommendations.

REVIEW OF NEW JERSEY STATUTES AND REGULATIONS

P.L.2019, J.R.2 directed the Task Force to identify and evaluate state laws that may unreasonably impede the testing and operation of autonomous vehicles on public roads in New Jersey. Toward this end, NJMVC and NJDOT staff conducted a review of N.J.S.A. Title 39, the law in New Jersey that governs motor vehicle and traffic regulation, and Title 16 of the New Jersey Administrative Code, which include rules and regulations related to the New Jersey's transportation agencies and authorities. This review found no Title 16 provisions and only one Title 39 provision that appears to present an immediate impediment to the testing of HAVs on public roadways in the State. This provision, which is contained in the definitions section (N.J.S.A. 39:1-1), defines "operator" as "a person who is in actual physical control of a vehicle or street car." This definition should be changed to accommodate the scenario where a self-driving vehicle is operating with the ADS engaged.

A number of additional Title 39 provisions potentially conflict with HAV operation but they appear not to be a problem until HAVs move beyond testing to deployment without a safety driver present in the vehicle or if the HAV use case involves commercial vehicles and/or school buses. These provisions can be revisited as HAV technology development advances and particular New Jersey pilot and demonstration projects are identified. Appendix 4 presents a summary these Title 39 provisions and how they potentially conflict. In addition, several provisions in Title 16 reference the presence, actions, and interactions of an "operator" or "driver," in either passenger or commercial vehicles. These provisions would also need to be clarified if and when HAVs move from testing to deployment without a human driver present in the vehicle.

SECTION 4. CONSIDERATIONS

The transition to AVs can be seen as a large, long-term technological disruption [(24)] yielding promising traffic safety benefits (3) but uncertain societal effects. There are many issues to consider as AV technology advances. Some of these considerations were noted in P.L.2019, J.R.2; others are evident in the literature and popular media covering AV technology development and adoption. This section explores the topics the New Jersey legislature directed the Task Force to address as well as several others that were raised as part of Task Force deliberations.

OUT OF SCOPE AREAS

AV technology development is in the early stages of development. HAVs may not represent a significant share of nationwide vehicle fleet for decades. Some issues and concerns, while important, may not need to be addressed by policy makers for the foreseeable future. Also, as mentioned in previous sections, there is a great deal of uncertainty surrounding what path AV technology development will take and how fast adoption will take place. Given the 180-day time frame available for deliberations, the Task Force agreed to focus its efforts on what New Jersey policy makers can and should do in the short term (1-2 years) to enable and encourage the safe testing and operation of HAVs on public roadways in New Jersey, while highlighting areas to monitor and address over the longer term as AV technology development advances. This dichotomy is reflected in this section and in the Task Force recommendations that appear in Sections 5. In addition, the Task Force recognized and agreed that issues related to vehicle design and safety standards were the purview of NHTSA and therefore not appropriate to address at the state level.

ADMINISTRATIVE CONSIDERATIONS

As noted in the previous section, some but not all states identify a lead agency to address HAV testing and operations. AAMVA's *Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles* recommends that a lead agency be designated and charged with establishing an HAV committee that includes representatives from various executive branch agencies, the state legislature and local governments. AAMVA further recommends that a range of interested stakeholders, including but not limited to university researchers, disability advocates, pedestrian and bicycle advocates, HAV manufacturers and others, be consulted on a regular basis regarding issues related to HAV testing and deployment. Establishing such a framework can encourage information sharing, learning and collaboration. [(25)] As detailed in Section 5, the Task Force recommends that NJMVC be designated as the lead agency responsible for authorizing and monitoring the HAV testing and deployment in New Jersey and that an on-going stakeholder engagement framework be put in place. The recommendations also call for the establishment of an Interagency HAV Advisory Committee.

VEHICLE CREDENTIALING, LICENSING AND REGISTRATION

Current practices among states vary widely in terms of their requirements for vehicle credentialing. Some jurisdictions require that entities wishing to test and operate HAVs on public roadways obtain an HAV testing or deployment permit. Others do not. AAMVA recommends that states establish an application and permitting process that collects the background information and details necessary for state officials and law enforcement personnel to know who is testing or operating an HAV, what type of testing or operation is planned, where the testing or operation will take place and how the testing or operation will be implemented. At a minimum, AAMVA recommends the following information be required: information about the company testing or operating the HAVs, vehicle information, information on the vehicle safety drivers, a summary of the safety driver training program to be implemented, and a range of certifications including but not limited to certification that the HAVs to be tested meet federal motor vehicle safety standards or have received an exemption from NHTSA. (25)

With regard to vehicle licensing and registration, AAMVA recommends that uniform terms and definitions be adopted and that vehicle registration documents be modified as needed to clearly note the vehicle's level of autonomy. AAMVA further recommends that states not adopt vehicle registrations and titling procedures that make it inefficient for vehicle manufacturers to test and operate in multiple jurisdictions. Finally, AAMVA discourages states from requiring special license plates. (25)

NJMVC staff reviewed the agency's existing vehicle licensing and registration processes and determined that they were adequate to allow the titling, registration, and licensing of HAVs for testing purposes in the short term. Over the longer term, NJMVC will monitor HAV registrations and licensing and consider whether modifications to existing procedures are necessary. This may include consideration of whether a special class of license plate is appropriate once there is sufficient demand to warrant such a change. Such a change could be made in a manner consistent with current procedures for licensing livery and omnibus vehicles.

INSURANCE AND LIABILITY

An important aspect of registering and licensing HAVs for testing or deployment is to ensure that the vehicles are appropriately insured. However, determining the appropriate type (i.e., personal, commercial, product liability) and cost of insurance coverage for HAVs is difficult because there is limited data available to establish underwriting and rating criteria. A recent survey of insurers found that "nearly half of the survey's 385 participants cited autonomous vehicles as an important emerging insurance issue, but most respondents had only begun informal discussions of the matter, if any." (26)

The impact of HAVs on insurance is not yet clear. Fully autonomous vehicles have the potential to significantly reduce vehicle collisions, injuries, and fatalities. Widespread deployment of HAVs could fundamentally change the model for providing insurance which currently rates driving behavior and risk characteristics of human drivers. The introduction of ADS-enabled vehicle operation with no human driver present could change how liability is assigned moving forward. If driving becomes safer, there may be fewer insurance claims and insurance requirements and costs might go down. On the other hand, the higher cost of repairing advanced technology equipped vehicles and assigning financial responsibility for vehicles involved in a collision when no driver is present or when driving responsibility is shared between the ADS and a driver could be very complicated and may increase the cost of insurance. (27)

Currently, state financial responsibility and insurance laws vary across jurisdictions. Generally, states require that vehicles and drivers be insured with some level of liability coverage as well as a range of other mandatory or optional coverages such as personal injury protection, uninsured motorist protection, collision and/or comprehensive insurance coverages. However, as noted earlier, there is little uniformity across states regarding the minimum insurance coverage requirements for HAVs.

To date, no consensus has emerged in the industry regarding best practices for insuring HAVs. (28) For example, some have suggested that a shift in responsibility from drivers to the ADS manufacturer may bring about greater reliance on no-fault automobile insurance because "product-liability lawsuits are more expensive and time-consuming than personal injury lawsuits, so a no-fault system that quickly compensates victims without assigning fault may be viable." (27) Others have suggested something like a federal no-fault compensation program for users of HAVs that have been deemed safe for operation by NHTSA that are involved in an accident. (27) It will take time and experience to know which approach makes the most sense. At a minimum, AAMVA recommends that HAVs be insured in the "form and manner" required for the same class of vehicle without ADS technology. (25)

Representatives from the insurance industry participating on the Task Force reviewed New Jersey's current vehicle insurance requirements and agreed that standard policy requirements for different classes of vehicles (e.g., private passenger, commercial, omnibus, etc.) should be adequate for the purposes of insuring HAVs for testing and operation on public roadways in the short term. As more data becomes available for underwriting purposes, these requirements should be revisited. In addition, in the short term, Task Force members agreed that it is important to clarify who should be held financially responsible if a crash occurs involving a vehicle being operated with ADS engaged. In this regard, the definitions for "driver" and "operator" in New Jersey statutes should be amended as needed to make clear that the "operator" of the vehicle when an ADS is engaged is the vehicle registrant, which in most cases will be the manufacturer of the ADS technology or the entity testing the HAV.

LAW ENFORCEMENT CONSIDERATIONS

There are a number of law enforcement considerations related to HAV testing and deployment. These include but are not limited to:

- ***Crash and incident reporting*** – Although HAVs are expected to significantly reduce the number of vehicle crashes over time, collisions and incidents involving HAVs are inevitable. Crash reporting is important for identifying safety concerns during testing and for establishing liability. During HAV testing in particular, it will be critical to obtain as much information as possible from

HAV testers that can expand available data and understanding of how and why incidents and crashes occur. This will help to improve system engineering, inform the possible need for regulation, facilitate assignment of liability, and increase public acceptance. At a minimum, AAMVA recommends that HAV testers be required to submit "crash-related information and a summary of the manufacturer's analysis of the incident" for each crash that occurs. [25]

In addition to the above, members of the Task Force law enforcement subcommittee discussed the need to standardize procedures statewide for law enforcement officers to capture AV data information on crash reports. In this regard, the committee members agreed that this could not be done within the Task Force 180-day schedule. As such the committee suggested that the New Jersey Statewide Traffic Records Coordinating Committee (STRCC) be tasked with conducting additional research on the practices being followed in other states. The STRCC can then make more detailed recommendations regarding how existing crash reporting protocols and forms should be modified moving forward.

- ***Distracted and impaired driving*** – Distracted driving is a leading cause of crashes in the U.S. HAVs have the potential to reduce or eliminate crashes attributable to distracted driving; however, during HAV testing, when safety drivers are present, they are expected to remain attentive to the driving environment and be prepared to retake control of the vehicle as needed. Existing laws related to distracted and impaired driving were enacted in the context of conventional driving conditions and did not anticipate the potential for ADS-enabled vehicles. Members of the law enforcement subcommittee discussed the need to clarify New Jersey existing statutes to make clear that distracted driving and impaired driving laws apply to safety drivers involved in HAV testing, even when the vehicle is operating with the ADS engaged.
- ***Law enforcement and first responder interaction with HAVs*** – Law enforcement and first responders have expressed a range of concerns related to HAV testing and deployment on public roadways. These include: identifying HAVs, knowing when vehicles are operating with the ADS engaged, and how to respond and interact with an HAV if it becomes disabled or is involved in a crash. Currently, there are no standards for vehicle identification and externally marking vehicles with information on the level of autonomy available in each vehicle. In the short term, the vehicles are generally recognizable from a combination of company logos and the array of visible sensors, radar, LIDAR, and other equipment mounted on the vehicles. Over the longer term, it is anticipated that industry standards for marking and identifying HAVs will emerge. [25] To the extent they do, these should be adopted by New Jersey and required for HAVs operating in the state. In addition, in the short term, local law enforcement officials should be consulted and informed whenever testing or deployment is proposed in their jurisdictions. This will increase awareness and familiarity with the technologies being tested or deployed and how to recognize them on the road.

  Task Force members and subject matter experts that participate on the law enforcement subcommittee articulated a number of concerns related to interacting with HAVs in the field if a traffic violation, incident, or crash occurs. These include unexpected vehicle movement, unknown hazards related to how vehicles are powered, how to override the ADS if necessary, and how to contact a responsible party if the vehicle is operating without a driver. An emergent leading practice in this regard among states where HAV testing is taking place is to require that the HAV tester submit a *law enforcement interaction protocol* as part of the application and permitting process. The protocol can address these and perhaps other concerns expressed by local law enforcement. Arizona, California and New York currently require HAV testers to provide such a protocol.

- ***Adherence to traffic laws and vehicle response to emergency vehicles, manual traffic controls, and atypical road conditions*** – Roadway safety often relies on drivers obeying traffic laws while responding effectively to a dynamic driving environment. Drivers experience atypical events on a regular basis. They encounter road debris and crash scenes on a regular basis and may encounter law enforcement or construction workers providing manual traffic direction. Drivers may also be called upon to yield to or move out of the way of emergency vehicles. (25) Law enforcement officials have expressed concerns regarding how HAV will perform while operating on public roads. While HAVs can be programmed to follow traffic laws and perhaps less formal "rules of the road" such as driving on a shoulder to avoid a hazard, it may not be possible to anticipate all situations (i.e., "edge" cases) the HAV may encounter. How to address these circumstances will require significantly more experience with HAVs operating on public roadways and coexisting with conventional vehicles. AAMVA recommends that states monitor research efforts as the technology development process continues and to wait to see how traffic laws may need to change as HAVs become more commonplace.

- ***Enforcement of HAV permit conditions*** – As noted under vehicle credentialing, AAMVA recommends that states establish an application and permit process for entities wishing to test and/or deploy vehicles for operation on public roadways. Such a process should have an enforcement mechanism. AAMVA recommends that a process be put in place to suspend or revoke testing and/or deployment permits and that fines or penalties be considered if HAV testers continue to operate in violation of a permit suspension or revocation. As detailed in Section 5, the Task Force recommends that a permit and application process be established in New Jersey with the NJMVC designated to oversee that process with the power to suspend or revoke HAV testing or operating privileges when necessary to protect public safety.

LAND USE AND ROADWAY INFRASTRUCTURE DESIGN

The adoption of HAVs, as with other innovations, is expected to follow a deployment pattern that moves over time from testing to successive stages of commercial release, product improvement, expansion, market diffusion, maturation, and saturation. (17) At the same time, there is considerable uncertainty as to the pace and duration of these stages, suggesting that there will likely be a mixed fleet of HAV and non-AV vehicles for a significant period of time. (17) (29) Such uncertainty has implications for research, planning, and policy development. Researchers have speculated that foreseeable impacts of HAV deployment may include: a continuation and expansion of "sprawling" development patterns;

redesigning and perhaps downsizing roadways to accommodate new traffic and travel patterns; more efficient right-of-way utilization; changes to how roadway access is managed; the need to rethink current approaches to signage, signalization, and roadway striping; pedestrian and bicycle interface conflicts; reduced need for parking; and others. The remainder of this section explores some of these issues in more detail.

- ***Planning with Uncertainty*** – A variety of public agencies have responsibilities that include long-range planning. These include state departments of transportation, metropolitan planning organizations, local governments, and others. The planning horizon for many of these efforts is 30 years or more. During this timeframe, it is foreseeable that HAVs could become a significant share of the overall vehicle fleet and account for a significant share of trip making in New Jersey. Although no consensus has emerged nationally regarding how to plan for the uncertainty surrounding HAVs, the Transportation Research Board (TRB) recently funded a research study to begin to answer a number of key questions facing planners and policymakers in this regard. (30)

  While HAVs are expected to transform the way that people travel and have a profound impact on land use patterns, the built environment, and communities, uncertainties extend not only to the timing of widespread AV adoption, but to the extent to whether a shared-use model will prevail over personal ownership of HAVs in the future. The cost of owning AVs may slow the pace of transition to an HAV fleet (17) and perhaps put personal ownership of AVs out of reach for a large segment of the population. Some of the greatest impacts on regional land development patterns, vehicles miles travelled (VMT), roadway design, and infrastructure may be experienced in the longer term once AVs comprise a majority of the vehicle fleet. (31) (32).

  State, regional, and local governing institutions in New Jersey will need to be forward-looking as the HAV technology development process continues. State, regional and local planning organizations can make an important contribution by putting forth good planning principles and participating in statewide and regional policy and planning working groups on HAV issues. Planners should convene diverse stakeholder discussions to understand the uncertainties and consider potentially foreseeable impacts -- positive and adverse -- under different future scenarios. They can also promote "…flexibility, experimentation and innovation" and encourage municipal demonstration projects and pilots, as a way to develop, share and learn best practices. (32)

- ***Development Patterns*** – On a regional scale, a potential long-term impact of HAV deployment could be an increase in sprawl development. Commutes that are longer may not seem so onerous since commuting time can be spent on alternatives to driving (e.g., reading, sleeping, paperwork, socializing). Commuters may live further from their jobs, resulting in an increase of VMT. New opportunities for personal convenience may arise from HAV deployment that could have negative impacts to the community. VMT and traffic congestion could rise if privately owned and operated HAVs are used by their owners to travel without any passengers, for example, if the vehicle is ordered to run errands, receive servicing, or "go home" and "come back" to park in the driveway while the owner is at work or on vacation. VMT could also rise if owners turn their HAV over to TNC services when it's not in personal use to have a "side-hustle" without needing to drive the car.

In addition, due to the longer travel distances between destinations in suburban communities versus urban communities, shared use of HAVs may be less practical as it would take additional time to rotate through different pick-up and drop-off locations in suburban and exurban areas. As a result, individual ownership of HAVs may prove more practical or desirable in suburban areas. The potential secondary effects of sprawling land use patterns include greater land consumption, generating higher infrastructure costs to address growth and, depending on how vehicles are powered, increased emissions. Ensuring that HAVs are electric or powered by other alternatives to fossil fuels could minimize negative energy-related and air emissions effects.

HAV ride sharing may be more attractive in urban settings because of the more compact development patterns. Urban users are also more accustomed to public transport options potentially making ride sharing more desirable for urban areas. While the potential of HAVs to contribute to sprawl is a concern, they may also provide opportunities for "sprawl repair." [32] HAVs may reduce the need for parking, especially if HAVs are shared. Reduced need for parking and the relocation of parking to remote areas outside core zones of activity could provide significant urban redevelopment opportunities. The reduction of land area for on-street or off-street parking should enable its reuse for infill redevelopment, increased open space, green infrastructure to manage drainage, or new park and recreational facilities. Similarly, traditional campus-like developments such as hospitals and medical centers, universities, shopping malls, or amusement parks may be able to intensify use through the conversion of surface or structured parking into additional buildings, open space, and park areas, if shared HAVs become the norm.

With reductions in on-site parking demand, local development regulations will need to be revised and site design plans for commercial and residential development can be changed to promote the more efficient and imaginative use of available space. Drop-off/pick up areas for shared HAV riders will become a more integral element of site design and this may affect placement of building structures in relationship to entrances and exits off highways and arterials to maximize convenience for passengers and buildable area for development. New Jersey's diverse geographies make HAV land use policy decisions challenging. What may be beneficial in an urban area might be detrimental in a suburban area, and vice versa. Over the long term, HAV policies and infrastructure decisions will need to be sensitive to potential unintended consequences both in a regional and local context.

- ***Future Roadway Design Considerations*** – HAV deployment has the potential to improve safety, relieve congestion, and increase road capacity. The capability of HAVs to communicate with surrounding vehicles and transportation network infrastructure may allow them to be smaller than conventional vehicles and to operate with a shorter following distance, in narrower lanes.

As a result, over the long-term, the cross-section of roadways may shrink. Some researchers have estimated that travel lane widths could be reduced to 10 feet or even 9 feet on urban or suburban arterials, or 9.5 foot or 10-foot lanes on expressways. [31] This may yield "surplus" space that could be repurposed for transportation enhancements (such as bike lanes, wider sidewalks, pedestrian paths, on-street parking), green space for stormwater management, or transferred to the adjacent property owners. [31] In the short term, however, opportunities to create "complete streets" through recaptured right-of-way will likely be limited until nearly full transition to an HAV fleet occurs.

Intersection design may also change. HAVs are expected to react to other vehicles and cross-traffic differently, moving when openings in traffic become available. In this evolution, traffic is likely to be free-flowing rather than a start-and-stop system, potentially reducing traffic congestion and increasing capacity. In the long-term, lane striping, too, could be eliminated in favor of "virtual lane systems" supported by connected infrastructure and reversible lanes or advanced traffic control systems could be programmed to dynamically reallocate infrastructure to accommodate peak flows. [31]

- ***Access Management and Parking*** – If HAVs are deployed for shared use, greater attention will need to be paid to drop-off and pick-up of passengers before going to park or pick up another passenger. Passengers will likely want to be dropped off/picked up near their final destination. Future urban site designers may place a higher priority on establishing dedicated areas for pick up/drop off along street frontages close to final destinations in areas formerly used for on-street parking. [31] A transition from parking to drop-off areas will have implications for access management including the location, form, and design of curb cuts and drop-off/loading areas. Drop-off considerations may need to become an integral element of future roadway design and local ordinances will need to address requirements for passenger loading and unloading.

  If a shared-use model is widely adopted, parking requirements will likely change significantly. Municipalities, particularly in more urbanized areas, may need to amend their land use plans, zoning ordinances, site design standards, circulation plans, and parking requirements to allocate less land for parking and circulation; they will need to determine how best to make use of "surplus" land through new approaches to land use and zoning. [31]

- ***Roadway Operations and Maintenance*** – Deployment of AVs will require the integration of new technologies and changes to the condition of highway infrastructure on which those vehicles operate. The HAVs being tested today rely on clear pavement markings and readable signage to stay in their lanes and navigate through traffic. [20] Before full transition to HAVs, major interstate highways as well as state, county, and local roads will need to accommodate both AVs and conventional vehicles with human drivers for years to come. [20]

  The Federal Highway Administration (FHWA) is expected to play a significant role during the long transition period to full HAV deployment, particularly through its administration of the Manual on Uniform Traffic Control Devices (MUTCD) and its national standard-setting for traffic control devices, such as road markings, intersection signals, and signage. FHWA is in the process of updating the 2009 MUTCD to address issues specific to AV technologies. However, not all states maintain highway markings at standards for supporting AV navigation and operations; this lack of uniformity for lane markings and road signs could be factor that inhibits testing and deployment. [20]

State and local transportation officials will need to update design standards, documentation, manuals, and training, as well as maintain high standards for maintenance of roadways, pavement markings, signage and intersections, during both regular operation of the road network and during times of altered roadway configurations, such as short- or long-term construction projects. This may require significant financial investment. It is reasonable to expect supportive roadway design and proper maintenance as a prerequisite condition for HAV testing and deployment. Minor roads without clearly defined road edges and center lines will make it more difficult for HAVs to position themselves correctly. [20] Similarly, dirt and gravel roads may also hinder HAVs from operating as cameras may be unable to spot potholes or edges in low-visibility conditions.

Federal and state transportation agencies are exploring how best to standardize methods to communicate information to vehicles and motorists about construction, road accidents, detours, and other changes to road environments. Even as HAV testing progresses, some researchers and officials have expressed concerns that the benefits of HAVs may not be realized until well-developed connected vehicle (CV) technologies are in place. If true, significant levels of infrastructure investment may be required for CV deployment.

Recognizing this challenge, the Transportation Research Board (TRB) has funded research to address how states can plan for and develop the CV infrastructure required for full HAV deployment and assess the business case for making investments in CV infrastructure – alone or in partnership with the private sector – to implement connectivity in addition to regular maintenance of highways, bridge and other traditional infrastructure. [33] Over the long-term, HAV developers may find new ways for AVs to navigate that are less dependent on roadway markings though greater use of guardrails, roadside barriers, sensors, and three-dimensional maps. [20] If highly detailed mapping can serve as a replacement for visual cues such as lane markings, then transportation agencies and automakers may need to develop an open standard so that all vehicles will understand the mapping technology. Vehicle-to-infrastructure (V2X) communications through dedicated short range communication (DSRC) and cellular communication may evolve to provide a mechanism for new types of vehicle guidance. [20]

The emergence of vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) technology changes the way information is transmitted to vehicles and drivers. When HAVs are initially deployed they will be sharing the road with conventional vehicles. Therefore, roadway signage, striping, and signals will need to accommodate the needs of both HAVs and conventional vehicles. Additional signs and signals may be required to demarcate where HAV and conventional vehicles may operate. In the longer-term, depending on how AV technology develops, physical traffic signs and signals may not be needed, except in relationship to protecting pedestrians and cyclists. Similar to signage, physical traffic signals may be replaced by sensors in roadways or towers that will communicate traffic information to vehicles.

- ***Pedestrian and Bicycle Interfaces*** – HAVs are expected to improve safety and efficiency for all roadway users, including pedestrians and bicyclists. However, the ways in which HAVs, pedestrians, and bicyclists will interact is not yet known. HAVs are being designed and "trained" to recognize and stop for pedestrians and bicyclists when they are encountered. However, it will still be necessary to ensure a safe operating environment for pedestrian and cyclists. This will require proactive human-centric planning and perhaps significant investment in technologies for crosswalk signaling, vehicle and pedestrian detection, signage, wayfinding, and other technologies to minimize conflicts, particularly when and if a full transition to HAVs occurs. As described above, roadway design and infrastructure that accommodate HAVs may eliminate traditional signage, signalization, and striping that currently protect pedestrians and cyclists. Similarly, redesigned roadways that prioritize drop off/pick up areas may divide bicyclist and pedestrian networks if not properly designed. Care will also be needed to ensure that future roadway and crosswalk designs remain accessible to those with disabilities or with limited mobility and access. [31] [32]

  At the same time, HAVs may provide opportunities to enhance walking by freeing up land area for a separate right-of-way for pedestrians and cyclists, for parks and plaza space, and for infill residential and nonresidential development. With proper pre-planning and collaborative urban design processes, reallocation of land areas could be used to promote urban design that facilitates livability and physical activity for residents and workers. [31] [32]

PUBLIC TRANSIT

As presented in Section 2, there are several use cases for deploying shared HAVs for public transit purposes. These include the use of highly automated buses in mixed traffic or dedicated lanes, automated low-speed shuttles, automated-taxis, and the use of automation in storage and maintenance facilities. While still in the early stages of testing and deployment nationally and internationally, highly automated transit vehicles hold great promise in terms of providing service efficiencies, increasing capacity, expanding the nature of services available to the public, and addressing long-standing barriers to greater transit use, including first/last mile connectivity, and providing service in lower-density areas and at lower-demand times of day.

In particular, the application and deployment of low-speed shuttles has expanded significantly in the past several years. These are typically offered to provide first- and last-mile connections to major destinations or transit hubs, or as a parking lot circulator to airport terminals and sports arenas. The outcomes for customers may include convenient access nearby destinations without the need to use a private automobile, particularly in areas where a traditional bus service could be inefficient. Services are now operating or planned on a demonstration or permanent basis in Columbus, OH, Corpus Christi, TX, Livermore, CA, Jacksonville, FL, Denver, CO, and Houston, TX. (15) Many of these deployments involve operation in mixed traffic. In 2019, NJ TRANSIT submitted a grant application to the Federal Transit Administration (FTA) to conduct a low-speed shuttle demonstration project at Fort Monmouth, and is awaiting FTA's decision.

The use of highly automated transit vehicles in dedicated lanes also holds significant promise for New Jersey as well. In the near-term, NJ TRANSIT is partnering with the Port Authority of New York and New Jersey (PANY&NJ) to conduct a pilot project. The project will explore the potential for using Level 3 automated vehicle technologies to increase the capacity and efficiency of bus movements using the Route 495 exclusive bus lane (XBL) to access the Lincoln Tunnel and the Port Authority Bus Terminal in Midtown Manhattan. In the longer term, as the technology advances, there may be opportunities to expand the number of dedicated bus lanes in New Jersey with HAVs operating alongside conventional buses.

POTENTIAL WORKFORCE IMPACTS: WHAT THE RESEARCH SAYS

The transition to HAVs may result in a variety of impacts to today's workforce. New jobs may emerge while others may need to adapt or could possibly be eliminated. There will most likely also be a significant need for training and retraining in a range of professions and job categories. Several recent studies have sought to assess the scale, timing and type of effects HAV deployment might have on America's workforce. These studies have been prepared by the U.S. government, (34) industry consortia, (24) (35) (36) and advocacy and think-tank organizations. (37) (38) The studies rely upon different data, methods, and, in some cases, scenario assumptions for the timing of HAV deployment in goods movement and market penetration rates for "personal use" versus "shared-use" vehicles in order to estimate the scale and distributional effects of HAVs on different occupations, industries, regions, and worker demographics (e.g., race and ethnicity, gender, income, educational attainment, health insurance, etc.).

Several studies identify the occupations most at risk as "primary drivers" of trucks, taxi cabs and buses and "other on-the-road" occupations whose jobs are associated with personal driving but whose primary responsibility is not driving, such as traffic and highway police officers, parking lot attendants, and driving instructors. (34) (24) (38) One study noted that these two "driving-related" occupational categories currently account for more than six million U.S. jobs – over four percent of U.S. nonfarm payroll jobs. (24)

With HAV adoption, other jobs will see duties change such as home health aides/visiting nurses, building contractors, real estate agents, regional supervisors, automobile, and vehicle insurance workers and taxi dispatchers (24). In total, the jobs whose duties are very likely to change with the adoption of HAVs includes 7.7 million people. (24) The change in duties could be interpreted as better or worse jobs from the perspective of pay or skills. (24) Some of these occupations may benefit from greater productivity or better working conditions offered by HAVs than the motor vehicle operator occupations that might be displaced. [24] New technologies and business practices that emerge from private, shared, and freight HAVs will also create new occupations and job opportunities in system production, repair, and operations. These new jobs may counteract job losses in traditional transportation occupations.

Another study estimates that the introduction of autonomous cars and trucks could directly eliminate 1.3 to 2.3 million workers' jobs over the next 30 years, depending on the adoption scenario followed. [24] Near-term effects are limited but, the maximum impact–which could occur during the 2040s–could raise the overall annual unemployment rate by about 0.1 percentage points and lower labor force participation by about 0.1 percentage points for a number of years, with stronger effects in hard-hit communities or during a recession. [24]

Still another study focused on near-term impacts concluded that there would be some displacement of passenger car-based driving jobs, mainly among taxicab drivers toward the latter half of the 2020s, but truck drivers were not likely to be displaced in large numbers due to existing truck driver shortages, and the belief that automated technology would largely support truck drivers instead of replace them. [35] As HAV technology progresses, the job function of truck drivers will likely transition to new roles. Truck operators will be expected to understand how to monitor software and hardware that automates the driving function and how to appropriately use the advanced safety systems in these vehicles. [35]

The impacts to truckers hinge greatly on the degree to which full automation occurs in the future. Truckers will experience greater job loss with rapid adoption of very high automation in trucks (i.e., no driver "in the loop" for most of the operation). In contrast, partial automation or teleoperation of trucks would not likely have significant adverse job loss impacts. [35] Similarly, limousine, bus, and paratransit drivers who are delivering services that require face-to-face interactions or passenger assistance were less likely to be displaced by automated vehicles in the foreseeable future. These drivers would likely undergo training to learn how to use the new ADS technology. [35]

Some studies make the case that there will be offsetting economic and job benefits from HAV investment and resulting productivity gains and consumer surplus. [36] SAFE, "a coalition of automobile manufacturers, technology companies, fleet managers, and thought leaders committed to advancing the future of transportation," asserts that HAVs will create jobs through the following effects:

- Firms will add jobs in fields directly associated with AVs, such as fleet service technicians or transportation aides for people with disabilities.
- Firms that support AVs will increase jobs, such as parts suppliers or software engineers.
- Falling costs for products and services resulting from AV adoption will free up discretionary income in the broader economy. New consumer demand will attract investment and lead to the growth of entirely new businesses otherwise unrelated to AVs.

Some workforce impact studies affirm the need to prepare for workforce impacts. [24] [36] SAFE concludes that good labor market policy should not impede changes in the job market; the evolution of worker skill requirements is part of a dynamic, growing economy. Instead, policy should focus on narrowing the time required for displaced workers to find new jobs. Workforce retraining measures should be developed rather than slowing technological change. Moreover, the current timeframe of AV transition suggests that policymakers have adequate lead time to invest in research, design, and implementation of workforce development solutions. (36)

After studying various historical cases of disruptive innovation, Groshen et al (24) observed that the primary risk of large technological disruptions stems not from permanent decline in the number of jobs available in the economy, but from the costs imposed on displaced workers and the negative social reaction if adjustments to the disruption are too slow or costly. Technological change in the long run leads to large social benefits, but in some cases these benefits are long-delayed or impose significant costs to those displaced. The length and difficulty of the adjustments varied greatly, depending upon the type and size of the skill changes needed and how it is intertwined with the geography, investment, bargaining power, and institutions to address these changes.

Some of the workforce impact studies articulate broad principles and specific policy recommendations, strategies or model practices that federal and state governments, industry, unions and educational institutions should take to prepare for and address job loss and retraining. (39) (40) (41) For example, the Transportation Trades Department (TTD) of the AFL-CIO asks that transit agencies give prior notification when investing in autonomous technologies, study their workforce impacts, and negotiate with affected employees when AVs are adopted. (42) More specifically, the TTD recommends that before a public transportation agency's total VMT reaches five percent in AV-miles, the agency should prepare a workforce training plan and update it on a biennial basis. (42) AVs in mass transit operations have also raised labor law issues regarding the duty to bargain under the National Labor Relations Act, the Railway Labor Act, and the protections afforded labor under the Federal Transit Act and the Worker Adjustment and Training Notification Act and its state counterparts. (43)

Research led by Michigan State University (MSU) noted that trucking industry employers should: 1) identify the specific skillsets needed by the automotive and technology industries to facilitate the creation and adoption of AVs, and 2) establish rapid coursework and training for current employees that meets those specific needs. (35) In September 2019, following the release of its 2018 report, MSU announced a follow-up four-year study of autonomous vehicles impacts on the future workforce. (44)

In 2014, PennDOT published a research study that assessed the implications of CV/AVs on management and operation of the state's surface transportation system. The study included an examination of the training currently offered by professional organizations, government agencies and educational institutions. (41) Subsequently, the *Pennsylvania Joint Statewide Connected and Automated Vehicles (CAV) Strategic Plan* was prepared to serve as a roadmap for organizational change as CAV technology advances. The *CAV Strategic Plan* succinctly lays out workforce training initiatives to prepare state agencies, such as PennDOT, and employers and talent sources for the deployment of AV technology. Partnerships, trainings, tools and investments are part of the toolkit required to address these needs with various key stakeholders such as community colleges, workforce boards, universities, and employers, among others. (40)

Researchers from the Brookings Institution (39) emphasize the importance of modernizing education and training systems to better prepare for the disruptive effects of AV and digitalization in transportation. The current workforce training model, according to the authors, is too narrowly focused on filling high-tech positions, including engineering and software jobs that emphasize advanced programming experience and concentrate on AV testing. Examples of fledgling, promising models are cited from educational institutions in Michigan, auto manufacturers and employers, labor groups and associations, and policy makers. The researchers conclude with a call for a digital workforce agenda, arguing that educators need to develop clearer curricula and programming; employers and labor groups need to clearly define future job requirements and provide applied learning opportunities; and policymakers need to promote portability and versatility of credentials—including any licenses and certifications—that might already be acting as a barrier to entry and career growth for some workers. Greater coordination and collaboration are required on a regional basis to unify planning and action among educators, employers, and other workforce leaders and to advance a shared understanding of the most pressing workforce challenges and opportunities. (39)

EQUITY AND ACCESS ISSUES

HAV deployment has the potential to improve safety and quality of service, and lower the cost of providing traditional transit services including paratransit. At the same time, HAVs offer promising mobility and access benefits for traditionally transportation-disadvantaged populations, including low-income individuals, minorities, persons with disabilities, young people, and older adults. However, there is significant uncertainty regarding how these services will operate in terms of availability, cost to consumers, convenience, reliability, speed, safety and comfort.

- ***Potential Barriers to HAV Access*** – Physical, technological, financial, cultural, and language barriers could impede use of AVs by traditionally underserved populations. (45) (46) For example, low-income populations could experience the benefits of HAVs differently compared to other populations, because they may have less access to personal vehicles, live farther from their workplace, or have evening and overnight work schedules that limit flexibility in reporting to a work location. (47) Unbanked or underbanked populations who do not have credit/debit cards or a bank account, or persons who have limited access to smartphones, high-speed internet, or cellular data services, could be excluded from using AVs as service. Similarly, persons with limited English proficiency may not be able to effectively use available mobility service options without vital information being translated. In some cases, persons with disabilities will require travel training services so that they may participate and avail themselves of this new service option.

  Discount fees may need to be established to overcome financial burdens for low-income households and services may need be designed, or mandated, to ensure that all persons have access to places of opportunity within the region, offering employment, education, medical services, shopping and recreation. Dynamic pricing policies may also be needed to incentivize use of shared use vehicles, particularly during peak-traffic periods, or to manage congestion along corridor or cordoned locations.

- ***Efficiency and Reliability*** – HAVs must advance the concept of shared and efficient use of vehicles, lanes, curbs, and land, while serving the needs of all populations, including traditionally transportation-disadvantaged populations. This may imply that governing jurisdictions and operators ensure that the HAV fleet being deployed is diverse and adequately sized to move people more efficiently to counteract congestion. (45) Personal HAVs will be one mode within a multimodal transportation system. Operating rules of engagement may need to favor pedestrians, cyclists, and public transit operations to ensure safe mobility for all. (45) (46) Future funding approaches may need to recycle revenues from dynamic pricing or fees placed on personal AVs to improve and maintain a financially sustainable multimodal system, or to ensure round-the-clock service frequency for persons working late-night shifts or seeking access to places that today are poorly served by mass transit. (47)

- ***Safety, Clean Air, and Health in Physical Environment*** – HAVs will need to ensure personal and public safety for all people, including traditionally transportation-disadvantaged populations. Historically, minority and low-income populations have been distributed unevenly in New Jersey and often times have lived in communities and places with less well-maintained infrastructure, greater exposure to high-volume roadways, and higher levels of pedestrian activity. While HAVs may improve access and safety in those places, there is also the potential for negative impacts if levels of funding for infrastructure investment or maintenance are unequal or inadequate for HAVs to reliably navigate with the infrastructure and operate safely. (45) (47)

  AVs should be deployed in ways that will reduce transportation-related air emissions and promote healthy living environments for all populations. This implies the need for strong collaborative planning with historically environmentally burdened communities and the prioritization of future transportation investments and land use strategies that will promote active transportation modes such as walking and cycling, and eventually the deployment of zero-emission public transit vehicles. In the future, this may require establishing incentives toward adoption of electric vehicles and shared use of vehicles over private AV ownership, particularly in urbanized areas and congested corridors. (45)

- ***Full, Fair Participation and Meaningful Involvement*** – A guiding principle in environmental justice is full and fair participation by all potentially affected communities in the transportation decision-making process. Responsible agencies should provide communities with opportunities for meaningful involvement in decision-making processes regarding the type, scale, and frequency of HAVs to ensure that deployed services meet the communities' mobility needs. Responsible agencies should seek out and facilitate the involvement of communities as they will be affected by service, infrastructure, and urban design decisions.

  Participants should be provided with adequate information so that they may participate in a meaningful way at points in the decision-making process that enable input and feedback on alternatives and preferences. Involvement processes should be scheduled at convenient locations, times of day, and vary in their degree of formality to invite constructive exchanges taking into consideration cultural differences and capacities. Through proactive and meaningful involvement processes, communities can assess for themselves the benefits and burdens from proposed services or design options and suggest alternatives to avoid, minimize, or mitigate adverse impacts and disproportionate burdens that sponsoring agencies may not have considered.

- ***Evaluation of Equitable Outcomes*** – There are few solutions in transportation where "one-size-fits-all." Differences in lifestyles, geography, and demographics will likely result in different levels of personal HAV use within a state or region, and likely require context-specific policy setting approaches. In urban areas, high-occupancy HAVs will likely be more appropriate as opposed to rural areas that may only need lower-occupancy HAVs. [45]

  Regardless, the state and its metropolitan planning organizations (MPOs) should closely monitor and evaluate the impact of HAVs on safety, congestion, VMT, mode share, emissions and other performance measures. Consistent with their obligations under Title VI and Environmental Justice, states and MPOs should seek to ensure that the benefits and burdens of AV deployment are fairly distributed in statewide and metropolitan area planning and programming, and transit agencies should be attentive to service equity and fare equity.

  In this early stage of testing, a key planning activity going forward should be to integrate equity analyses through discussion and evaluation of possible future scenarios. These analyses should also include consideration of how shifting investments from other priorities to HAV infrastructure development might affect the fair distribution of benefits received from overall investments. Where possible, demonstration projects should be funded and case studies, best practices, model policies and programs should be part of a continuing dialogue. For example, model programs and practices are emerging in transit, tolling and shared mobility to ensure access and affordability for low-income, unbanked and underbanked and limited-English proficiency (LEP) populations; lessons from such approaches should be applied and refined to ensure fare policies and future services will provide mobility for all with AVs.

  Over the longer term, transit routes may be complemented with "last-mile" partnerships with HAV service providers, dedicated HAV shuttles, or bike sharing or e-scooter mobility providers to serve populations more efficiently at lower costs. These approaches may require subsidies that specifically account for low-income riders. They may also necessitate improved access as required by the Americans with Disabilities Act, especially as traditional transit services are reduced in areas. [45] [46]

SECTION 5. RECOMMENDATIONS

As stated in P.L.2019, J.R.2, the purpose of the Task Force was to study and make recommendations regarding how "to safely integrate advanced autonomous vehicles on the State's highways, streets, and roads." This section presents a set of consensus recommendations for how to enable and encourage safe testing and operation of HAVs on public roads in New Jersey. The recommendations emerged from Task Force deliberations, are intended to be consistent with Federal AV guidance, and were informed by a review of leading practices implemented in other States including but not limited to: Arizona, California, Florida, Michigan, Nevada, Ohio, Pennsylvania, and Texas.

GUIDING PRINCIPLES

Task Force members discussed and endorsed the following guiding principles, which were adapted from the USDOT's automation principles presented in Automated Vehicles 3.0: Preparing for the Future of Transportation, published in 2018: [(3)]

- ***Prioritize safety*** – Automation offers the potential to improve safety for vehicle operators and occupants, pedestrians, bicyclists, motorcyclists, and other travelers sharing the road. However, these technologies may also introduce new safety risks. Policy makers should proactively address potential safety risks while advancing the life-saving potential of automation.
- ***Remain technology neutral*** – To respond to the dynamic and rapid development of automated vehicles, policy makers should adopt flexible, technology-neutral policies that promote competition and innovation as a means to achieve safety, mobility, and economic goals.
- ***Encourage a consistent regulatory and operational environment*** – Conflicting State and local laws and regulations surrounding automated vehicles create confusion, introduce barriers, and present compliance challenges. Policy makers should promote regulatory consistency so that automated vehicles can operate seamlessly across the nation. Policy makers should also work to build consensus among transportation agencies and industry stakeholders on technical standards and advance policies to support the integration of automated vehicles throughout the transportation system.
- ***Prepare proactively for automation*** – Automation policies should be informed by leading practices, pilot programs, and research. Public officials should plan for and make the investments needed for a dynamic and flexible automated future, including the potential need for workforce training and complementary technologies that can enhance the benefits of automation and programs to ensure everyone benefits from automation.

In addition, the Task Force was guided by the desire to encourage HAV testing and deployment by creating a welcoming policy environment that fosters collaboration, promotes public acceptance of automation, uses technology to improve the efficiency of the State's transportation system, and enhances the lives of New Jersey residents, workers and visitors by expanding travel options and making travel safer, easier, and more affordable for all.

RECOMMENDATIONS FOR ENABLING SAFE HAV TESTING AND DEPLOYMENT

1. **Adopt AV-related terms and definitions consistent with *SAE J3016™: Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems*.** These should include:

   a. **"Automated Driving System (ADS)"** means the hardware and software that is collectively capable of performing all aspects of the dynamic driving task within its specific *operational design domain*, if any. This term is used specifically to describe a Level 3, Level 4, or Level 5 driving automation system as defined in SAE J3016 as revised periodically.

   b. **"ADS-equipped Vehicle"** means a motor vehicle equipped with a Level 3, Level 4, or Level 5 ADS as defined by SAE J3016 as revised periodically.

   c. **"Autonomous technology data recorder"** means a mechanism, in addition to, and separate from, any other mechanism required by law, installed in an autonomous vehicle to record technical information about the status and operation of the vehicle's autonomous technology sensors for 30 seconds prior to a collision.

   d. **"Deployment"** means the operation of an autonomous vehicle on public roads by members of the public who are not employees, contractors, or designees of a manufacturer or for purposes of sale, lease, providing transportation services for a fee, or otherwise making commercially available outside of a testing program.

   e. **"Driver"** means the rider or driver of a horse, bicycle or motorcycle or the driver or operator of a motor vehicle, unless otherwise specified.

   f. **"Dynamic Driving Task"** means the operational (steering, braking, accelerating, monitoring the vehicle and public road) and tactical (responding to events, determining when to change lanes, turn, use signals, etc.) aspects of driving, but not the strategic (determining destinations and waypoints) aspect of the driving task.

   g. **"Highly Automated Vehicle (HAV)"** means a motor vehicle equipped with an ADS capable of performing all aspects of the dynamic driving task within its operational design domain, if any, including achieving a minimal risk condition, without any intervention or supervision by a conventional human driver. This definition encompasses automated vehicles considered to be Level 4 or Level 5 ADS as defined by SAE J3016 as revised periodically

   h. **"HAV Deployment Certificate"** means a letter issued and signed by the Chief Administrator of the New Jersey Motor Vehicle Commission granting an HAV Operator permission to deploy HAVs on New Jersey public roadways in a manner consistent with the information presented in the certificate application and any conditions imposed as part of the certification process.

i. **“HAV Operator”** means any person that has received an HAV Deployment Certificate authorizing the deployment of HAVs on public roadways in New Jersey.

j. **“HAV Tester”** means any person that has received an HAV Testing Permit authorizing the testing of HAVs on public roadways in New Jersey.

k. **“HAV Testing Permit”** means a letter issued and signed by the Chief Administrator of the New Jersey Motor Vehicle Commission granting an HAV Tester permission to test HAVs on New Jersey public roadways in a manner consistent with the information presented in the permit application and any conditions imposed as part of the permitting process.

l. **“Minimal Risk Condition”** means an operating mode where an ADS brings an HAV to a safe stop or safe running condition because of an ADS system malfunction, a failed request for safety driver intervention, or other occurrence that prohibits the ADS from fully and completely performing the dynamic driving task.

m. **“Operational Design Domain (ODD)”** means the definition of the conditions in which the ADS, or the differing automated components thereof, is intended to operate with respect to public road types, geographical location, speed, range, lighting conditions for operation (e.g., day or night), weather conditions, and other operational domain constraints, including a description of how the ADS provides for object and event detection and response under normal driving scenarios, expected hazards (e.g., other vehicles, pedestrians), and unspecified events (e.g., emergency vehicles, temporary construction zones) that could occur within the operational domain.

n. **"Operator"** means a person who is in actual physical control of a vehicle or street car who is seated in the driver’s seat or, if there is no person in the driver’s seat or if the vehicle is not equipped with driver controls and the vehicle’s Automated Driving System is engaged, the registrant of the vehicle.

o. **“Person”** means a natural person, firm, co-partnership, association, or corporation (existing definition in NJSA 39:1-1, needs no modification).

p. **"Safety Driver"** means an individual employed by or otherwise affiliated with an HAV Tester who has successfully completed the HAV Tester’s safety driver training program and can take immediate manual or remote control of the HAV.

q. **“Safety and Risk Mitigation Plan”** means a plan developed by an HAV Tester to provide adequate safety in case of ADS failure. The plan should contain no proprietary information regarding the ADS.

r. **“Testing”** means the operation of an autonomous vehicle on public roads by employees, contractors, or designees of a manufacturer for the purpose of assessing, demonstrating, and validating the autonomous technology’s capabilities.

2. **Designate the New Jersey Motor Vehicle Commission as the lead agency responsible for approving and overseeing the testing and deployment of Highly Automated Vehicles (HAVs) in New Jersey.**

3. **Establish an HAV Interagency Advisory Committee to monitor HAV testing and operation in New Jersey.** The advisory committee should consist of representatives from NJMVC, NJDOT, NJ TRANSIT, NJ Department of Banking and Insurance (NJDOBI), NJ State Police, the NJ Division of Highway Traffic Safety (NJDHTS), NJ Department of Human Services, the NJ Economic Development Authority (NJEDA), the NJ Department of Labor and Workforce Development, and such public and private stakeholders as deemed appropriate. Advisory committee responsibilities should include:

    a. review and comment on each HAV Testing Permit and HAV Deployment Certificate application;
    b. meet with HAV Testers and Operators on a quarterly basis or more often as necessary to monitor safety performance, discuss lessons learned, and address any issues and concerns related to testing and operations in New Jersey; and
    c. make recommendations as needed to the Governor and Legislature regarding policy, regulatory, and other matters pertaining to HAV testing and operation in New Jersey.

4. **Create an on-going HAV stakeholder engagement framework.** The framework should include the following working groups, jointly administered by NJMVC and NJDOT:

    a. <u>Policy & Planning Work Group</u> – Topics to be addressed should include but not be limited to: public education and promoting user acceptance; ensuring fair and equitable access to HAV technology for people with disabilities, older adults, low-income, and other traditionally disadvantaged populations; creating a business environment that supports innovation and economic development; the implications of HAV deployment and operations in terms of local regulations (e.g., land use, allocation of curb space, etc.); addressing insurance and liability issues; clarifying law enforcement responsibilities; incorporating advanced mobility considerations in local, regional, and state planning processes; and understanding potential workforce impacts and training needs.

    b. <u>Smart Infrastructure Work Group</u> – Topics to be addressed should include but not be limited to: telecommunication infrastructure needs; road and roadside infrastructure needs, deployment, operations, and maintenance; infrastructure design standards; and identifying infrastructure investment priorities.

    c. <u>HAV Applications Work Group</u> – Topics to be addressed should include but not be limited to: ensuring safe deployment, testing, and operation of HAV technologies in a mixed traffic environment; identifying research priorities, funding sources, and partnership opportunities; exploring various HAV business models, use cases, and adoption pathways including the following:

        i. *Automated passenger vehicles* – use cases may include but not be limited to: traffic jam guidance; highway autopilot; highway platooning; mixed traffic autopilot; fully-automated, all-roadways operation. Technology deployments might include new vehicle design and retrofitting older vehicles.

ii. *Automated public transit and mobility service vehicles* – use cases may include but not be limited to: Mobility as a Service (MaaS); improved accessible transportation options for people with disabilities and older adults; commercial shared-use operations; slow-speed automated shuttles; connected/automated buses; bus platooning; and other public or semi-public means of transportation. Technology deployments might include mixed-traffic or dedicated-lane operations.

iii. *Automated freight vehicles* – use cases may include but not be limited to: highly automated vehicles in confined areas such as work zones, maintenance yards, etc.; truck platooning; hub-to-hub operations in either mixed traffic or dedicated lanes; and highly automated last-mile micro-delivery solutions.

5. **Establish a process for companies wishing to test HAVs on public roadways in New Jersey to obtain a permit from the NJMVC.** The permit process should be as follows:

   a. Require prospective HAV Testers to complete an "Authorization to Conduct AV Testing" permit application form. The form should be used to process first-time applications, requests for permit renewals, and requests for permit modifications. The application and supporting documentation should be submitted to the NJMVC Chief Administrator for review and approval. The application should require the following information:

      i. <u>Application type</u>: Check boxes for: Initial HAV Testing Permit, Biennial Permit Renewal, or Permit Modification.

      ii. <u>Applicant Information</u>, including entity name, address, and point of contact information.

      iii. <u>Vehicle Information</u>, including the license plate number; state issued; vehicle identification number; year, make and model; and proof of registration for each vehicle to be tested.

      iv. <u>Safety Driver Information</u>, including legal name; driver license number; State/Country where the driver license was issued; and safety training completion date.

      i. <u>Overview of the Operational Design Domain</u> applicable to the testing, including specific geographical locations where the testing will take place, road types where the testing will occur and which government agencies have jurisdiction over the roadways and description of any commonly-occurring or restricted conditions. A detailed description of the ODD must be submitted as an attachment to the application.

   b. Require the applicant to complete an acknowledgements/certification section on the application that includes the following:

      i. The HAVs comply with all applicable federal laws and regulations, including Federal Motor Vehicle Safety Standards or an appropriate exemption or waiver has been granted by the National Highway Traffic Safety Administration for the HAVs to be tested.

ii. The HAVs have been tested under controlled conditions (e.g., in simulation, closed track, or on-road) for the Operational Design Domain (ODD) in which the HAV Tester intends to operate and the HAV Tester has reasonably determined that the HAV is capable of operation within the parameters of the ODD(s).

iii. The HAVs meets all applicable New Jersey title and registration, licensing, and insurance requirements.

iv. The HAVs are capable of complying with all applicable traffic and motor vehicle safety laws and regulations of the State of New Jersey and can obey traffic control devices within its ODD.

v. The HAV Tester and the Safety Drivers monitoring or operating the HAV may be issued a traffic citation or other applicable penalty in the event of a failure to comply with traffic, motor vehicle or any other law of the State of New Jersey.

vi. The HAVs will be operated on public roads in New Jersey solely by employees, contractors, or other persons authorized by the permit holder.

vii. All Safety Drivers have completed an HAV Safety Driver training program.

viii. A Safety Driver will be present in the HAV and either in immediate physical control of the HAV or actively monitoring HAV operations and can take over immediate physical control during operation as needed if the ADS disengages.

ix. The HAV can safely alert the Safety Driver, when applicable, that the Safety Driver must take control back of the HAV.

x. The HAV has a mechanism to engage and disengage the ADS that is easily accessible to the HAV Safety Driver, law enforcement and other emergency responder personnel.

xi. The HAV has an audio signal or visual display inside the cabin to indicate when the ADS is engaged.

xii. If a failure of the ADS occurs that renders the HAV unable to perform the entire dynamic driving task relevant to its intended ODD, the HAV is capable of achieving a minimal risk condition.

xiii. Any crash originating from the operation of the vehicle on public roads that resulted in the damage of property or in bodily injury or death must be reported to local law enforcement at the time of the crash.

xiv. The HAV is equipped with an “autonomous technology data recorder” capable of recording technical information about the status and operation of the vehicle’s ADS features and sensors for 30 seconds prior to a crash. The data will be accessible via a commercially available software package and shall be made available to NJ State Police and other applicable law enforcement agencies in accordance with established procedures in the State of New Jersey, and shared or discussed with the HAV Interagency Advisory Committee if requested.

xv. The HAV Tester has considered and implemented reasonable measures, which may include industry standards, best practices, company policies, or other measures to help defend against, detect and respond to cyber-attacks, unauthorized intrusions, or false vehicle control commands.

c. Require the applicant to submit the following attachments to the application:

i. Detailed description of the ODD applicable to the testing to be done.

ii. Safety and Risk Mitigation Plan <u>OR</u> Voluntary Safety Self-Assessment approved by NHTSA.

iii. Law Enforcement Interaction Protocol. This submission should include the following information:

1. How to communicate with the HAV Tester at all times that the vehicle is in operation, including providing a contact telephone number for the original manufacturer;
2. Where, in the vehicle, to obtain owner information, vehicle registration, and proof of insurance in the event of a collision or traffic violation involving the vehicle;
3. How to safely remove the vehicle from the roadway;
4. How to recognize whether the vehicle is in autonomous mode, and if possible, how to safely disengage the autonomous mode;
5. How to detect and ensure that the autonomous mode has actually been deactivated;
6. How to safely interact with electric and hybrid vehicles, when applicable;
7. A description of the operational design domain of the vehicle;
8. Any additional information the HAV Operator deems necessary regarding hazardous conditions or public safety risks associated with the operation of the autonomous vehicle; and
9. Acknowledgement that the Law Enforcement Interaction Protocol must be reviewed and updated as needed on at least an annual basis.

iv. If applicable, evidence of exemptions or waivers approved by NHTSA for the vehicle(s) to be tested.

v. Proof of insurance for each HAV being tested that meets the standard New Jersey statutory requirements for a class of vehicle being tested.

vi. Description of the HAV safety driver training program and copy of course curricula.

d. NJMVC should have 10 business days to review an application to conduct AV testing. Within 10 days, NJMVC must either deem the application complete or request clarification of the information submitted. If clarification is requested, the applicant shall have 30 days from receipt of notice to respond. Once an application is deemed complete, NJMVC has 45 days to approve or deny the application. Alternatively, if the application is submitted by an HAV Tester that has been approved to test or operate the HAV in AZ, CA, OH, MI, or PA, the application or request can be approved at the time it is deemed complete (see recommendation 22). The decision to approve or deny the application shall be made in consultation with the HAV Interagency Advisory Committee. If approved, NJMVC will provide an "HAV Testing Permit" permit letter indicating any conditions of approval. If denied, NJMVC must provide a written explanation stating the reasons why the application was denied and provide an opportunity to meet to discuss the deficiencies. The applicant may reapply until approval to test is granted. HAV testing permits should be granted for a period not to exceed 2 years. Permit renewal requests should be submitted at least 90 days prior to the expiration date.

6. **Establish a process for companies wishing to deploy and operate HAVs on public roadways in New Jersey to complete a certification process.** The certification process should include the following:

   a. Require prospective HAV Operators to complete an "HAV Deployment Certificate" application form. The form should be used to process first-time requests for certification, as well as requests for biennial certificate renewal or modification. The form should be completed and submitted along with supporting documentation to the NJMVC Chief Administrator. The certification request form should require the following information:

      i. <u>Application type</u>: Check boxes for: Initial HAV Deployment Certificate, Certificate Renewal, or Certificate Modification.

      ii. <u>Applicant Information</u>, including entity name, address, and point of contact information.

      iii. <u>Vehicle Information</u>, including the license plate number; state issued; vehicle identification number; year, make and model; and proof of registration for each vehicle to be tested.

   b. Require prospective HAV Operators to acknowledge/certify the following as part of the certification process:

      i. The HAVs have been tested under controlled conditions (e.g., in simulation, closed track or on-road) and on public roads for the Operational Design Domain (ODD) in which the HAV will operate and the certificate requester has reasonably determined that the HAV is capable of operation within the parameters of the ODD(s).

      ii. The HAV is designed to be incapable of operating in autonomous mode in areas outside of the disclosed ODD.

iii. The HAVs meets all applicable New Jersey title and registration, licensing, and insurance requirements.

iv. The HAVs are capable of complying with all applicable traffic and motor vehicle safety laws and regulations of the State of New Jersey, and updated as necessary to reflect any changes in these laws.

v. The autonomous technology is designed to detect and respond to roadway situations in compliance with all provisions of New Jersey law or regulation applicable to the performance of the dynamic driving task in the vehicle's operational design domain, except when necessary to enhance the safety of the vehicle's occupants and/or other road users.

vi. The HAV Operator may be issued a traffic citation or other applicable penalty in the event of a failure to comply with traffic, motor vehicle or any other law of the State of New Jersey.

vii. The HAV has a mechanism to engage and disengage the ADS that is easily accessible to law enforcement and other emergency responder personnel.

viii. If a failure of the ADS occurs that renders the HAV unable to perform the entire dynamic driving task relevant to its intended ODD, the HAV is capable of achieving a minimal risk condition.

ix. The HAV meets appropriate and applicable current industry standards to help defend against, detect, and respond to cyber-attacks, unauthorized intrusions, or false vehicle control commands.

x. The HAV Operator or manufacturer has conducted all necessary and appropriate safety and validation testing and is satisfied that the autonomous vehicle is safe for deployment and operation on public roads in New Jersey.

xi. For HAVs that do not require a driver, the autonomous vehicle has a communication link with the HAV Operator to provide information on the vehicle's location and status, and allow two-way communication between the HAV Operator and any passengers (if applicable) and law enforcement or other first responders, should the vehicle experience any failures that would endanger the safety of the vehicle's passengers or other road users while operating without a driver.

xii. For HAVs that do not require a driver, there is a process to display or transfer vehicle owner or operator information to law enforcement or other first responders in the event that the vehicle is involved in a crash, collision, or accident, or if there is a need to provide that information to a law enforcement officer for any reason.

xiii. Any crash originating from the operation of the vehicle on public roads that resulted in the damage of property or in bodily injury or death must be reported to local law enforcement at the time of the crash and must be separately reported to NJMVC within 10 days.

xiv. The HAV is equipped with an "autonomous technology data recorder" capable of recording technical information about the status and operation of the vehicle's autonomous technology systems and sensors for 30 seconds prior to a crash. The data shall be made available to NJ State Police and other applicable law enforcement agencies in accordance with established procedures in the State of New Jersey, and shared or discussed with the HAV Interagency Advisory Committee if requested.

xv. Any vehicle not equipped with manual controls for completing the dynamic driving tasks, such as steering wheel, brake pedal, and accelerator pedal, complies with all applicable Federal Motor Vehicle Safety Standards, or evidence of an exemption that has been approved by the NHTSA has been provided as an attachment to the application.

c. Require the following items be included as attachments to the application:

i. Detailed description of the ODD applicable to HAV deployment.

ii. Proof of insurance for each HAV being tested that meets the standard New Jersey statutory requirements for a class of vehicle being tested.

iii. Description of how vehicle passengers will be made aware that the vehicle is capable of achieving a minimal risk condition such as bringing the vehicle to a complete stop upon experiencing a malfunction of the vehicle's ADS that renders the vehicle unable to perform the entire dynamic driving task.

iv. Copy of a Law Enforcement Interaction Protocol that includes but is not limited to the following:

1. How to communicate with the HAV Operator at all times that the vehicle is in operation, including providing a contact telephone number for the original manufacturer;
2. Where, in the vehicle, to obtain owner information, vehicle registration, and proof of insurance in the event of a collision or traffic violation involving the vehicle;
3. How to safely remove the vehicle from the roadway;
4. How to recognize whether the vehicle is in autonomous mode, and if possible, how to safely disengage the autonomous mode;
5. How to detect and ensure that the autonomous mode has actually been deactivated;
6. How to safely interact with electric and hybrid vehicles, when applicable;
7. A description of the operational design domain of the vehicle;

8. Any additional information the HAV Operator deems necessary regarding hazardous conditions or public safety risks associated with the operation of the autonomous vehicle; and
9. Acknowledgement that the Law Enforcement Interaction Protocol must be reviewed and updated as needed on at least an annual basis.

v. A copy of the Automated Vehicle Voluntary Safety Self-Assessment submitted to NHTSA or a summary of the autonomous technology testing completed in the ODD in which the autonomous vehicle is designed to operate. The summary must describe all locations where the vehicle has been tested and include:

1. Discussion of the roads, test tracks, or other private roads where the vehicle has operated successfully in autonomous mode.
2. A description of the testing methods used to validate the performance of the subject autonomous vehicles, including as appropriate the testing Scenarios used to demonstrate safe driving conditions for drivers and the public, including results.
3. The number of collisions originating from the operation of the HAV test vehicles in autonomous mode on public roads and a full description of the cause of each collision.

vi. If applicable, evidence of an exemption approved by NHTSA for vehicles that do not comply with all applicable Federal Motor Vehicle Safety Standards, Title 49 Code of Federal Regulations, Part 571.)

vii. If applicable, evidence of an exemption approved by NHTSA for vehicles that are not equipped with manual controls for completing the dynamic driving task, such as steering wheel, brake pedal, and accelerator pedal.

d. NJMVC should have 10 business days to review an HAV Deployment Certificate application. Within 10 days, NJMVC must either deem the application complete or request clarification of the information submitted. If clarification is requested, the applicant shall have 30 days from receipt of notice to respond. Once an application is deemed complete, NJMVC has 45 days to approve or deny the application. The decision to approve/deny the application shall be made in consultation with the HAV Interagency Advisory Committee. If approved, NJMVC will provide an “HAV Deployment Certificate” indicating any conditions of approval. If denied, NJMVC must provide written explanation stating the reasons why the application was denied and provide an opportunity to meet to discuss the deficiencies. The applicant may reapply until approval to deploy is granted.

e. HAV Deployment Certificates should be granted for a period not to exceed 4 years. Certificate renewals should be requested at least 90 days prior to the expiration date.

7. Require permit and certificate holders to notify NJMVC in writing if there are changes in the testing program, operational capabilities of the HAV or if there are any other modifications to the

ODD such that the approved permit or certificate no longer accurately or adequately describes the scope of the testing program or HAV deployment. The notification should include a completed request for permit or certificate modification form and related materials as needed to facilitate review and approval of the requested modifications.

8. **Require permit and certificate holders to notify NJMVC of any change to the permittee/certificate holder's contact information.** This should include changes in contact names, telephone number, mailing address, or the name of the permit/certificate holder. Notification should be made in writing within 10 days of the change.

9. **Require HAV Testers to meet with the HAV Interagency Advisory Committee and local officials on a quarterly basis or more frequently if warranted depending on the testing being done.** During this meeting the HAV Tester will be expected to discuss performance results including but not limited to: ADS disengagements; near misses, collisions, or other incidents involving the public as well as the circumstances surrounding them; learning milestones; safety concerns; lessons learned; feedback on infrastructure adequacy and challenges; and potential process improvements.

10. **Require HAV Testers to submit an annual data report.** The data report should be submitted by January 31st of each year documenting activities during the previous year or partial year for newly authorized HAV Testers. The HAV Interagency Advisory Committee will determine the information and data to be reported based on the nature of the testing being conducted. At a minimum the reporting should document the following information:

    a. Locations where testing was completed and the type of public roads where the majority of testing occurred with approximate number of miles traveled with ADS engaged in each location and each type of roadway;

    b. Approximate number of employees in New Jersey involved with HAV testing; and

    c. If applicable, the approximate number of new facilities constructed, purchased, or rented in New Jersey because of testing.

11. **Require all HAVs to be tested or deployed for operation on New Jersey Public roadways to be registered and licensed under existing NJMVC processes, including NJ Manufacturer Plate provisions for traditional OEMs that have applied to be HAV Testers.** If the HAVs are already registered and licensed in one of the States for which New Jersey recognizes HAV testing reciprocity, no additional registration should be required. In the longer term, NJMVC should consider creating a special class of registration and licensing for HAVs similar to the Omnibus, Livery and other special classification plates currently available in New Jersey.

12. **Require HAV Testers/Operators to show proof of insurance, surety bond, or self-insurance that meets the standard statutory insurance requirements in the State of New Jersey for the class of vehicle being tested or operated.** This includes the following coverages for private passenger vehicles applicable as of the date of this report but subject to future adjustment:

Type of Coverage	Minimum Standard Policy

Bodily injury liability	$15,000 per person, $30,000 per accident
Property damage liability	$5,000 per accident
Personal injury protection	$15,000 per person or accident Up to $250,000 for certain injuries* regardless of selected limit
Uninsured/Underinsured motorist Coverage	$15,000 per person, $30,000 per accident
*Permanent or significant brain injury, spinal cord injury or disfigurement or for medically necessary treatment of other permanent or significant injuries rendered at a trauma center or acute care hospital immediately following an accident and until the patient is stable, no longer requires critical care and can be transferred to another facility in the judgment of the physician.	

Source: NJ Department of Banking and Insurance. Accessed online at: https://www.state.nj.us/dobi/division_consumers/insurance/standardpolicy.html

13. **Require all HAVs to be tested or operated on public roadways in New Jersey to comply with all relevant Federal Motor Vehicle Safety Standards, Title 49 Code of Federal Regulations, Part 571, or provide evidence that an exemption has been approved by NHTSA.** Evidence of exemption should be submitted to NJMVC as part of the application process.

14. **Require that all testing of HAVs on public roadways in New Jersey be conducted with a safety driver present in the vehicle.** A safety driver should be licensed to operate the class of vehicle being tested in New Jersey or have a license from another state accepted by the State of New Jersey. All safety drivers must meet the following criteria:

    - Is a licensed driver for at least 3 years immediately prior to operating an HAV on public roads;
    - Does not have more than one violation point on their driving record;
    - Was not the at-fault driver involved in a collision that resulted in injury or death of a person; and
    - For ten years immediately prior to application was not convicted for driving or operating a vehicle under the influence of alcohol or any drug, and did not suffer any driver's license suspension or revocation based on driving or operating any vehicle under the influence of alcohol or of any drug.

15. **Require HAV Testers to implement a safety driver training program.** The program must include, but should not be limited to:

    - Instruction on the ADS technology being tested, including behind-the-wheel instruction provided by an experienced driver with expert knowledge of the capabilities and limitations of the ADS being tested; and
    - Defensive driver training, including practical experience in recovering from hazardous driving scenarios.

16. **Require HAV Testers and HAV Operators to acknowledge that they are subject to all applicable laws, rules, ordinances, and statutes, of the State of New Jersey and its political subdivisions**. This

means that the ADS, safety driver and/or the HAV Testing Permit holder or HAV Deployment Certificate holder may be considered the “operator” of the vehicle (depending on the circumstances) for the purposes of enforcing Title 39 or any other New Jersey Statutes, regulations codified in New Jersey Administrative Code (N.J.A.C.) or Executive Order issued by the Governor of the State of New Jersey.

17. **Require HAV Testers to acknowledge that impaired and distracted driving laws apply to safety drivers even when an HAV is operating with ADS engaged.**

18. **Require HAV Testers and HAV Operators to cooperate with NJ State Police and local law enforcement in the event of a violation of the law or regulations of the state, or in the event of a crash.** HAV Testers and HAV Operators should be required to cooperate with any appropriate law enforcement agency request for information about the incident, including sharing any non-proprietary data recorded and preserved by the vehicle or the company pertaining to the incident and maintaining a record of all other information until the conclusion of any investigation by law enforcement. If a crash occurs, representatives from the HAV Tester team should not be permitted to enter the crash site until permitted by first responders. Generally, local authorities should identify a nearby muster point where State and local officials, first responders, and the representatives from the HAV Tester team can meet and review the circumstances of the collision.

19. **Require that all HAVs being tested or operated on New Jersey public roads be equipped with an “autonomous technology data recorder” capable of recording technical information about the status and operation of the vehicle’s autonomous technology systems and sensors for 30 seconds prior to a crash**. The data must be made available in a format readable by third-party software and shall be made available to NJ State Police, and other applicable law enforcement agencies in accordance with established procedures in the State of New Jersey, and shared or discussed with the HAV Interagency Advisory Committee upon request.

20. **Authorize the Chief Administrator of NJMVC to immediately suspend or revoke any permissions to test or operate an HAV on New Jersey public roads in order to ensure public safety.** Circumstances potentially warranting suspension or revocation may include: if the HAV Tester or HAV Operator falsified information submitted in support of the permit or certificate application; fails to comply with any conditions or requirements of their permit or certificate; fails to provide crash-related data within a reasonable period of time after the data is requested; violates any laws and regulations relating to HAVs; or at any time if deemed necessary to ensure public safety. The process of suspending or revoking HAV testing or operating privileges and any fines or penalties for continuing to operate after a suspension or revocation should be consistent with existing New Jersey laws and regulations pertaining to NJMVC’s existing business license procedures.

21. **Require HAV Testers/Operators to certify that they have considered and implemented reasonable measures, which may include industry standards, best practices, company policies, or other measures to help defend against, detect, and respond to cyber-attacks, unauthorized intrusions, or false vehicle control commands.**

RECOMMENDATIONS FOR ENCOURAGING HAV TESTING AND DEPLOYMENT IN NEW JERSEY

22. **Offer prospective HAV Testers already approved to test HAVs in the states of Arizona, California, Ohio, Michigan, and Pennsylvania testing reciprocity**. This means that prospective HAV Testers are entitled to a streamlined application process and automatic approval once the testing permit application is deemed complete. Other states can be added to the list of reciprocity states at the discretion of the HAV Interagency Advisory Committee. Reciprocity is a novel approach that could set New Jersey apart and signal to HAV developers that the State is open for business while still providing state officials and local law enforcement the information they need to protect public safety. Once enabled, State officials should proactively work with counterparts in targeted states to formalize the reciprocity arrangements and work toward regionalizing HAV testing in key long-distance corridors and to cooperatively address any cross-jurisdictional challenges that might arise.

23. **Prohibit local government jurisdictions and government agencies and authorities from enacting laws and regulations related to testing and deployment of ADS-equipped vehicles on public roadways in New Jersey.** HAV testing and deployment in New Jersey should be guided by State-level planning and policy direction. Preemption of local laws and regulations that might limit or impede HAV testing and operation will help to reduce confusion. At the same time, every effort should be made to engage local leaders and law enforcement from the jurisdictions where HAV testing and operation will take place in the process of monitoring and evaluating testing efforts and safety performance.

24. **Create a single point of contact for companies wishing to test and deploy HAVs in New Jersey and proactively encourage HAV testing in the State.** For example, New Jersey could create a program similar to Ohio's that seeks to link municipalities interested in promoting HAV testing with companies that are seeking to test vehicles. Participation in the program should be completely voluntary. Priority should be given to identifying partnerships and pilot projects that solve important mobility and goods movement challenges in New Jersey. Examples might include improving first/last mile connectivity to NJ TRANSIT fixed route services to grow transit ridership; providing paratransit services for people with disabilities in a more customer-focused and cost-efficient manner; connecting low-income workers with job sites, making transit services and good movement more efficient; making port operations more efficient; and others. The program could be administered by NJMVC or in partnership with the New Jersey Economic Development Authority or Choose NJ.

25. **Promote public acceptance of HAV technologies and use the proposed stakeholder engagement framework to create a culture of HAV learning, collaboration, and problem solving in New Jersey**. One potential impediment to HAV development and adoption is lack of public acceptance. HAV technology is new and many people are either unfamiliar or skeptical of the technology. Steps can and should be taken to create opportunities for the general public and key constituencies, including

traditionally transportation-disadvantaged communities to interact with the technology and learn the potential benefits and challenges associated with HAV deployment. Creating opportunities to “see and touch” the technology can help to break down unnecessary barriers to adoption related to fear and lack of trust in the technology. In addition, state leaders should use the proposed stakeholder engagement framework to proactively investigate and address the full range of longer-term HAV adoption issues that will need to be resolved, including equity and access issues, potential workforce impacts, and others. The proposed stakeholder work groups can sponsor research, convene conferences, and facilitate discussion of important topics as they emerge.

These recommendations represent a starting point for creating a framework to advance the beneficial testing and use of HAVs in New Jersey. Ongoing work by the HAV Interagency Advisory Committee in collaboration with stakeholders will be required to continue to develop and execute a robust comprehensive program aimed at the broad deployment of HAVs that can provide affordable, high-quality mobility throughout New Jersey.

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APPENDICES

The following documents are available in a separate document entitled ***Final Report Volume 2: Appendices***.

1. Task Force Authorizing Legislation
2. State-by-State Comparison Matrix
3. Enabling Framework Case Study Tables
4. Proposed NJ Enabling Framework
5. Review of N.J.S.A. Title 39 provisions that may impede testing and operation of HAVs on public roadways in New Jersey