NETC 20-4

Coordinating State Policies, Laws, and Regulations for Automated Driving Systems across New England

June 30, 2022

Prepared for:
New England Transportation Consortium

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TECHNICAL REPORT DOCUMENTATION PAGE

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

Automated Driving System (ADS)-equipped vehicles may challenge existing regulatory and governance structures. For this reason, states have been encouraged to and are actively preparing for their testing and deployment through the review of existing policies, laws, and regulations around vehicle operations. The purpose of this report is to identify legal issues and provide recommendations on how the New England States ("NE States") can coordinate on a uniform, or more consistent, policy, statutory and regulatory approach to support multi-state deployment of ADS-equipped vehicles across the region. The coordinated research and visioning that has been invested in and completed by the NE States provides a strong foundation for the continued collaboration to bring increased testing and deployment of ADS-equipped vehicles to the region.

A consistent, coherent, and regionally focused approach to ADS will benefit all stakeholders, bring investment to the region, and provide a model for other regions in the country seeking to collaborate around ADS deployment.

This project seeks to develop a consistent approach to the setting of policies, laws, and regulations of ADS-equipped vehicles within New England by merging the research and analysis herein with an established vision for seamless operation of ADS-equipped vehicles across the NE States. With coordination towards the safe operation of ADS across state lines in New England, the NE States can support operations in surrounding states and take advantage of strategic corridor and international opportunities for more efficient goods and passenger movement. The research builds from previous work funded by the New England Transportation Coalition (NETC) that identified a roadmap of initiatives to support the testing and deployment of connected and ADS-equipped vehicles in the NE States.

The objectives of this research include:

1) Conducting a literature review of ADS-focused research;

2) Analyzing existing policy, legal, and regulatory issues to overcome anticipated barriers to multi-state ADS operations;

3) Recommending coordinated steps for the NE States to take in consideration of the operations of vehicles on the roadway transitioning from human driven to ADS operated;

4) Developing recommendations towards facilitating testing and deployment of ADS-equipped vehicles operating in multiple states or traveling across state lines; and

5) Supporting the development of policy, legal, and regulatory approaches that inform national and other regional ADS efforts.

This project is important because, while the testing and deployment of ADS-equipped vehicles continues to grow nationally, ADS operations to date tend to focus on particular geographies centered around the presence and interests of industry, permissive regulatory structures, venture capital, favorable weather, and research institutions, and have not scaled to every part of the country. This presents both an opportunity and challenge for the New England region. While the New England region has challenging operational domains, it also presents important use cases focused on the positive benefits that ADS offers, including, but not limited to: rural mobility connections; transportation across small, but densely populated urbanized areas and communities; cross-state on-demand passenger services; commercial trucking; and international operations. Further, if it is expected that ADS technology continues to mature so that it can gain public trust and adoption for being able to operate in all the different operating environments of the U.S., the New England region presents a strong testing and deployment partnership opportunity.

Research Process

Section 1 of this report provides further background on the project, the current deployment and policy, legal, and regulatory landscape for ADS-equipped vehicles, and the methods of engagement and research used to develop the final recommendations. The research process included an in-depth literature review of ADS reports related to policy, legal, and regulatory issues. (Please see Appendix B titled “Literature Review” for more information.) The key themes identified through this review were then incorporated into stakeholder engagement conversations. In addition to receiving feedback from the standing Technical Committee (TC) representing the NE States, the research team conducted a workshop with representatives from states outside of New England that are active in ADS testing and deployment. It also interviewed a series of ADS stakeholders representing industry, transportation professional organizations, municipalities, insurance firms, and legal organizations. The focus of this phase of the project was to move beyond the surface of issues related to ADS operations and to engage on the more complicated policy, legal, and regulatory issues that need to be addressed in order to realize more widespread ADS deployment nationally.

Key Issues Identified Through the Research Process

The regional focus of this Project is an opportunity to overcome concerns of an inconsistent state-by-state regulatory approach to ADS regulations.

Section 2 of this report is a discussion of the challenges and opportunities identified through the research process. This includes issues like distinguishing between commercial goods and passenger movement, insurance considerations, safety verification, and managing information exchanges. A key theme that repeats throughout the report is the need for better coordination among states around such issues. But to accomplish this coordination, further clarification of ADS terminology may be needed, as even terms such as “driver,” “testing,” and “deployment” have different meanings in different contexts or states.

While differences of opinion remain regarding the appropriate policy, legal, or regulatory approaches to overseeing an evolving and maturing technology at this stage in its development, one area of opportunity is coordination and standardization of testing and permitting processes. The regional focus of this project was received with positive feedback during the strategic outreach and engagement from stakeholders representing a variety of interests. Finally, a critical factor in advancing ADS remains education to the public, decision-makers, and elected officials about the technology so that the public better understands what ADS-equipped vehicles are, their technological capabilities, and decision-makers understand how to support adaptable regulatory structures for a developing technology.

Policy, Legal, and Regulatory Considerations for Vehicle Operations

Image Source: Stantec

Section 3 of this report analyzes the roles and responsibilities of federal, state, and local governments, including the existing statutory and regulatory environment for vehicles, and how it may need to change to accommodate ADS-equipped vehicles. ADS-equipped vehicles present the opportunity to improve safety, enhance mobility, decrease congestion, reduce emissions, and increase accessibility to reliable and convenient transportation options for all users. But, ensuring the positive benefits of ADS are realized will require federal, state, local, and industry coordination. Supporting the deployment of new mobility innovations while managing risks is made difficult right now as federal safety regulations are still working to catch up to ADS. New approaches to Federal regulations may continue to evolve as more ADS-equipped systems are deployed onto roadways and data can be analyzed to better understand how ADS-equipped vehicles will merge into the transportation system. Additionally, there are foundations to build from, including both industry standards and federal guidance, as discussed in this report, for developing a coordinated approach around policy, legal, and regulatory issues for ADS.

In addition to questions around how vehicle operations may be impacted by the continued integration of ADS onto roads, there are unknowns around how existing roles and responsibilities around vehicle regulation may change. This includes important issues like vehicle safety – a computer instead of a human will be operating a vehicle some or all of the time; licensing – if a person is no longer expected to handle any of the driving tasks, why would they need a license; and, traffic enforcement – if a vehicle does not require human intervention or monitoring and can be programmed to follow all laws, will traffic laws become nationalized to facilitate the programming of ADS-equipped vehicles. Answers to these

questions are challenged by different levels of automation and confusion around what different levels of automation mean and expectations around human monitoring of systems. Section 3 discusses these issues from the perspective of the NE States, considers national trends and approaches, and analyzes policy, legal, and regulatory issues for supporting continued deployment of ADS.

Key Project Findings and Recommendations

Section 4 of this report identifies key project findings and recommendations in support of the NE States planning their near- and medium-term actions to coordinate policies, laws, and regulations to support the vision for seamless ADS operation across the New England region and surrounding regions of the US and Canada. The following is a summary of the key recommendations for the NE States to consider:

Develop a multi-state regulatory approach to ADS testing and deployment that is deliberate around different use cases and has a regional focus.	Execute a Memorandum of Understanding signed by each state and explore the creation of an ADS regional entity to coordinate and streamline process.	Coordinate around the passage of ADS legislation and consider when legislation is warranted and a productive use of resources to advance the safe testing and deployment of ADS in the region.
Implement a common set of definitions for "operator" and/or "driver" that considers a "person" shall include a non-human in the context of ADS-equipped vehicles.	Outline and implement a uniform approach to insurance, vehicle registration, licensing, and crash reporting. This should include prioritizing law enforcement coordination.	Draft and approve a regionally focused ADS operations permit prioritizing on-demand ridehailing services, commercial freight, and purpose-built vehicles for local goods movement and delivery.
Support the standardization of ADS focused data exchange between the public sector and industry, including a more consistent approach to protecting data that may be considered proprietary, confidential, or trade secrets.	Proactively explore ways to educate the public and decision-makers about ADS technology. Outreach should focus on the capabilities for different types of ADS-equipped vehicles, including use cases and expected responsibilities for human monitoring.	Ensure the perspectives of the New England region are heard nationally to inform development of ADS policies, laws, regulations, and standards.

Establishing ADS Policies, Laws, and Regulations – Licensing Registration Insurance
Data
Outreach and Education
Pilots/Deployments
Coordination – MOU/Regional Entity

Draft Memorandum of Understanding

To support the implementation of the findings and recommendations, Section 4 of this report also includes a draft Memorandum of Understanding ("MOU"). The title for this MOU is **"Advancing Testing**

and Deployment of ADS-Equipped Vehicles in New England through Coordination, Partnerships, Outreach, and Education." For each NE State to sign the MOU provides an even greater opportunity to memorialize the vision and coordinated efforts by the region around the deployment of ADS, and it provides a tangible resource that the NE States can point to and share in efforts to engage in partnerships for the deployment of ADS-equipped vehicles in New England.

It is necessary to note that while this report does discuss and evaluate legal issues, it is not intended to be, nor should it be interpreted as legal advice. However, the project does provide considerations for breaking down silos and merging conversations between ADS planning, legal, and policy matters. Further, since ADS is a fast-moving issue, it is important to note that this research is current up through June of 2022.

Image Source: Courtesy of Connecticut Department of Transportation

How Can This Project Inform ADS Deployment?

In completing this report, the intention is for it to inform and guide various stakeholders in the advancement of ADS deployment. This includes:

NE States. As noted in the introduction to this report, this Project is intended to provide a foundation for the NE States to continue coordination efforts, prioritize resources, and implement the recommendations to support the multi-state seamless operation of ADS-equipped vehicles in the New England region.

Other regional efforts. This Project, through its research and analysis, and accompanying discussion, can inform other regional efforts around ADS operations. This report is more than just a listing of potential issues; instead, it seeks to align the discussion around policy, legal, and regulatory issues with the development of use cases for ADS.

National dialogue. This Project can also inform national efforts to support the safe deployment of ADS. This includes important and complicated considerations around roles and responsibilities between local, state, and federal entities, and how those roles and responsibilities may be challenged as higher levels of ADS (i.e. full driving automation) are integrated into the transportation system.

Academic and research. A strong body of research has already been developed around ADS. The focus of this Project around policy, legal, and regulatory issues highlight the need for multi-discipline collaboration on reengineering laws as legal barriers around the human driving status quo are identified.

Policy, legal, and planning staff at State DOTs. The Project can help DOTs and other public agencies that have not been proactive around ADS by providing a guide around where efforts can start. This is especially true for those agencies with more limited resources, and which may be looking for opportunities around regional coordination.

Industry. The discussion in this report also provides the opportunity to break down silos between the public and private sector around ADS. For industry, this report provides insights into what issues State DOTs are concerned about and why.

Definitions Of Key Terms

During the completion of this project, one of the recurring themes was the lack of consistency in use of terminology when discussing the testing and deployment of ADS-equipped vehicles. This lack of consistency was identified in all aspects of the project, including project discussions with the TC, review of the literature, stakeholder outreach, and monitoring of ongoing events around ADS and ADS-equipped vehicles. Without consensus around accepted terminology, confusion can result before even getting to the important discussions around findings and recommendations for analysis completed as part of this project. This is an important takeaway from this project, and it will be important for the New England States ("NE States") to continue to develop consensus as a region and support outreach and education around terminology for ADS-equipped vehicles being discussed and adopted by both industry and the public sector, particularly when coordinating around legislation.

Part of the challenge with terminology has to do with the lack of understanding around the different categories or components of driving automation systems. While not perfect, the Society of Automotive Engineers (SAE) J3016 standard titled "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles" provides the most cited source for referencing the various categories or components of driving automation systems. Due to the complexity of issues around ADS-equipped vehicles and the importance of clear terminology for the evaluation of policy, legal, and regulatory issues around ADS, it is important to clarify the following definitions for purposes of this report.

For clarity, this project is not seeking to recommend new terms for ADS considerations; instead, the following terms and definitions should be seen as a baseline to support the discussion and analysis herein. Note several of the definitions below are SAE J3016 standardized definitions and some are not; the ones that are not are clearly indicated as such.

"Automated Driving System" (ADS) means 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); this term is used specifically to describe Level 3 – Conditional Driving Automation, Level 4 – High Driving Automation, and Level 5 – Full Driving Automation.

"Automated Driving System Equipped Vehicle" or **"ADS-equipped Vehicle"** means a vehicle that is equipped with an automated driving system.

"Automated Driving System-Issued Requests to Intervene" means a notification by the automated driving system to a human driver to begin or resume performance of the dynamic driving task.

"Deployment" is not a term that is defined in SAE J3016. Here, it is used to refer to the operation of an ADS-equipped vehicle on public roads by members of the public; or for use by the public who are not employees or contractors of an ADS-tester; or for purposes of sale, lease, providing transportation services for a fee, or otherwise making commercially available outside of a testing program. For purposes of this report, it is important to provide further considerations around broad use of a term like "deployment" as follows:

- Limited Deployment – This typically refers to the stage beyond testing, but before full scale commercial deployment (defined below) operations for a particular use case. This is the stage when a limited set of ADS-equipped vehicles may be deployed on public roadways or in limited operational design domains for specific use cases. Information sharing and coordination between the public and private sector is anticipated to be extremely valuable during limited deployments to further the development, adoption, and success of the ADS technologies.
- Full Scale Commercial Deployment – This typically refers to the stage beyond limited deployments for a particular use case. This is when a full or large fleet of ADS-equipped vehicles may be deployed on public roadways or in limited operational design domains for specific use cases. During full scale commercial deployment, ADS technology is considered established and mature, consideration (i.e. payment) has been exchanged between user and the ADS operator or provider, the ADS-equipped vehicles are for sale and resale, and may be prevalent or growing in volume on public roadways or in limited operational design domains.

"Dynamic Driving Task" means 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.

"Dynamic Driving Task Fallback" or **"DDT Fallback"** means the response by the user to either perform the DDT or achieve a minimal risk condition after occurrence of a DDT performance-relevant system failure or upon operational design domain exit, or the response by an ADS to achieve a minimal risk condition given the same circumstances.

"Dynamic Driving Task Fallback-Ready User" or **"DDT Fallback Ready User"** means the user of a vehicle equipped with an engaged ADS feature who is able to operate the vehicle and is receptive to ADS-issued requests to intervene and to evident dynamic driving task (DDT) performance-relevant system failures in the vehicle compelling them to perform the DDT fallback.

"Dynamic Driving Task Performance-Relevant System Failures" or **"DDT Performance-Relevant System Failures"** means a malfunction in a driving automation system and/or other vehicle system that prevents the driving automation system from reliably performing the portion of the DDT on a sustained basis, including the complete DDT that it would otherwise perform.

"Legal" is not at term that is defined in SAE J3016. For the purposes of this report, the use of the term refers to regulations or requirements that have been enacted by Congress or a state legislative body via statute and have the force of law from an enforcement perspective.

"Levels of Driving Automation" refers to the SAE taxonomy adopted in the latest version of SAE J3016[1], which defines Levels from Level 0 (no driving automation) to Level 5 (full driving automation) in

[1] J3016_202104: *Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles* - SAE International. (n.d.). https://www.sae.org/standards/content/j3016_202104/

the context of motor vehicles and their operation on roadways. Regarding the specific levels referenced in this report, the following definitions apply:

- **"Level 3,"** or **"Conditional Driving Automation,"** means the sustained and operational design domain-specific performance by an automated driving system of the entire dynamic driving task under routine/normal operation with the expectation that the dynamic driving task fallback-ready user is receptive to automated driving system-issued requests to intervene, as well as to dynamic driving task performance-relevant system failures in other vehicle systems, and will respond appropriately.
- **"Level 4,"** or **"High Driving Automation,"** means the sustained and operational design domain specific performance by an automated driving system of the entire dynamic driving task and dynamic driving task fallback.
- **"Level 5,"** or **"Full Driving Automation,"** means the sustained and unconditional (i.e., not ODD-specific) performance by an automated driving system of the entire dynamic driving task and dynamic driving task fallback.

"Motor carrier" is not a term that is defined in SAE J3016. It means a person providing motor vehicle transportation for compensation. For purposes of this report, a motor carrier transports passengers or property for compensation.

"Operate" means collectively the activities performed by a (human) driver or by an automated driving system to perform the entire dynamic driving task for a given vehicle. The use of the word "operate" or "operation" refers broadly to ADS-equipped vehicles being used on public roads. It is not meant to distinguish between testing, deployment, and full scale commercial deployment.

"Operational Design Domain" or **"ODD"** means the operating conditions under which a given automated driving system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions and the requisite presence or absence of certain traffic or roadway characteristics.

"Platooning" is not a term that is defined in SAE J3016. For the purposes of this report, truck platooning refers to when multiple trucks travel together connected by a computer system normally controlled by the lead vehicle. The system communicates with the trucks in the platoon to align speed, acceleration, and braking, which allows vehicles to safely operate at close proximity to each other.

"Policy" is not a term that is defined in SAE J3016. This term takes many forms, including such documents as published policy papers and policy statements. These less formal means of communicating policy are similar in kind and type to other policies, like human resources policies, travel policies, and other statements of the intent of a governing body as to how certain functions are to be performed. From a legislative point of view, the ultimate expression of policy is the adopting of statutes, which codify policy into law. Administrative rules and regulations promulgated pursuant to legislative authorization are also laws based on policy. For instance, a state transportation agency's highway access policy may be a policy document describing the intent of the rule making agency and providing justification for the policy. The rules that codify that policy are administrative laws, enforceable in a legal context. The nature of public policy, whether for transportation purposes or for other valid exercises of state power, is that it is a

statement of what the governing body intends for an outcome. Many policies are simply that—an expression of intent or will. Some policies are carried forward and become laws. Others remain statements of intent.

"Preemption" is not a term that is defined in SAE J3016. This is meant to refer to when state or local authority is removed through statute or existing jurisdiction resulting in a state or local government not having the authority to implement laws or regulations in a specific area.

"Regulation" or **"regulatory"** are not terms defined in SAE J3016. They refer to the implementation of policy or laws in the form of legally enforceable requirements.

"Testing" is not a term that is defined by SAE J3016. It means operating an ADS-equipped vehicle on public roads by employees or contractors of an ADS-tester or other entities for the purpose of assessing, demonstrating, or validating the ADS capabilities. The use of this term typically refers to the piloting of ADS technologies within a specific or limited operational design domain and usually for a set amount of time.

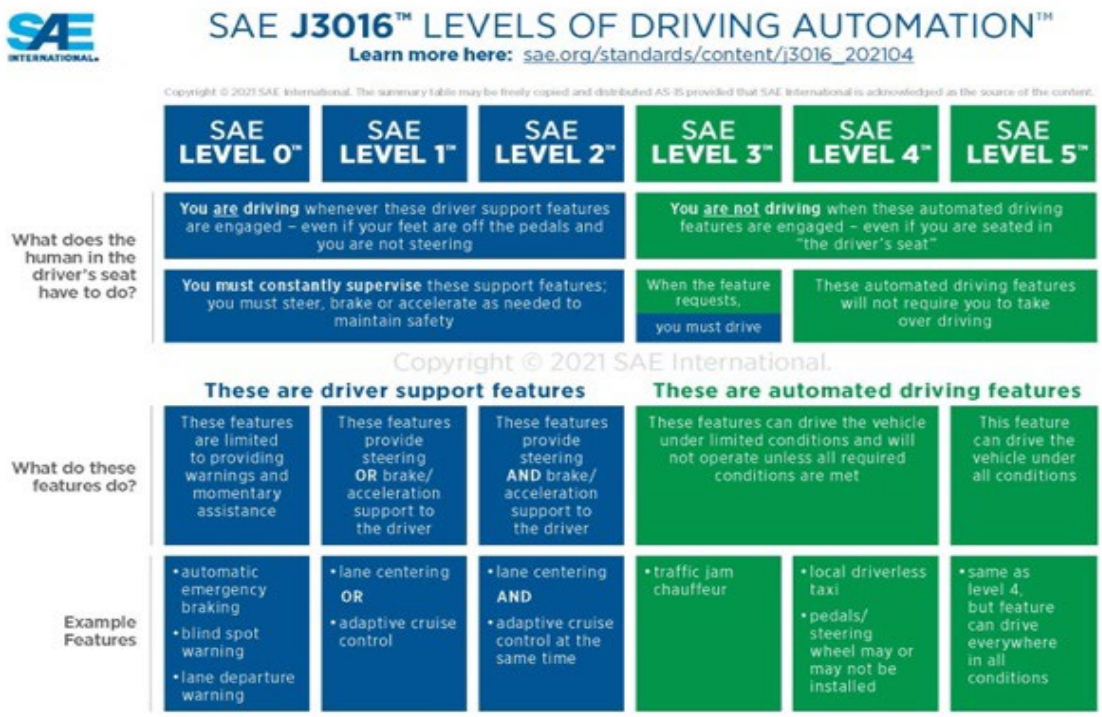

Image Source: SAE International

1.0 Introduction

The conversation around mobility and innovation has a come a long way since Karl Benz patented the three-wheeled motor car, known as the "Motorwagen," in 1886. As the automobile made its way onto roads, drivers had to navigate an interesting operational domain—horses, horse and buggy, people in streets, and street cars. Amazingly, this was all done without traffic systems to manage streets. Today, America's roads have unfortunately become less safe with rising pedestrian and cycling deaths, and vehicle crashes.[2] This rise in accidents and fatalities are occurring despite development of policies focused and continued investments in infrastructure focused on road safety.

With the introduction of ADS-equipped vehicles onto public roads, there is a new inflection point for the transportation system that may require reengineering policies, laws, and regulations for governing vehicle operations, especially if humans are no longer required. The notion of ADS-equipped vehicles has led to a reimagination of the transportation system, including opportunities to decrease the need for vehicle ownership; create safer streets, roads, and highways; and increase mobility access for populations with limited access to transportation options and those with disabilities. Many take for granted that access to safe, reliable, convenient, and accessible mobility options means something valuable; freedom to move within and outside of cities, states, and even across international borders.

For ADS, a looming question is whether such positive benefits will indeed materialize or whether ADS will exacerbate existing inequities in the transportation system or lead to increased vehicles miles traveled and congestion. How to implement and enforce new policies, laws, and regulations focused on the next generation of mobility will be an important determinant for what ADS operations look like on roads and is an important consideration for the New England region. An overall challenge fueling this report is how the NE States can continue to coordinate around supporting innovation while balancing the specific transportation needs and goals of each state.

1.1 Issue Background

Merging automation and transportation is not a new concept. The idea of ADS-equipped vehicles has been around since at least 1939 when General Motors created an electric vehicle that was guided by radio-controlled electromagnetic fields and operated from magnetized metal spikes embedded in the roadway[3]. From a public transportation perspective, the metro system operated by the Washington Metropolitan Area Transit Authority is designed for Automatic Train Operation; however, it has not

[2] *Newly Released Estimates Show Traffic Fatalities Reached a 16-Year High in 2021 | US Department of Transportation*. (n.d.). https://www.transportation.gov/briefing-room/newly-released-estimates-show-traffic-fatalities-reached-16-year-high-2021#:~:text=Preliminary%20data%20reported%20by%20the,from%201.34%20fatalities%20in%202020.
[3] *History of Autonomous Cars*. (2021). TOMORROW'S WORLD TODAY®. https://www.tomorrowsworldtoday.com/2021/08/09/history-of-autonomous-cars/

operated in an automated manner since 2009. Airports around the world use automated trains to move people from terminal to terminal daily.

One of the best-known automated systems is that of "autopilot" on airplanes. Although it is a system that allows a pilot to fly a plane without continuous hands-on control, it is not meant to replace human monitoring at this point in time. However, what the computer system does do is monitor inputs, or data, to self-regulate based on the operational environment and assist pilots in the complicated operation of planes and monitoring of the skies. For many, the example of autopilot on a plane can help with the complicated discussion around what an "ADS-Equipped Vehicle" may be expected to be capable of based on the different levels of automation or features thereof currently being integrated into vehicles.

Image Source: Stantec

Many drivers take for granted how complicated and unsafe the task of driving can be, especially with all the different operating environments that drivers encounter. Over the last several years vehicle manufacturers have introduced and continue to deploy and improve a variety of advanced driver assistance systems (ADAS) technologies into new vehicles like collision warnings, collision interventions, driving control assistance, parking assistance, and other driver assistance systems to aid the driver with safely performing some of the driving tasks. It is critical to note these driver assistance technologies are not considered ADS[4], as they are designed to assist, not replace an engaged driver, and thus are not the focus of this report. However, as these ADAS technologies mature and take over more and more of the driving tasks, it is anticipated that drivers may become more accustomed to manually driving less and may be more open minded (or maybe not) to vehicles that fully drive themselves all of the time, which leads to the focus of this report – ADS-Equipped Vehicles.

If ADS technology were capable of a complete one-for-one replacement of human driven vehicles by handling the sustained and unconditional performance of the entire dynamic driving tasks and the dynamic driving task fallback (what is defined as Level 5 – Full Driving Automation), then there may not be a need for a report such as this one. This report considers the fact that existing policies, laws, and regulations around vehicle operation all assume a human driver behind the wheel. In line with the fact that the development of ADS technology is ongoing and will take time, so will reengineering policies, laws,

[4] *Clearing the Confusion: Recommended Common Naming for Advanced Driver Assistance Technologies*. (2020). Consumer Reports. https://advocacy.consumerreports.org/wp-content/uploads/2018/10/Clearing-the-Confusion-ADAS-Nomenclature-one-pager-8-3-20-FINAL.pdf

and regulations to accommodate all the driving tasks and fallback being completed by an onboard ADS instead of a human driver. The goal of this report is not to provide definitive answers, especially since the ADS technology and viable use cases are still maturing, but to instead identify policy, legal, and regulatory issues that the New England States ("NE States") can continue to collaborate and coordinate on in preparing for the continued integration of ADS-equipped vehicles across the region.

1.2 How did the regional focus of the project come about?

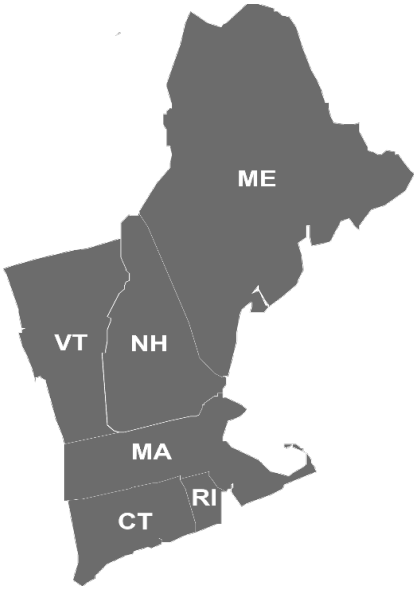

Figure 11: Map of NE CAV States

The regional focus of the project builds from previous work funded by the New England Transportation Consortium (NETC) and completed by the New England Connected and Automated Vehicle Coordination Group (NECAV) as further described below.

In 2017, the NETC funded an NETC quick response project titled, "New England Connected and Autonomous Vehicles" (Project 17-1). The objectives of this project were to:

- Identify multi-state issues related to the testing and deployment of connected and autonomous vehicles (C/AVs) in New England;
- Document opportunities and challenges related to multi-state C/AV issues; and
- Prepare an action plan that minimizes challenges and pursues opportunities for regional C/AV collaboration in New England.

Two important outcomes resulted from this project work, which was completed in 2018:

1. A roadmap of initiatives which support the testing and deployment of C/AVs in the six New England states; and

2. An active working group, the Northeast Connected and Automated Vehicle Coordination Group (NECAV), with representatives from the transportation agencies in each of the six New England states (Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont), that is also supported by the input of The Eastern Transportation Coalition (TETC) and continues to meet quarterly to share, learn and support each other in areas and initiatives related to C/AVs. The NECAV Coordination group members made up the Technical Committee advising the completion of this research project.

The vision of the NECAV group is for seamless operation of ADS-equipped vehicles across New England and surrounding regions of the United States and Canada. The mission of the NECAV group is to share resources and information, and work collaboratively with neighboring transportation agencies and other key stakeholders to facilitate the deployment of ADS-equipped vehicles in New England and its surrounding region for freight and passenger movement.

New England is a region composed of six small states with unique government structures and diverse numbers and types of urban, suburban, and rural communities that have aging infrastructure and four seasons of variable weather conditions. The geographically small states (with frequent cross-border travel across jurisdictions) also means that a consistent approach to ADS regulation, policy and deployment is critical for the region.

This Project focuses on the following question: How to develop, implement, and provide continuing updates towards a uniform statutory and regulatory approach to facilitate the safe multi-state deployment of ADS-equipped vehicles across the NE States?

1.3 What are the research goals and objectives of the project?

The goals and objectives of this research project (hereinafter referred to as “Project”) are the following:

- Conduct a review of similar or related ADS focused research efforts to document known issues and to ensure relevant multi-state policy, legal, and regulatory issues are considered
- Analyze existing policy, legal, and regulatory issues to overcome anticipated barriers to multi-state CAV mobility in the New England region
- Focus on foundational policy, legal, and regulatory issues that require action in consideration of transitioning from human driving to ADS-equipped vehicles with a focus on cross-state consistency and consideration of future roles and responsibilities for states
- Develop and identify specific recommendations towards facilitating testing and deployment of ADS-equipped vehicles in multiple states and across state lines within the New England region with the goal of collaborating on the development of policy, legal, and regulatory approaches
- Avoid duplication of previous research projects and inform national and other regional efforts around ADS through the findings of the Project

For this Project, the focus of the research and analysis is on ADS, which is the "hardware and software that are collectively capable of performing the entire DDT on a sustained basis, regardless of whether it is limited to a specific operational design domain (ODD); this term is used specifically to describe a Level 3, 4, or 5 driving automation system.

Image Source: Courtesy of Connecticut Department of Transportation

What is not covered in the scope for this Project?

The breadth and scope of issues that come with the deployment of ADS is cumbersome, evolving, and challenging. Like any research project taking on a complicated and ever changing issue like ADS deployment, parameters had to be placed around what this Project could cover. For clarification purposes, the following issues were not comprehensively evaluated as part of the Project, although they may be mentioned in parts of the report as these are issues that are important to and warrant further research and consideration around the deployment of ADS.

Connected vehicles: ADS-equipped vehicles and connected vehicles are sister technologies that are being developed in parallel paths and oftentimes tend to be merged together in discussions among transportation professionals. One of the reasons connected vehicles are largely not included as part of this Project is because connected vehicle technologies involves different policy, legal, and regulatory issues or considerations that are being debated at the national level with some state or local implications for installation and deployment. This includes considerations around both vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) connected vehicle communications. While both ADS and connected vehicle technologies may compliment one another, the extent or implications of that outcome are still unknown. An important consideration for future connected vehicle related policy, legal, and regulatory tracking and coordination is the prioritization of wireless spectrum for transportation specific communications and the development and consistent application of interoperable equipment standards for industry to follow, which

will make it easier and provide a focus on future readiness for state and local infrastructure owner operators (IOOs) to install related equipment onto roadways.

Infrastructure needs and considerations: There are still a number of questions around what infrastructure is needed to support the safe operation of ADS. While lane markings and signage are often discussed, issues like broadband connectivity may need to be addressed as well should remote operations or monitoring take shape for fleet operations. Infrastructure considerations will be an important subject area to continue to track and issues related to use and control of right-of-way may be challenged with the increased deployment of ADS onto public roads. Additionally, any requirements around lane markings and signage should be tracked through the ongoing update to the Manual on Uniform Traffic Control Devices[5].

Personal Delivery Devices: Personal delivery devices (PDDs) are not specifically covered in this report due their operations mainly being focused on the use of sidewalks as opposed to public roads. The Project does consider larger vehicles being used for local goods delivery and operating on public roads without any driver. These are referred to herein as “ADS purpose-built vehicles.”

1.4 ADS Technologies Can Support a Safe, Sustainable, And Accessible Transportation System

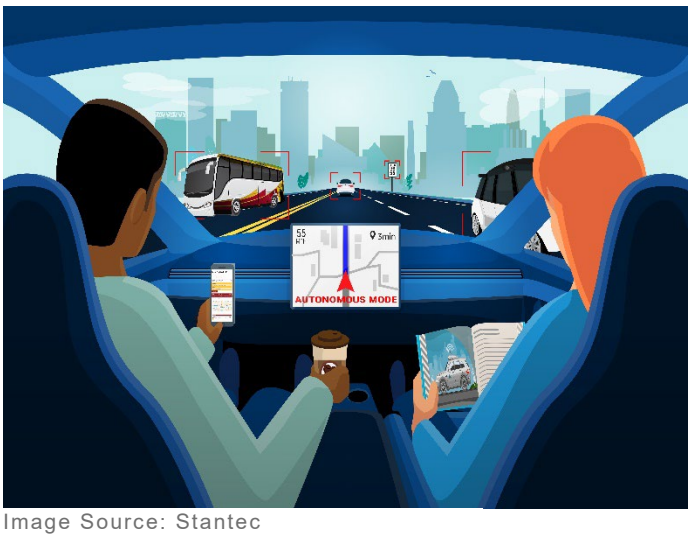

Image Source: Stantec

Why is it important to be investing resources into planning for ADS-equipped vehicles? ADS technologies have the potential to provide significant safety, mobility, environmental, economic, and other quality of life improvements that could benefit nearly every user of the transportation system. However, in order to maximize such benefits, a modernization of policies, laws, and regulations will be needed to support the

[5] *Status of Rulemaking for the Eleventh Edition of the MUTCD - Knowledge - FHWA MUTCD*. (n.d.). https://mutcd.fhwa.dot.gov/mutcd11status.htm

minimization or elimination of human responsibilities for the operation of vehicles. Further, coordination will be needed to foster the equitable deployment of ADS-equipped vehicles, including overcoming focus on urban and highly populated areas of the country from a market share perspective which may leads to focus areas like rural access and first-last mile paratransit to not be prioritized.

The renewed enthusiasm for ADS in vehicles arguably came in 2016 when the United States Department of Transportation (USDOT) under the Obama Administration released policy and guidance aimed at getting more ADS-equipped vehicles on public roads. In March of 2016, the Senate Committee on Commerce, Science, and Transportation convened a hearing entitled "Hands Off: The Future of Self-Driving Cars[6]." During that hearing, Senator Nelson (a former astronaut) described his experience in a vehicle with driver assist technology where his "instincts could not resist, and I grabbed the wheel, touched the brake, and took over manual control." He then went to on state "[u]nderserved communities without reliable means of transportation could finally be integrated into the national economy. In so many states, this technology could be particularly beneficial for seniors and those with disabilities." These statements summarize the important mobility opportunities and one of the biggest impediments for ADS-equipped vehicles – consumer trust and adoption.

Unfortunately, many of the complicated policy issues addressed in the initial policies and guidance, and the 2016 Senate hearing, including safety, oversight, funding, consumer trust, and public and private coordination continue to be barriers to the widespread adoption of ADS-equipped vehicles. These barriers are exacerbated by lack of national regulatory coordination, the great cost for the development of proprietary systems for safe ADS operations, and the reality of the diverse infrastructure, operating, and weather considerations that exist across the country.

[6] *Hands Off: The Future of Self-Driving Cars.* (2016). https://www.govinfo.gov/content/pkg/CHRG-114shrg22428/pdf/CHRG-114shrg22428.pdf

Image Source: Courtesy of New Hampshire Department of Transportation

Even with identified challenges, the opportunities around a safer, more inclusive, and efficient transportation system continue to fuel warranted interest around the integration of ADS into vehicles. This is evidenced by the continued investment in the development of ADS by both traditional and non-traditional players in the automotive space; the increasing number of advocacy organizations focused on ADS; the formation of subcommittees within traditional transportation organizations like the American Association of State Highway and Transportation Officials ("AASHTO") and the American Public Transportation Association ("APTA") focused on ADS; and the growing size of chapters within state and local transportation plans centered on mobility and innovation, including ADS-equipped vehicles. A common theme from policy documents being released by such entities is the need for a national strategy and vision to address the different layers around the operation of ADS-equipped vehicles on public roads[7].

[7] *AASHTO Connected and Automated Vehicle Policy Principles*. (2021). AASHTO. https://cav.transportation.org/wp-content/uploads/sites/61/2021/11/CAV-Policy-Principles-v4-press.pdf; Alliance for Automotive Innovation. (2020). *Policy Roadmap to Advance Automated Vehicle Innovation*. https://www.autosinnovate.org/innovation/AVRoadmap.pdf

1.5 Current Deployment and Regulatory Landscape

While ADS-equipped vehicles are not yet mainstream across the nation's roads and highways, their presence on roadways is growing, including through on-demand ride hailing,[8] freight and transit use cases. Having a clear understanding of the capabilities and proposed uses of ADS is an important discussion point around the integration of ADS into ground vehicles. Through ongoing testing and development of ADS technologies, the following use cases are evolving in the short-term:

Image Source: Stantec

- Commercially operated fleets of vehicles for passenger services focused on demand responsive mobility or ridehailing
- On-road commercial vehicles focused on the movement of freight on highways with focus on specific corridors
- Fleet and purpose-built vehicles without any in-vehicle operator for local goods delivery, including both road and sidewalk delivery
- Public transportation, including both agency operated or procured services from private companies
- State-owned fleets of vehicles for maintenance services

[8] *CPUC Issues First Driverless Autonomous Vehicle Passenger Service Deployment Permit*. (2022). https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-issues-first-driverless-autonomous-vehicle-passenger-service-deployment-permit

Figure 22: NHSTA Test Tracking Tool Map

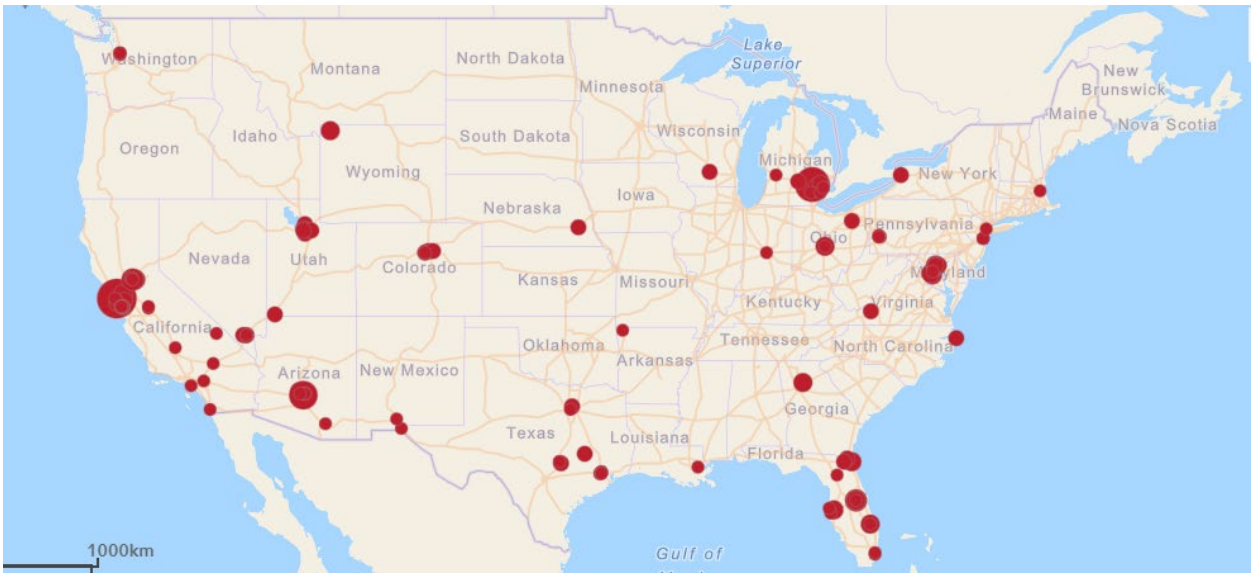

Image Source: Esri, Bureau of Transportation Statistics, GeoSystems Global Corporation in association with National Geographic Maps and Melcher Media, Inc. | Esri, FAO, NOAA, USGS, NRCan (May 2, 2022)

At this point in time, the operation of ADS-equipped vehicles on public roads is somewhat limited geographically across the country. As part of the "AV TEST" Initiative launched in June of 2020, NHTSA developed an interactive map that shows ADS testing locations, state information, and company information ("Tool")[9]. States and companies voluntarily submit information about ADS operations to NHTSA, which then compiles the information into the Tool. The Tool shows locations of ADS operations, and the map reflects the amount of operations by dot size.

Increasing opportunities for the operation of ADS-equipped vehicles in the Northeast is an important goal of this Project, including its focus on a coordinated approach around policy, legal, and regulatory issues for the NE States.

While the Tool does not capture all ongoing operation of ADS-equipped vehicles on public roads, it does provide an informative snapshot around where testing appears to be focused. In the Northeast, there is very limited operation at this time. Besides the City of Boston now and the CTfastrak project in central Connecticut starting in 2023, the majority of ADS operations are happening in locations where there is already an existing industry, government interest, and/or research institution interest or presence for ADS, business/market share opportunity, and/or geography or climate suitable to industry and the use case and readiness status of the ADS technologies.

[9] *Automated Vehicle Test Tracking Tool | NHTSA*. (n.d.). https://www.nhtsa.gov/automated-vehicle-test-tracking-tool

While ADS testing and deployment across modes and use cases have continued, there has been a lag in the implementation of federal ADS safety regulations. Although federal regulations are still forthcoming, it is important to note there are a number of standards and best practices focused on ADS that have been developed and adopted by industry.[10] In fact, NHTSA is presently considering many of these standards as it reviews comments submitted to a recent advanced notice of proposed rulemaking focused on developing a framework for ADS safety[11]. These standards also provide insights for states seeking to foster, coordinate, and assist with the permitting of safe testing and deployment of ADS-equipped vehicles on public roads. Without a nationally coordinated approach for ADS testing and deployment that fosters public and provide collaboration in support of ADS deployments in all parts of the country, barriers have arisen through the different policy, legal, and regulatory approaches states are taking around ADS-equipped vehicles.

Through the research for this Project, five general approaches being taken by states have been identified:

- Implementation of state policies, legislation, and/or regulations directly focused on the testing and/or full scale commercial operations of ADS
- Implementation of state policies, legislation, and/or regulations seeking to establish a commission or working group to study and make recommendations around potential state regulatory changes needed for the safe testing and/or operation of ADS
- Issuance of a Governor's Executive Order promoting the testing of ADS-equipped vehicles or establishing a commission or working group to study and make recommendations around potential regulatory changes needed for the safe operation of ADS-equipped vehicles
- Intentionally not implementing new ADS policies, legislation, and/or regulations as an active and flexible strategy to attract and engage ADS industry or to implement ADS pilots, or following a determination that no policies, legislation, and/or regulations are needed at this time due to very limited full scale commercial deployments of ADS
- Intentionally not implementing new ADS policies, legislation, and/or regulations as a strategy to remain inactive in this space while ADS technology, use cases, and regulatory issues continue to evolve and standards continue to evolve from USDOT and industry

Each of these approaches informs the different opportunities and risks that will be discussed further in Section 3 of this report. With such a backdrop in mind, the NETC has engaged this Project to proactively evaluate policy, legal, and regulatory issues around ADS from a regional perspective. This Project seeks to help advance the important and difficult conversations needed across sectors to further the multi-state

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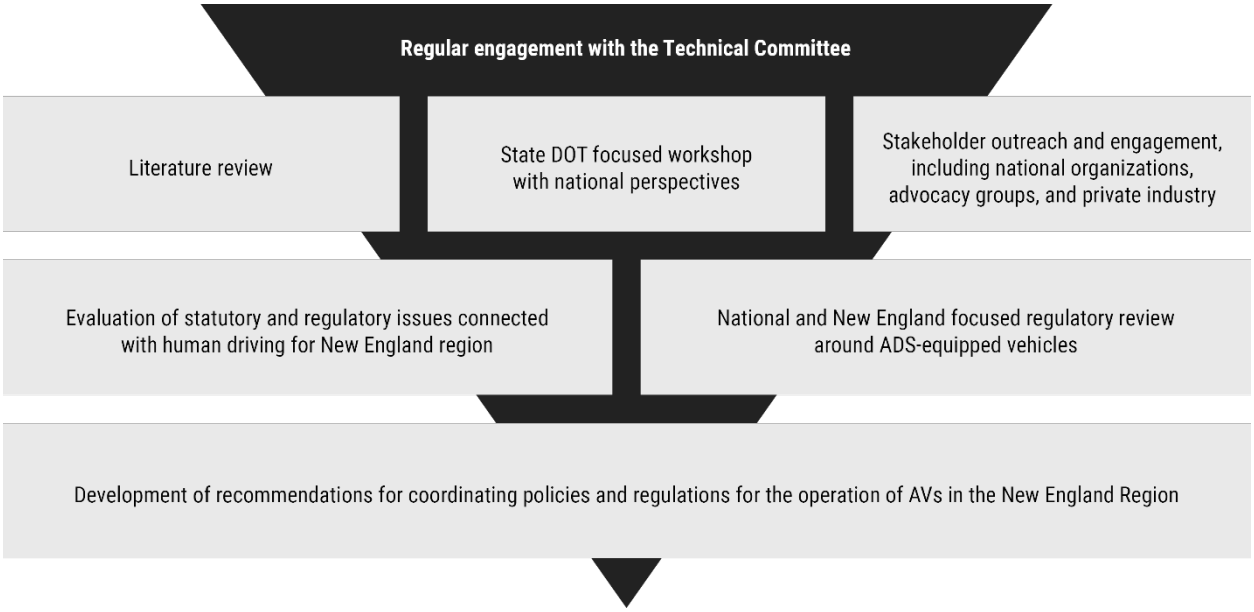
[10] These industry standards include SAE J3061 and SAE 21434 for cyber security and computer security; ISO 26262 for functional safety and equipment faults; ISO 21448 and SaFAD/ISO TR 4804 for dynamic driving function and environment and edge cases; and UL4600 for system safety or safety beyond dynamic driving, including the totality of an ADS safety case. In addition to the above deployment industry standards, there are also other SAE standards and industry best practices focused on testing of ADS-equipped vehicles, including: SAE J3018 for Safety-Relevant Guidance for On-Road Testing of Prototype Automated Driving System (ADS)-Operated Vehicles; AVSC Information Report for Adapting a Safety Management System (SMS) for Automated Driving System (ADS) SAE Level 4 and 5 Testing and Evaluation; AVSC Practice for Metrics and Methods for Assessing Safety Performance of Automated Driving Systems (ADS); and others.

[11] *Framework for Automated Driving System Safety.* (2020, December 3). Federal Register. https://www.federalregister.gov/documents/2020/12/03/2020-25930/framework-for-automated-driving-system-safety

use of ADS-equipped vehicles while also addressing new risks and grey areas that come with the deployment of an emerging and imagination capturing technology.

1.6 Research Process



In coordination with the TC, the research team developed a multi-phase process for the Project that included the following steps:

1. Regular engagement with the TC
2. Literature review
3. State transportation agency focused workshop with national perspectives
4. Stakeholder outreach and engagement, including national organizations, advocacy groups, and private industry
5. Evaluation of statutory and regulatory issues connected with human driving
6. National and New England focused regulatory review around ADS-equipped vehicles
7. Development of recommendations for coordinating policies, laws, and regulations for the operation of ADS-equipped vehicles in the New England Region

While the scope of this Project is large when one considers an issue like ADS-equipped vehicles, the focus on policy, legal, and regulatory issues kept the Project grounded around issues focused on vehicle operations and roles and responsibilities, particularly state and federal governance and oversight roles. It is also necessary to note that participants in the stakeholder outreach are not identified as part of agreement to promote more candid information sharing to inform development of more robust recommendations as part of this Project.

Technical Committee Engagement

The TC, comprised of representatives from each of the New England state transportation agencies (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) was set up to provide guidance, input, and feedback to the Principal Investigator to ensure the research was useful to each of the states involved. This Project has been informed by feedback from the Technical Committee on a regular basis. This included monthly meetings where Project issues were discussed. The Technical Committee was highly engaged during the review of all drafts of the final report.

Literature Review

Using the Project scope as guidelines, the literature review scanned 40 documents with a focus on policy, legal, and regulatory matters for ADS, primarily assessing these ADS matters in the United States (though the team did include a few international examples).

The reviewed documents included:

- Reports from ADS state-level working groups;
- Comprehensive research published by the Transportation Research Board (TRB) and National Cooperative Highway Research Program (NCHRP);
- Papers published by research institutions and individual transportation researchers and advocacy groups; and
- Policy and guidance documents from several state departments of transportation, USDOT, and national associations addressing ADS.

Through the literature review, the research team identified key ADS legal and regulatory issues for discussion with stakeholders and the TC. Key notes and observations from the documents reviewed can be found in Appendix A – Annotated Literature Review. The research focused on a review of documents that did not just identify issues, but included robust discussions around policy, legal, and regulatory issues facing ADS. The key findings of the literature review are included in Appendix B – Literature Review. This appendix also includes the full bibliography of documents reviewed.

Stakeholder Outreach

Image Source: Stantec

The research team created a stakeholder outreach discussion guide to help collect feedback from representatives from different organizations and stakeholder groups relevant to ADS. For the guide, see Appendix C – Stakeholder Outreach Discussion Guide. The stakeholders that met with the research team

for virtual meetings reflected a diverse set of opinions and perspectives in ADS. This was to ensure that the discussions would be representative of the scope and interests of the Project, including the challenging issues included within the scope of research.

The stakeholders interviewed for the Project can be put into the following categories of organization types:

Private industry vehicle manufacturers (5 stakeholders)

- Passenger vehicles
- Freight vehicles
- Local delivery vehicles

Governmental/transportation professional organizations (5 stakeholders)

- National advocacy organization for municipalities
- Public transportation professional organization
- Motor vehicle administration
- Law enforcement and highway safety

Legal organizations (2 stakeholders)

- Law firm representing coalition with focus on ADS-equipped vehicles
- Professional association

High tech transportation manufacturer (1 stakeholder)

- Professional organization

Development and deployment of ADS (1 stakeholder)

- Consultant firm

Insurance (1 stakeholder)

- Insurance company

A major goal of the outreach was to educate interviewees about the Project and its goals, and to find opportunities and solutions for collaboration across sectors to support the safe deployment of ADS.

Discussion topics included:

- Areas of ADS operation that states should try to coordinate
- Areas of law where states should strive for reciprocity
- Use cases for passenger or goods movement that would lend themselves to operation across state lines
- Appropriate terms of ADS operations i.e., “testing/pilot,” “deployment,” or “commercial use”
- Experience in codifying or litigating issues related to ADS operations
- Lessons learned from experiences, along with any sharable documentation from pilot projects

State DOT Focused Workshop

As part of the research and engagement, a workshop was also held with representatives from state and local departments of transportation outside of the New England states that are actively involved with ADS testing and deployment activities. The invited speakers were asked to share ongoing initiatives and approaches around the deployment of ADS-equipped vehicles in their states. The goal was to include a national spectrum of viewpoints around complicated issues like risk-sharing and safety, how to approach terminology like “deployment,” and how to approach legislation around ADS. The perspectives included representatives from Arizona, Florida, Maryland, Minnesota, Ohio, Pennsylvania, and Washington.

A sample of questions discussed during the workshop included the following:

While the need for national coordination was mentioned throughout the literature review and stakeholder engagement, the notion of multi-state regional coordination was received with interest and positive feedback.

- Tell us about what policy and regulatory approach you are taking in your state and why?
- If you did implement new policies or regulations, how did you achieve elected / stakeholder / public buy-in on your current approach?
- How did you get dedication of resources for ongoing efforts focused on ADS integration in your state?
- What do you think is needed to promote collaboration around a national testing program to overcome challenges like risk management, safety verification, and information sharing?
- What are roles and responsibilities of the public and private sector in the absence of federal regulations?
- What is the right regulatory balance – safety vs. promoting innovation?

2.0 Discussion of ADS Challenges and Opportunities Identified Through Research Process

There is great opportunity for coordination around the development of testing and deployment regulations that align ADS use cases with the identified transportation needs of the NE States and region.

The literature review and stakeholder outreach processes helped the Project team identify key topics and considerations for policies, laws, and regulations arising from ADS-equipped vehicles in a regionally coordinated manner. The discussion below presents the issues raised during the literature review and stakeholder outreach phases of the Project and informed the focus of the analysis in Section 3, in addition to the findings and recommendations in Section 4. While ADS technologies present the opportunity to enhance the transportation system, they also challenge existing paradigms and accordingly, raise questions towards existing policy, legal, and regulatory boundaries.

Important questions that were raised and discussed during the research included:

- What are the different potential use cases and operational design domains for ADS?
- How to understand and mitigate evolving risks for pilot projects and limited deployments without a clear timeline for when ADS will be ready for full scale commercial deployment operations?
- How will ADS be available to consumers? For example, will this be a shared fleet subscription format or personal ownership?

- How will existing roles and responsibilities change or not change between all levels of government (federal, state, local)?
- How can states promote safe and effective ADS testing and deployment opportunities in support of advancing ADS technologies while being mindful of untested liability questions for states as federally adopted safety standards are further developed?
- What are the industry standards that exist today for ADS and are they enforceable or do they provide a legally defensible position?
- What are specific actionable steps (adoption of policies, laws, regulations, etc.) that can be taken today and in the near-term or mid-term collectively by the NE States to advance ADS development, performance, and adoption? Are any of these steps more important, effective, or essential to take compared to others?
- What needs to happen to support a coordinated and collaborative approach around the adoption of policies, laws, and regulations by the NE States?

These topics considered as part of this Project and the resulting findings and recommendations in Section 4 provide a foundation for the NE States to continue to coordinate resources around actionable steps to implement the region's vision for seamless operation of ADS-equipped vehicles.

2.1 State Coordination

Through the completion of both the literature review and stakeholder engagement, a common theme arose – increased and better state coordination will benefit and help the continued maturation of ADS. While challenges have been identified for regional collaboration, including overcoming different individual state interests that influence legislative decision-making, the safety, economic, and accessibility interests around ADS offer an opportunity for a regional coordinated approach to maximize the positive benefits of ADS-equipped vehicles on public roads. From the research, key issues identified for focused multi-state coordination in consideration of ADS include commercial freight, insurance, safety certification, and information sharing.

In considering ADS commercial freight operations, an important state safety consideration may be: what is the maximum number of vehicles that should be allowed to platoon, and what are safe following distances?

Commercial freight traffic is one area where coordination may be easier, in part because commercial freight operations are accustomed to being regulated at the federal level more comprehensive than passenger vehicles. ADS-equipped vehicles focused on commercial trucking are already crossing state lines with regularity, albeit on specific corridors primarily in the Southwest and through states with a permissive regulatory structure. In many cases, these limited deployments are working closely with law enforcement to plan and coordinate for ADS operations. Further, through the Federal Motor Carrier Safety Administration (FMCSA), most regulatory activities have already been determined to be under federal jurisdiction, including information sharing around safety and driver hours. This avoids some of the

ongoing tensions around federal, state, and local control associated with the regulation of ADS for passenger movement.

Insurance coordination was a priority area for several stakeholders. The Project research identifies that five million dollars is a commonly seen insurance cap in many states that have ADS-related insurance requirements, and that insurance was an effective way to resolve incidents in the current deployment stage of ADS. However, whether a state supported "at fault" or "no fault" insurance policies was one area that would affect fleet owners' ability to cross state lines while taking on risk of potential crashes.

ADS-equipped vehicles bring new replacement and sustainability considerations due to the current costs of replacement parts and recalibrating ADS monitoring systems following an accident. This creates a sustainability challenge around what could be viewed as vehicles that cannot be operated again after a minor accident and how vehicles with significant e-waste can be safely scrapped.

In speaking with a prominent global insurance company providing coverage to ADS operators, the following points were made that inform both future insurance and operational considerations:

- Operating environments impact insurance costs. This includes consideration around how complicated the operational environment is, which impacts the risk around an insurable incident.
- New risks with ADS include "ADS bullying" with people looking to challenge ADS-equipped vehicles and causing accidents, which may provide an opportunity for a new law to disincentivize such behavior by human drivers.
- The fleet operations model will create a new chain of liability that may look similar to the leasing and operation of commercial airplanes. Another model in consideration of the on-demand subscription use case is the insurance approach used for rental cars where the renter decides what level of insurance to pay for.

Safety certification is an area that state and local stakeholders identified as important to consider for possible coordination. Currently, differences in required certifications for various pilots and deployments could lead to inconsistent evaluation of safety issues and the development of effective and coordinated responses to safety concerns identified through testing. Inconsistent approaches to safety can also inhibit or deter testing/deployments and slow the maturation of ADS. The research suggests better coordination is needed across the public and private sector to address and overcome safety concerns in consideration of existing federal jurisdiction for vehicle safety.

What information should be required to be shared concerning crashes, disengagements, and operating environment presents both an important collaboration opportunity and challenge for states and private companies testing and deploying ADS-equipped vehicles.

Coordination around **information sharing** is more realistic at the state level than the federal level, even though the latter would be more ideal for private industry since there is concern around inconsistent privacy laws being enacted by states. Currently, there are no specific federal laws that address data collection and sharing by ADS-equipped vehicles, including considerations around consumer protection. Municipal stakeholders noted that data sharing concerns are complicated by the uneven levels of wireless and broadband connectivity from place to place (such as rural versus urban areas), the different types of data that are collected by ADS (as well as some data types still being unknown), including potential rider information, and sensitivity around confidential and proprietary systems information. While some freight stakeholders are comfortable sharing their data, others, like package shippers or technology companies (whose day-to-day operations are built on proprietary data) have greater concern about the need to protect their data. Legal stakeholders noted that, at the moment, states do not take the same approach to crash data reporting and disclosing. Nevertheless, the trucking industry in general is much more transparent with its crash data than the passenger vehicle industry because their bar for reporting data is traditionally higher.

Existing laws will serve these new ADS technologies, but only if there is a named entity who is the driver.

2.2 ADS Terminology

One of the identified barriers for state coordination is the differing taxonomy used to describe ADS and their technological and operational capabilities. As noted in this report, whether formally or informally, a number of states have adopted the “Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles” found in SAE J3016.

Legal stakeholders urged preservation of the current definition of **“driver”** because this term is legally meaningful in maintaining a separation between product liability and driver responsibility law. Stakeholders commented that states should regulate ADS operators as driving entities, similar to human drivers (bearing in mind that tests would be different, and regulations on human drivers should arguably be tougher). Purpose-built ADS vehicle stakeholders expressed that their industry would benefit if the same access and privileges granted to human drivers were granted to ADS delivery vehicles so that they could deliver goods where metro areas straddle state lines.

There was disagreement between some stakeholders on the application of the term **"testing"**. Consultant stakeholders noted that testing is the only stage the industry is truly in right now because there is a robust test phase needed to prove to the public that these technologies are safe; only after this phase can there be real proliferation of the technology. This was also an issue brought up during the DOT-focused workshop that generated the most robust discussion. Attendees provided different perspectives around whether the term **"deployment"** should be incorporated into policies and legislation right now or not based on the types of ADS operations occurring and state of the technology.

On the other hand, the research identified that a path to **"deployment"** must be baked into any limited stepwise approach. Other stakeholders added that regulation specific to deployment is important to establish, and that examples on deployment rules for drone integration could be useful for the ADS space in terms of allowing some level of operation (with defined limitations and restrictions), then monitoring and expanding deployments for adherence to project specifications or "good behavior." Through a pilot model supporting public/private collaboration, testing or limited deployments can be approved based on operational data and decisions can be based on safety and risk considerations. Such operational data can also be used to coordinate with the public and address any concerns.

Real-time information sharing brings with it potential liability considerations for state DOTs as infrastructure deficiencies may be reported by an ADS-equipped vehicle, which may be interpreted to put a DOT on notice of an infrastructure hazard.

The terminology also leads to further difficulties in supporting a definition for **"commercial deployment."** It was noted through stakeholder interviews that jumping from testing to commercial deployment is not easy and some sort of collaborative path forward around a "limited deployment approach" may be beneficial towards achieving collaboration between the public and private sector, reducing risks, and ensuring consumer buy-in. However, taking the California permitting and regulatory approach as an example, sequential permitting is currently working in California, but the process does not have room in it for a third phase in the sequence; in that state's process, the requirement to go through extensive testing and reporting precedes deployment, but the application process for deployment begins in the testing stage. Inserting a third stage in between could change and lengthen the testing/reporting stage to an extent that would not be sustainable for product development.

2.3 Liability

There was consistent agreement in the literature that insurance requirements should remain a state responsibility, and legal stakeholders felt certain that liability could be accommodated by existing law. The legal system has integrated new technologies for years and is robust enough to accommodate the technologies introduced by ADS-equipped vehicles. Stakeholders also felt it is unwise for states to try to predict the legal needs of an emerging ecosystem before it has matured; even if there is a need to design a liability system, it makes more sense to let it develop through the courts as legal uncertainties arise. For example, the ideal safety outcome of ADS over the long term is that crashes may go down, meaning that

the context of liability should reflect that change, and the need for legal action should actually abate. In addition, Terms of Use agreements will mainly serve to pass on a share of liability from the company to the rider; this has occurred in other transportation market segments as well (such as ride hailing), and stakeholders felt that the ADS context for transportation should not be solely targeted. This being said, stakeholders did acknowledge that relying on courts will not produce expedient results, especially considering these cases will be cases of first impression that may make their way to the Supreme Court; a process that normally takes many years – sometimes decades.

Further thoughts from the legal perspective are that the risk of ADS should be spread amongst the parties who share the risk, and no entity should be granted immunity because then the victim pays for it (this includes public agencies). In crash incidents when an ADS disobeys the rules of the road, the driver responsibility needs to be properly assigned; the risk and liability should be distributed among the parties who have the ability to prevent the harm that would produce liability.

All stakeholders agreed it is important to consider ADS use cases, operational design domains, functional design specifications, and whether or not and if so the extent upon which a human driver may be expected to take over or operate an ADS-equipped vehicle when determining what types of ADS operations would or should be allowed on public roadways or public rights-of-way in each state. In addition, each of these factors will determine what part of the code or which regulatory agency will govern the given vehicle use or type. For example, agency stakeholders noted that delivery vehicles may need to be subject to licensing and titling requirements since they operate on roadways, while delivery devices operate on sidewalks and therefore will not need to undergo licensing and titling (depending on the jurisdiction of the road adjacent to the sidewalk).

Image Source: Courtesy of New Hampshire Department of Transportation

2.4 Legislative Approaches and Use Case Considerations

From the private passenger vehicle industry perspective, too much legislation is premature; laws need to remain flexible as the technology grows. For example, companies seeking to provide ADS on-demand subscription services advocated that Arizona has a good model bill, while Texas' bill provides decent flexibility. Meanwhile, California's dual regulatory approach creates jurisdictional challenges and is not an example preferred by private industry. This also includes concerns around the regulation of subscription fleets by the California Public Utilities Commission[12].

While the U.S. typically relies on self-certification in the manufacturing of vehicles for compliance with FMVSS, there is still a public need to know what state regulations have done to protect them (especially regarding issues like safety and cybersecurity for emerging vehicles technologies). The British model for this, known as "trialing", allows developers to develop their own safety cases, then prove to the government that their criteria are effective and that they have met them[13].

[12] California Public Utilities Commission. (n.d.). *Autonomous Vehicle Programs*. https://www.cpuc.ca.gov/regulatory-services/licensing/transportation-licensing-and-analysis-branch/autonomous-vehicle-programs
[13] *Code of Practice: automated vehicle trialing*. (2022, January 29). GOV.UK. https://www.gov.uk/government/publications/trialling-automated-vehicle-technologies-in-public/code-of-practice-automated-vehicle-trialling

Building a foundation for a public / private / federal collaboration to support consumer understanding and to provide technical assistance to states around ADS focused legislation is opportunity identified through this research to support coordinated and informed regulation of ADS.

State and local stakeholders likened the operational safety certification process to the discussions around scooter integration into a city's transportation eco-system, in that new vehicles and integrated technologies must have certain parameters for approval and places to operate (even as they are insured and safety certified). For cities, these concerns in approving operations of ADS arise from managing public space and well-being. From an industry perspective, there is concern that new mobility innovations are being targeted with regulations that are stricter than those imposed on human driven vehicles.

One stakeholder perspective offered that mobility hubs in metropolitan areas for ADS providing delivery of goods to rural communities across state lines may present strategic commercial ADS freight opportunities for regions like the Northeast.

From the freight perspective, the need for regulations has shifted for ADS in recent years. The freight industry would like to eliminate the many gray areas existing in the legal and regulatory space around ADS, thus confirming concerns that inconsistencies in regulation have become a significant barrier towards ADS advancement. Logistics for refueling infrastructure will continue to be important, especially with ongoing movement towards zero-emission vehicles. Additionally, coordination with law enforcement was emphasized as an important priority, including around truck inspection stops.

2.5 Politics, Consumer Confidence, and Education

The research identified the need for facilitation of bipartisan conversations about ADS. The current challenges around bipartisan legislation is made more complicated by the fact that many lawmakers introducing and supporting ADS legislation do not always fully understand the capabilities of the technology. There is also continued and increasing confusion around the difference between ADS and ADAS,[14] in addition to concerns that ADS will increase vehicles miles traveled, which directly conflicts with some states' and local governments' desires to reduce the number of vehicles on roads. Industry can help to educate policy makers by facilitating conversations around the potential use cases and business models for ADS (including goods delivery, first/last mile connections, and shared subscription/fleet

[14] Singer, J., & Jennes, J. W. (2020). *Impact of Information on Consumer Understanding of Partially Automated Driving System. AAA Foundation for Traffic Safety*. https://aaafoundation.org/wp-content/uploads/2020/07/Impact-of-Information-on-Consumer-Understanding-of-a-Partially-Automated-Driving-System.pdf

models). Transportation regulators can also provide this education service as well, hosting facilitated conversations between multiple stakeholders and identifying gaps in stakeholder conversations and issues that require further research and exploration. At the federal level, continuing efforts to collect and share information around ADS deployments to support the development of best practices and technical support is also desired.

Regarding consumer confidence, the industry perspective is that consumer confidence will grow with consumer education and technology demonstration and experience. From the standpoint of organizations representing ADS interests, the best way to accomplish this is to allow more ADS on the roads so that people can get used to them through interactions and understand them and their capabilities. Legal stakeholders noted that the misuse of terminology for ADAS systems has caused consumer confusion[15]. This blurring of technology through terminology causes consumers and regulators to doubt the entire ADS industry. The ongoing investigations and orders being administrated by NHTSA appear to be focused on closing this understanding gap and focusing on the difference in technology capabilities between ADS versus ADAS, in addition to informing the development of federal safety standards for ADAS and ADS.

High tech professional organization stakeholders noted that it was very important to distinguish between connected vehicles and ADS, since they do not function in the same ways and have different technical requirements.

3.0 Policy, Legal, and Regulatory Considerations for Vehicle Operations and ADS-Equipped Vehicles

The lack of federally focused regulations for ADS has arguably created uncertainty around some issues like liability for states allowing for the testing and deployment of ADS-equipped vehicles on public roads, in addition to questions about how states may need to update or adjust their traditional roles for governing operator licensing, vehicle registration, safety and emissions inspections, insurance requirements, crash reporting requirements, information sharing requirements, and enforcing traffic laws. Thinking through the opportunities and uses cases for ADS-equipped vehicles), including considering that for some ADS-equipped vehicles licensing may no longer be needed for anyone in the vehicles, these are areas where more emphasis on new statutes, regulations, and changes to existing roles and responsibilities are expected to be seen.

Through a lens considering how the existing policy, legal, and regulatory approaches to vehicles and vehicle operations may change with the deployment of ADS, this Section 3 of the report looks at existing roles and responsibilities around vehicles and vehicle operations on public roads, as well as how ADS-equipped vehicles might change those responsibilities. Like other mobility innovation-related issues right now, there may be some grey areas with ADS as legal concepts catch up to new innovative solutions that

[15] *AV Industry Statement on NHTSA's Planned Standing General Order Reporting*. (2022, June 8). Autonomous Vehicle Industry Association (AVIA). https://theavindustry.org/newsroom/press-releases/av-industry-statement-on-nhtsas-planned-standing-general-order-reporting

challenge existing regulatory and governance structures governing the transportation system. With this Section 3 analysis, the Section 4 recommendations are informed with what issues the NE States can prioritize to focus on and allocate resources towards.

3.1 What is the role of the federal government?

When getting into a vehicle, almost no one stops to think about how the vehicle is determined to be safe when it is first sold, and then how and when safety responsibilities may shift between the manufacturer, the government, the owner, and the driver of the vehicle. ADS-equipped vehicles have brought the issue of safety into the spotlight, including roles and responsibilities among federal, state, local, and industry entities around how to support the continued deployment and maturation of ADS technologies in vehicles.

National Highway Traffic Safety Administration (NHSTA)

NHTSA has federal jurisdiction over the safety of motor vehicles. NHTSA's federal authority over vehicle safety is recognized through its powers to: 1) issue letters of interpretation; 2) exempt motor vehicles from existing standards; 3) issue rulemakings to amend existing standards or create new standards; and, 4) exercise enforcement authority to address defects in vehicles that pose an unreasonable risk to safety[16].

In a 2013 Preliminary Statement of Policy Concerning ADS-equipped vehicles, NHTSA indicated that states are competent in regulating the testing, permitting, licensing, test-driver training, and operational conditions for ADS operation without analysis of the different Levels of Automation[17]. Versions of the Federal Automated Vehicles Policy have provided that existing roles and responsibilities of states around vehicles are expected to remain[18]. Accordingly, in the short term, NHTSA appears to take the position that states are well situated to address licensing, driver training, and conditions for ADS operations. While NHTSA has recommended testing principles in their Preliminary Statement, they do not expressly require any implementation before allowing for testing. In line with the approach taken in the 2013 NHTSA Preliminary Statement, states have not faced preemption in ADS testing. However, over the long term, NHTSA's Preliminary Statement implies that it can be expected to create safety regulations and standards for new ADS which will likely preempt state laws that are found to be in conflict with those federal regulations and standards established.

As additional background, NHTSA has authority to regulate two areas of safety standards: new vehicles and equipment, and after-market technologies and modifications to used vehicles. Broad statutory definitions give NHTSA extensive authority to issue safety standards for vehicles originally manufactured with ADS, and/or equipment that enables vehicle operations using ADS[19]. NHTSA can preempt state tort

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[16] *Understanding NHTSA's Regulatory Tools: Instructions, Practical Guidance, and Assistance for Entities Seeking to Employ NHTSA's Regulatory Tools*. (n.d.). NHTSA. https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/understanding_nhtsas_current_regulatory_tools-tag.pdf

[17] Autonomous Vehicles Team. (2014). *The Risks of Federal Preemption of State Autonomous Vehicle Regulations*. Technology Law and Policy Clinic, School of Law University of Washington. http://techpolicylab.uw.edu/wp-content/uploads/2014/12/UW-Law-Clinic-Research-Memo-to-the-ULC-The-Risks-of-Federal-Preemption-of-State-Regulations-of-Autonomous-Vehicles.pdf

[18] *USDOT Automated Vehicles Activities* | US Department of Transportation. (n.d.). https://www.transportation.gov/AV

[19] *NHTSA Statutory Authorities*. https://www.nhtsa.gov/laws-regulations/statutory-authorities

law "only" where that law conflicts with a "significant regulatory objective." However, given the reasoning of courts in leading cases[20], it is likely that courts will defer to NHTSA on when to exercise such preemption. The Supreme Court has turned to the NHTSA Safety Act of 1966 which provides an express preemption for federal agency regulative authority in the auto industry. But, of note is that the Supreme Court has also interpreted the Safety Act to say, "the absence of a regulation itself does not necessarily constitute regulations[21]." Based on such a finding and since Federal Motor Vehicle Safety Standards (FMVSS) have not been updated to accommodate ADS, an argument can be made that a state can enact its own safety standards for ADS-equipped vehicles until NHTSA acts. That being said, such safety standards will likely face a preemption challenge sooner or later based on NHTSA's recognized authority and may not be the best use of resources for a state.

The comments to the 2020 NHTSA ANPRM also address policy considerations around both the opportunity and implementation challenges for ADS and anticipated positive enhancements to mobility, especially when paired with electrification, connectivity, and shared mobility.

NHTSA has increased rulemaking activity around ADS over the past two years with the most notable being focused on establishment of an ADS safety framework[22]. With this 2020 Advanced Notice of Proposed Rulemaking ("ANPRM"), NHTSA seeks to move forward considerations through public comment for how NHTSA can use its authority over national vehicle safety to implement a safety framework specifically tailored to ADS, which can ultimately operate partially or completely without a human driver. NHTSA received over 700 comments on the ANPRM from a wide range of stakeholders, including automakers, software developers, trade associations, researchers, companies focused on ADS deployment, and state and local government agencies.

As the design and use cases for ADS continue to evolve, so do the considerations around safety and performance, which are traditionally within the jurisdiction of NHTSA. However, how that jurisdiction does or does not move into the built environment based on the policy considerations raised by comments will be interesting to track. This also dovetails with the comments focused on jurisdictional considerations for the regulation of vehicles and operation, particularly ADS where human operation is minimal or none at all.

Many of the comments from automakers to the 2020 ANPRM recommended that NHTSA work with industry stakeholders to develop a coordinated and consensus framework as the technology evolves and

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[20] *See Geier v. American Honda Motor Co., 529 U.S. 861 (2000); Williamson v. Mazda Motor of America, Inc., 562 U.S. ___ (2011).*
[21] Matthew Roth. (2020). *Regulating the Future: Autonomous Vehicles and the Role of Government*, 105 Iowa L. Rev. 1411. https://ilr.law.uiowa.edu/assets/Uploads/ILR-105-3-Roth-9.pdf, See Freightliner Corp. v. Myrick, 514 U.S. 280, 286 (1995).
[22] *U.S. Department of Transportation Seeks Public Comment on Automated Driving System Safety Principles* | NHTSA. (n.d.). [Text]. https://www.nhtsa.gov/press-releases/us-department-transportation-seeks-public-comment-automated-driving-system-safety

more data can inform intelligent rulemaking. There was general consensus that the federal government should be working closely with stakeholders in the private sector and with state and local governments to define what a safety framework should ultimately look like.

In June 2021, and subsequently amended in August 2021, NHTSA released a general order about mandatory crash reporting for SAE Level 2 ADAS and ADS equipped vehicles[23]. The order was released under NHSTA's authority under the Safety Act and aligns with NHTSA's interpretation that its authority is preventive, and NHTSA does not need to wait for injuries or deaths, but tries to identify safety defects before they occur. The information collected and shared under the general order is anticipated to assist states in evaluating the safety of ADS, but it will likely take time to standardize and interpret such data. The first summary of this reporting was released by NHTSA in June of 2022[24].

Federal Motor Carrier Safety Administration (FMCSA)

The FMCSA was created through the Motor Carrier Safety Improvement Act of 1999 and is a separate administration within the USDOT. The FMCSA's primary mission is to reduce crashes, injuries, and fatalities involving large trucks and buses. It creates standards for testing and licensing commercial motor vehicle drivers, collects data on and directs resources to motor carrier safety, operates a program to improve safety and remove high-risk carriers from the highways, coordinates research and development to improve the safety of motor carrier operations and commercial motor vehicles, provides financial assistance to states for roadside inspections, and helps develop unified motor carrier safety requirements for North America.

The FMCSA is responsible for regulating and providing safety oversight of commercial motor vehicles and has jurisdiction over commercial trucking companies, interstate bus companies, and commercial driver's license holders. The FMCSA has authority to determine that state laws on commercial vehicle safety are preempted.[25] This is because Motor Carrier Safety Act gives the Secretary of Transportation express power to preempt state law. A state law or regulation is on commercial motor vehicle safety if it "imposes requirements in an area of regulation that is already addressed by a regulation promulgated under § 31136." This can include a regulation about work hours and mandatory breaks for commercial motor vehicle drivers. The FMCSA's jurisdiction also relates to established federal jurisdiction around interstate commerce.

Accordingly, and similar to state considerations for seeking to implement regulations for ADS-equipped passenger vehicles, any state regulation should consider FMCSA jurisdiction and considerations around interstate commerce. As a part of USDOT, the FMCSA is also tracking and researching issues with ADS and motor carriers. The FMCSA is doing its own testing on rear radar, braking system, and sensor performance testing. Outside of testing, the FMCSA has published an advance notice of proposed

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[23] NHTSA. (2021). *Incident Reporting for Automated Driving Systems (ADS) and Level 2 Advanced Driver Assistance Systems (ADAS)* (Standing General Order 2021-01). NHTSA. https://www.nhtsa.gov/sites/nhtsa.gov/files/2021-08/First_Amended_SGO_2021_01_Final.pdf

[24] NHTSA. (2022). *Summary Report: Standing General Order on Crash Reporting for Automated Driving Systems* (DOT HS 813 324). https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-06/ADS-SGO-Report-June-2022.pdf#:~:text=Crashes%20involving%20an%20ADS%2Dequipped,report%20on%20July%2013%2C%202021

[25] *Intl. Bhd. of Teamsters, Loc. 2785 v. Fed. Motor Carrier Safety Administration*, 986 F.3d 841 (9th Cir. 2021)

rulemaking (ANPRM) about ADS and is reviewing comments received[26]. Current issues being looked at around highly automated commercial vehicles (HACV) include: driver seating; hours of service; vehicle markings; licensing; and balancing emerging technology with rulemaking. The agency is also considering a pilot program that allows temporary exemptions for HACVs and how information sharing requirements may need to change with ADS.

[26] *Safe Integration of Automated Driving Systems-Equipped Commercial Motor Vehicles*. (2019). Federal Motor Carrier Safety Administration. https://www.govinfo.gov/content/pkg/FR-2019-07-31/pdf/2019-16331.pdf

Congress and ADS-focused Legislation

There is also a possibility of future preemption in areas other than ADS safety via legislation from Congress. In 2017, the House passed the "SELFDRIVE" Act which had express preemption of federal safety regulation over the design, construction, and performance of ADS-equipped vehicles. The same year, the Senate considered the "AVSTART" Act which had a corresponding preemption provision focused on education and public safety, data and privacy, and a definitional hierarchy. With Congress also actively monitoring the progress of ADS-equipped vehicles, including through hearings, proposals around future roles and responsibilities can be expected, and states will need to be in a position to advocate for continued authorities around the operation of ADS.

3.2 What is the role of industry?

Commercially focused operations around ADS are materializing, including around the movement of commercial freight and goods, and on-demand passenger services. While standards are being worked on, updated, and adopted by industry, there are no federal safety regulations that have been adopted for ADS at this time.

What is role of industry in the safe deployment of ADS? This question is especially relevant as federal safety requirements are catching up to a maturing technology that offers the opportunity to transform the experience in vehicles – from passenger vehicles to transit to freight and local goods movement.

With the movement of goods, the existing jurisdiction of the FMCSA over interstate commerce is clear and the evaluation of ADS technologies being integrated into heavy commercial trucks appears less complicated than passenger vehicles. However, nuances are developing with the introduction of low-speed ADS-equipped purpose-built vehicles designed to operate on public roads and without any space for a driver[27].

While ADS-specific safety regulations are developed at the federal level, there is a collaborative opportunity that involves the public and private sector to better understand and mitigate ADS operational risks in the short term. As the private industry seeks a clear path to the full scale commercial deployment of ADS, state DOTs reasonably seek a clear understanding of ADS capabilities as operations are being approved or allowed on public roads. The research for this Project identifies that finding the right model for this collaboration in the short term will also benefit public trust and adoption for ADS.

[27] NHTSA Grant of Temporary Exemption to Nuro, Inc. for low-speed ADS-equipped vehicles. https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/nuro_grant_notice_final-unofficial.pdf

Industry organizations have been focused on the development of voluntary technical standards for ADS, including the Society of Automotive Engineers, the government's National Institute of Standards and Technology, and the International Organization for Standardization.

3.3 What are the roles of state and local governments for operating motor vehicles with a focus on New England region?

State governments are traditionally responsible for driver licensing, vehicle registration, titling, insurance requirements, safety and emissions inspections, traffic laws and enforcement, and crash reporting. With the increased deployment of ADS, states are interested in supporting the safe testing and deployment of ADS-equipped vehicles and confirming the roles and responsibilities of jurisdictions and the federal government[28].

Home Rule Considerations

Within New England, it is necessary to consider the concept of "home rule." Under home rule, a municipality may have authority to exercise powers of governance delegated to it by the legislature unless the state legislature passes laws to expressly deny that power. Generally, when a matter is of "state-wide concern," it is beyond the scope of home rule authority and should be decided by the state legislature rather than by the county or municipality. Whether a matter is of state-wide concern is left up to the discretion of the court reviewing a challenge to home rule authority. In the context of ADS, if a court decides roadway safety in association with ADS is a matter of state-wide concern, then state authority to regulate ADS likely exists, but if it is not a matter of state-wide concern, a home rule municipality could create ordinances to regulate ADS in that municipality. A state's constitution may also grant powers associated with home rule and should be looked at with any analysis. The issue of home rule will be an important consideration for the NE States as they consider what level of coordination at the local level will be warranted for ADS testing and deployment.

How should existing reciprocities around the operation of motor vehicles be considered?

The primary source of reciprocity is Article IV, § 1 of the United States Constitution, which is commonly called the "full faith and credit clause." This clause requires each state to recognize the public acts, records, and judicial proceedings of other states in areas where states exercise state level jurisdiction. For instance, this clause requires each state to recognize the public acts and legal judgments of other states. In the context of vehicle operations, the public act of granting a license or registration by one state should be recognized by all the other states. This is known as the doctrine of reciprocity.

[28] American Association of Motor Vehicle Administrators - AAMVA. (2020). *Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, Edition 2.* American Association of Motor Vehicle Administrators. https://www.aamva.org/assets/best-practices-guidance/guidelines-for-testing-drivers-in-vehicles-with-ad

While there are many exceptions to this rule based on decisions of federal courts (e.g., marriage), this framework provides context for the prevailing view that licenses and registrations issued by one state will be recognized in all other states.

To memorialize the basis of reciprocity, states often enter into legal agreements referred to as compacts. Compacts are sanctioned by the U.S. Constitution (see Article I, § 10, Clause 3) and are frequently used to regulate relationships between states. Compacts must be approved by Congress and can only be dissolved by an act of Congress.

Since 1960, there has been a **Driver License Compact**, which obligates signatory states to report motor vehicle infractions to the home state of the vehicle operator. However, this compact does not obligate signatory states to recognize the driving privileges of the citizens of other signatory states. Of the NE States, only Massachusetts is not a signatory. However, Massachusetts passed legislation enabling the state to enter into the compact, but has not yet joined the compact[29].

There is also a **Multistate Reciprocity Agreement**, which governs vehicles that are used in interstate travel (e.g., charter buses). This compact allows interstate travel vehicles to operate in any of the signatory states without paying additional registration fees. None of the New England States is a signatory to this compact. While no New England states are signatories to this compact, it serves as an example of how differing rules in neighboring states (New York, in this case) can cause disharmony in the context of interstate travel.

Perhaps the most relevant compact to this research is the **Drivers License Agreement**, which obligates, among other things, signatory states to honor licenses issued by other member states. This agreement came into force in 2002, with the first state to become a signatory. Connecticut and Massachusetts are both signatories.

Applying this background to the context of ADS operations, the use of an interstate compact could be the basis of coordinating state laws pertaining to the operation of ADS-equipped vehicles throughout the New England states.

Existing Statutory and Regulatory Environment for Vehicles

Before examining ADS-specific laws and regulations, it is helpful to examine the current statutory and regulatory framework for motor vehicle operations across the six NE states. As part of such analysis, this section also analyzes potential future scenarios for registration and operation in an ADS environment, with special emphasis on the potential to coordinate the statutory and regulatory landscape across the New England region. Finally, it surveys considerations for regional and national consideration as ADS become more prevalent. For a review of state level ADS legislation outside of New England that guided these considerations, refer to Appendix D – State Level ADS Legislation Outside of New England.

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[29] American Association of Motor Vehicle Administrators. *Driver License Compact, Non-Resident Violator Compact, Member Joinder Dates.* accessed January 9, 2020. https://www.aamva.org/getmedia/6baff2c2-4a63-49f3-8338-cdfb5b968f9b/Driver-License-Compact-Non-Resident-Violator.pdf

Also complementing this analysis is Appendix E – Key Considerations for ADS Regional Coordination, which is a working review addressing specific vehicle operational questions and future-forward coordination considerations that guided the analysis in Section 3 and development of Section 4 Recommendations.

Driver's Licenses

Driver's licenses are issued by each state and authorize the licensee to operate a motor vehicle, within the limits established by statute in each state. The requirements for licensing vary by state, to include such matters as residency, age, and testing (see Table 1). However, the essential premise of a state-level licensing regime is focused on authorizing a natural person to operate a motor vehicle on public roads and ensuring an understanding of requirements for the safe operation of a vehicle.

Table 1: NE States' Driver Licensing Requirements for Vehicle Operation

	Statutory References	Vehicle Operator Licensing
CT	C.G.S 246A, Sec. 14-36	Citizenship and residency required; license issued to a natural person; minimum age of 16
ME	29-A MRSA§1751	Citizenship and residency required; minimum age of 16
MA	MGL c.90 Sec. 7A; MGL c.90 Sec. 8	Citizenship and residency required; minimum age of 16.5
NH	RSA 263:5-e; RSA 263:14	Citizenship and residency required; minimum age of 16
RI	RI Gen L § 31-10-1; RI Gen L § 31-10-3	Citizenship and residency required; minimum age of 16
VT	23 V.S.A. § 601; 23 V.S.A. § 607	Citizenship and residency required; minimum age of 16

What are the ADS considerations for the NE States' for drivers licenses?

National context: In the ADS focused statutes reviewed outside of the NE states, "driver" or "operator" are defined generally as a licensed person who has control of a vehicle, or a person who causes an ADS to engage. More specific examples include Texas defining human operator and ADS separately to be explicit about who is controlling the vehicle. Florida and Utah also define a remote human operator/driver as a person who has control over a vehicle that they are not physically present in. Several states also require the operator or driver of an ADS to have a valid driver's license. Though there is some variation in the definitions, most states have or are in the process of accommodating legislation to include "control of an ADS-equipped vehicle or ADS" under the definition of operator and driver.

ADS Implications: In an ADS future with driverless vehicle operations, the role of a natural person may in some cases be relegated to simply being a passenger. However, not all ADS-equipped vehicles will be driverless, nor will all driverless vehicles be driverless all the time.

- *ADS-equipped vehicles with a Level 3 ADS or "conditional driving automation" system* will require a dynamic driving task fallback-ready user (a licensed driver) who is receptive to ADS-issued requests to intervene, as well as to dynamic driving task performance-relevant system failures in other vehicle systems, and will respond appropriately.
- *ADS-equipped vehicles with a Level 4 ADS or "high driving automation" system* do not require a fallback-ready user (licensed driver) to perform dynamic driving task fallback, but these ADS-equipped vehicles are limited to operate only in specific operational design domains (ODD) and would require a licensed driver to operate these vehicles outside its ODD.
- *ADS equipped vehicles with a Level 5 ADS or "full driving automation" system* do not require a fallback-ready user (licensed driver) to perform dynamic driving task fallback, and these ADS-equipped vehicles are not limited to operate only within specific ODDs, meaning a licensed driver would never be required. That said, vehicles equipped with a Level 5 ADS are likely several generations away, if they ever get developed at all.

The varying deployment scenarios ahead for ADS-equipped vehicles, and whether they may necessitate a licensed driver or operator or not, present a dilemma for states as they consider how or if they should regulate "operators" of motor vehicles in an ADS environment. The likely scenario is that for dual-mode vehicle operations, existing driver licensing requirements issued by states will continue. However, if the regulation of ADS technology ultimately becomes a federal responsibility pursuant to the Commerce Clause (see Article 1, § 8, Clause 3) and FMVSS (See 49 CFR 571), as enforced by NHTSA, the role of the state in the licensing of motor vehicle operations, particularly for Level 4 and Level 5 ADS, may be a relic of the past. Also, the elimination of licensing requirement for an "operator" of a driverless vehicle (whether a dual-mode vehicle or an ADS-dedicated vehicle) also makes sense when considering the positive social benefits of allowing access to additional mobility options for those with disabilities, including those who are blind and not able to obtain licenses under the current licensing regime.

New England Considerations: The following are considerations for the NE States around driver licensing requirements in consideration of ADS in vehicles:

- Consideration should be given to modifying state statutes and/or regulations to reflect that a driver can be either a natural person or a non-natural person, and that age requirements are not applicable to non-natural persons.
- Consideration should be given to modifying state statutes and/or regulations to reflect that a prospective operator who is a non-natural person does not need to present a birth certificate to be eligible for a driver's license.
- Consideration should be given to modifying state statutes and/or regulations to reflect that a prospective operator who is a non-natural person does not need to take a qualifying exam, but rather needs to be approved based on testing and evaluation data. The requirements around such a qualification may be preempted by future NHTSA action.
- Consideration should be given to modifying state statutes and/or regulations to reflect an alternative driver's license format for ADS, including potential user expectations around systems operations.

Motor Vehicle Registrations

Each state registers motor vehicles for the purpose of protecting the health, safety, and welfare of its citizens. However, each state has a different approach to the public act of registering motor vehicles for operation on public roads. In the context of a private consumer registering a motor vehicle, there are differences from state to state as shown in Table 2.

Table 2: Ownership and Residency Requirements for Registration within NE States

	Statutory References	Registration and Titling
CT	C.G.S 246, Sec. 14-12a; C.G.S 246, Sec. 14-12	Identity of owner and owner residency required; required as part of a sale and for all ownership
ME	29-A MRSA§351; 29-A MRSA§406	Identity of owner and owner residency required; required as part of a sale and for all ownership
MA	MGL c.90 Sec. 2	Identity of owner and owner residency required; required as part of a sale and for all ownership
NH	RSA 261:45; RSA 261:32	Identity of owner required; owner residency is not required; required as part of a sale and for all ownership
RI	RI Gen L § 31-3-3; RI Gen L § 31-3-4	Identity of owner and owner residency required; required as part of a sale and for all ownership
VT	23 V.S.A. § 301; 23 V.S.A. § 321	Identity of owner and owner residency required; required as part of a sale and for all ownership

What are the ADS considerations for the NE States for motor vehicle registrations?

National context: In states where ADS-equipped vehicles are not mentioned in licensing and registration statutes, the general vehicle registration and licensing laws are followed. These laws usually require clearly displaying registration plates and having a valid driver's license. The states that have express licensing and registration laws for ADS-equipped vehicles have different procedures for how an ADS equipped vehicle should obtain a license or registration. These include requiring state departments of motor vehicles to approve testing.

ADS Implications: The issue of vehicle registration is expected to continue to be a state issue no matter what level of automation. States will want to know how many vehicles are operating in their states for planning and asset allocation purposes. However, the issue of registration may be impacted by how ADS-equipped vehicles are utilized. Will vehicles continue to be personally owned or will operations be more focused on subscription and fleet models? What classification category should purpose-built vehicles fall into when they are designed to not have any drivers or operators in the vehicles, but still use public roads? Regardless of ADS use case, states requiring vehicles equipped with an ADS to be registered as an "ADS-equipped vehicle" would enable more opportunities within states and across states for identifying ADS-equipped vehicles operating on public roadways. This in turn could be foundational for helping aid law enforcement responding to incidents involving ADS-equipped vehicles; could help better ensure more complete information or fields be included or standardized on crash report forms to accommodate ADS-operated vehicles; and could ultimately aid in the overall information sharing possibilities of ADS-equipped vehicles within and across states, including with NHTSA to improve the reporting received via the Standing General Order for ADS crash reporting.

New England Considerations:

Aligning vehicle registration processes and requirements across the New England states will ensure that vehicles operating in multiple states and across state lines are adhering to the same standards, thus increasing or improving possibilities for information sharing, and ultimately helping the NE states achieve the region's vision for seamless ADS operations. For instance, if the registration regulations in one state require an ADS-equipped vehicle to be equipped with an on-board processor that has been independently tested and validated while a neighboring state does not, there will be a clear regulatory barrier to multi-state use of ADS. As noted throughout this report, it will be important to balance such potential requirements with NHTSA's existing jurisdiction around vehicle safety. Further, with the freight context, it will be important to consider the jurisdiction of the federal government around interstate commerce. The fees generated from vehicle registrations will also be a consideration. Finally, any vehicle registration process also needs to be nimble enough to account for evolving capabilities of ADS-equipped vehicles, including over the air updates. State regulators collaborating with industry and law enforcement for updating the vehicle registration process is essential for success.

Insurance Requirements

All the NE States except New Hampshire currently have proof of insurance requirements. Moreover, the amount of required insurance varies from state to state. This environment leads to inconsistent laws from state to state, with implications for multi-state travel. For instance, with different amounts of insurance required from state to state, a motor vehicle registered in one state that is involved in a crash in another state may cause financial hardship due to a lesser amount of insurance (see Table 3).

Table 3: Insurance Requirements for Registration within the NE States

	Statutory References	Insurance Requirements for Registration
CT	CGS §§ 38a-334 to 38a-343; Sec. 38a-372-1	Proof of insurance must be presented. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $25,000 for property damage, and $25,000 / $50,000 per accident for uninsured motorist bodily injury coverage.
ME	29-A MRS Sec. 1605; 29-A MRS Sec. 402	Evidence of insurance required for registration. Minimum requirements: $50,000 / $100,000 per accident for bodily injury, and $25,000 for property damage. Combined single limit of $125,000 is also acceptable.
MA	MGL c.90, Sec 1A; MGL c.175, Sec 113A	Insurance stamp required on application for registration (or electronic equivalent). Minimum requirements: $20,000 / $40,000 bodily injury liability coverage, $5,000 property damage coverage, $20,000 / $40,000 uninsured motorist bodily injury coverage, and $8,000 personal injury protection.
NH	N/A	Insurance is not required; no minimum requirement

	Statutory References	Insurance Requirements for Registration
RI	RI Gen L § 31-32-19; RI Gen L § 31-32-24	Proof of insurance must be presented. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $25,000 for property damage, and $25,000 / $50,000 per accident for uninsured motorist bodily injury coverage.
VT	23 V.S.A. § 800	Self-certification that registrant meets insurance requirements. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $10,000 for property damage liability coverage, and $50,000 / $100,000 per accident for uninsured motorist bodily injury coverage.

What are the ADS considerations for the NE States for insurance requirements?

National Context: The issue of insurance continues to be a high-ranking consideration for the deployment of ADS-equipped vehicles. Generally, most states around the country (including some of the NE states) that legislatively allow ADS-equipped vehicle operations on public roadways in some way (even just for testing) often have a $5 million insurance minimum requirement for ADS-equipped vehicles (see Appendix D – State Level ADS Legislation Outside of New England for more details). Presently, insurance minimums applicable to ADS-equipped vehicles around the country range from whatever existing minimums there are in each state for conventional motor vehicles (e.g. $25,000 / $50,000 per accident for bodily injury, $25,000 for property damage $25k-$50k) to as high as $10 million in at least one state, with several states requiring $5 million for damages by reason of bodily injury, death, or property damage caused by an ADS-equipped vehicle. One of the stakeholders interviewed as part of this report points out that the USDOT sets a statistical value of human life at $11.6 million for 2020, with yearly increases[30]. This stakeholder contends that such an amount should be taken into consideration when setting minimum insurance minimum requirements, which should be per person, not per incident based.

ADS Implications: As more ADS-equipped vehicles deploy onto public roads, finding the right balance for insurance is important. Considerations around insurance for ADS-equipped vehicles may involve a variety of factors, including but not limited to the type of ADS use case or intended use of the ADS-equipped vehicle, the vehicle class or size and weight of the ADS-equipped vehicle, the responsibility or potential level of automation and potential human role in driving operations, whether the vehicle is an ADS-dedicated vehicle or dual-purpose vehicle, whether or not self-insurance and surety bonds should be permitted as a form of insurance and if so for whom. Further, there is a danger of inadvertently imposing insurance requirements that are too low or limited to not ensure a duty of care for the safety of all users (especially vulnerable users) operating on public roadways, especially in the nearer term as the technology for ADS-equipped vehicles is still relatively new and in development. From a regional

[30] Koopman, P., & Widen, W. H. (2022, February 1). *Five Principles for Regulation of Highly Automated Vehicles. Safe Autonomy*. https://safeautonomy.blogspot.com/2022/02/five-principles-for-regulation-of.html

deployment perspective there is also a risk of inadvertently imposing insurance requirements that are too high that may deter industry from deploying ADS-equipped vehicles in the New England region, especially in the nearer-term.

New England Considerations: The importance of consistent and uniform insurance requirements can be highlighted by discussing the type of insurance to be required on an ADS-equipped vehicle with consideration of its proposed use. During the early stage of deployment of ADS, there is also potential for risk-sharing models between the public and private sector such as approaches known as owner-controlled insurance program or contractor controlled insurance program which have both sides contributing towards insurance coverage. If each state legislature takes its own approach, the lack of harmony creates the same issues as the current automobile insurance regime in New England.

Safety and Emission Inspection Requirements

Each NE State has some safety and emissions inspection requirements, but they vary (see Table 4). Only Connecticut does not require safety inspections; all other states require annual or biennial safety inspections. Emissions tests vary from state to state along the lines of the age of the vehicle to be inspected.

Table 4: NE States' Safety and Emissions Inspection Requirements by State

	Statutory References	Safety and Emissions Inspection Requirements
CT	C.G.S 246A, Sec. 14-164c	Safety inspection only required for certain vehicles. Most passenger vehicles exempt. Emissions test biennially. Exemptions for vehicles less than 4 years old and more than 25 years old
ME	29-A MRSA§1751	Safety inspection is required once a year; vehicles registered in Cumberland County require an emissions test.
MA	MGL c.90 Sec. 7A	Safety inspection is required once a year; vehicles under 15 years old require an emissions test.
NH	RSA 21-P:14, V(a); RSA 266:59-b IV; CHAPTER Saf-C 3200	Safety inspection is required once a year; vehicles under 20 years old require an emissions test.
RI	RI Gen L § 31-38-3; 280-30-15 R.I. Code R. § 3.3	Safety inspection is required biennially; emissions test is required biennially.
VT	23 V.S.A. § 1222	Safety inspection is required once a year; emissions test is required once a year.

What are the ADS considerations for the NE States for safety and emissions inspections?

National context: Currently, most states with ADS operations require manufacturers of ADS-equipped vehicles to self-certify and comply with federal laws and FMVSS (this is consistent with model legislation from the Autonomous Vehicle Industry Association, formerly known as the Self-Driving Coalition for Safer Streets). Generally, the ADS statutes of other states allow manufacturers to obtain an exemption in lieu of FMVSS compliance. A couple of states have put together task forces to research ADS and determine safety standards to recommend to lawmakers.

In the case of the NE States, there is variation in how to address safety in the context of ADS-equipped vehicles. Some states require a safety certification prior to testing or using the vehicle. The safety certification programs vary, with some requiring that FMVSS compliance and others requiring a more in-depth plan.

One popular national trend is requiring a plan for interaction with emergency responders, also known as law enforcement interaction plan. However, plans vary greatly with one state requiring that different municipalities must preapprove testing, another state requiring geographic boundaries, and another adding the USDOT's voluntary safety self-assessment. The variation in safety requirements indicates that each state is approaching safety verification differently in the absence of federal safety standards.

ADS Implications: Looking forward, safety inspections are already evolving with the integration of electric vehicles into the fleet since electric vehicles do not require emissions inspections. Whether or not states will continue to see a need to inspect vehicles that are electric (no longer emissions concerns) or have ADS, or rely more on the verifications of manufacturers and regulations by NHTSA as part of the safety verification process, will be an important consideration moving forward. States may still want to confirm a vehicle has the most up to date software with knowledge of all existing traffic laws within a state, but that will likely require investment in new equipment and workforce training. Further, whether or not this conflicts with NHTSA jurisdiction remains an untested legal issue.

New England Considerations: The need for consistent safety inspection regulations from state to state reflects different policy preferences on the part of each state. As ADS technology advances, some states are likely to have greater hesitancy in trusting the technology than others. Given the technical complexity of ADS-equipped vehicles, a patchwork approach will cause great challenges for manufacturers trying to field vehicles that meet standards for the NE States, as well as the rest of the United States and the world. Accordingly, this issue warrants investment in public / private coordination and cooperation. This is anticipated to become less of an issue as federal ADS safety standards are adopted and more safety data is collected and evaluated from ADS operations.

Commercial Vehicle and Fleet Considerations

The registration regime becomes more complex when registering a commercial vehicle. Commercial vehicles, which may be operated by private persons or by corporations as part of a commercial fleet on an intrastate basis, have a different set of regulations to satisfy (see Table 5). For instance, the FMCSA may have concurrent jurisdiction over the vehicle and may require the owner to obtain a USDOT number. In addition, commercial vehicles require business insurance and distinctive commercial plates.

Table 5: Insurance Requirements for Commercial Registration within NE States

	Statutory References	Insurance Requirements for Commercial Registration
CT	CGS §§ 38a-334 to 38a-343; Sec. 38a-372-1	Proof of insurance must be presented. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $25,000 for property damage, and $25,000 / $50,000 per accident for uninsured motorist bodily injury coverage.
ME	29-A MRS Sec. 1605; 29-A MRS Sec. 402	Evidence of insurance required for registration. Minimum requirements: $50,000 / $100,000 per accident for bodily injury, and $25,000 for property damage. Combined single limit of $125,000 is also acceptable.
MA	MGL c.90, Sec 1A; MGL c.175, Sec 113A	Insurance stamp required on application for registration (or electronic equivalent). Minimum requirements: $20,000 / $40,000 bodily injury liability coverage, $5,000 property damage coverage, $20,000 / $40,000 uninsured motorist bodily injury coverage, and $8,000 personal injury protection.
NH	N/A	Insurance is not required; no minimum requirement.
RI	RI Gen L § 31-32-19; RI Gen L § 31-32-24	Proof of insurance must be presented. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $25,000 for property damage, and $25,000 / $50,000 per accident for uninsured motorist bodily injury coverage.
VT	23 V.S.A. § 800	Self-certification that registrant meets insurance requirements. Minimum requirements: $25,000 / $50,000 per accident for bodily injury, $10,000 for property damage liability coverage, and $50,000 / $100,000 per accident for uninsured motorist bodily injury coverage.

What are the ADS considerations for the NE States for commercial vehicle and fleet considerations?

National context: Fleet vehicles providing on-demand passenger services and goods delivery present interesting oversight considerations in the ADS context. Fleet vehicles operating in interstate commerce are regulated by the International Registration Plan (IRP). The IRP is an interstate agreement providing for registration reciprocity among member jurisdictions across the U.S. and Canada. The IRP requires that only a license plate and cab card are issued for each vehicle in a fleet by the base jurisdiction. However, the IRP provides for the payment of apportioned registration fees based on the proportion of miles driven in all jurisdictions by the vehicle fleet.

A fleet vehicle subject to the IRP may be operated both between member jurisdictions and within any single jurisdiction where it is registered. The IRP applies to a wide range of commercial fleets, including moving companies (U-Haul), parcel companies (FedEx), and passenger buses (Greyhound). Notably, it also applies to rental car companies. All New England states are member jurisdictions of the IRP.

ADS Implications: Consideration of commercial and fleet registration regimes is important to formulating approaches to the registration of ADS-equipped vehicles. This is because it is widely anticipated that many ADS-equipped vehicles may operate as part of large fleets of commercially owned vehicles providing on-demand ridehailing or goods movement. While the prospect of individual private ownership certainly exists in the long-term, in the short-term and medium-term, it is much more likely that freight, mobility on demand, or shared mobility will be the dominant near term models for the use of ADS-equipped vehicles. While several factors may contribute towards why certain ADS use cases like freight, mobility on demand, or shared use mobility may outpace individual private ownership and other ADS use cases to market, the main drivers for predicting market readiness come down to the business case, the complexity of the use case, and whether or not or when the status or trajectory of ADS technologies is capable of meeting both.

New England Considerations: Commercial and fleet registration regimes may present a useful approach to considering how ADS-equipped vehicles are regulated and registered. A fleet registration approach offers the potential additional benefit of using the IRP framework (or a similar compact) to manage such matters as safety inspections, crash reporting, and insurance requirements. Coordinating fleet regulations across the NE states in such a manner provides a potential means of targeting the largest share of ADS-equipped vehicles without states relinquishing significant sovereignty over the registration process for the average citizen. Moreover, regulations governing TNC's may also provide a regulatory vehicle for ADS operations covering on-demand ridehailing.

Crash Reporting

The crash reporting laws, regulations, and policies of the six New England states represent another area of opportunity where more coordination and harmonization between or among the states is needed to improve roadway transportation safety and to better prepare for and achieve the NE States' vision for seamless ADS operations across the region and beyond. Table 6 below references the existing minimum legal or statutory requirements for crash reporting in each NE State.

Today, while basic statutory similarities exist between the NE States that require the completion of crash reports for roadway traffic crashes resulting in fatality, injury, or property damage, nuanced statutory differences between or among the states' approaches towards crash reporting does exist. For example, all NE states except Vermont maintain a minimum statutory threshold of $1,000 in property damage to trigger crash reporting requirements (Vermont has a $3,000 statutory threshold). Also, all NE states except Connecticut put the statutory responsibility on the driver, operator, or owner of the motor vehicle(s) involved in the crash to report to authorities to complete and submit required crash report(s). Connecticut statutes put the responsibility for crash report completion squarely on the investigating law enforcement officer (if any) and remain silent on whether the driver, operator, or owner involved in a crash needs to contact law enforcement, regulators, or other parties involved in a crash. In addition, all NE States except Maine statutorily require crash reports get submitted to a state transportation agency (Department of

Transportation, Department of Motor Vehicles, Registry of Motor Vehicles, etc.) to manage and maintain the crash report records. Maine law requires the state police to receive and maintain crash report records. Beyond the statutory differences, other policy or practice differences between the NE states also exist including differences in some of the data elements and attributes collected on the required crash reports as well as the percentage of alignment each state has towards following national standards and best practices for documenting crashes and completing crash reports.

Table 6: Crash Reporting

	Statutory References	Crash Reporting
CT	C.G.S 246, Sec. 14-108a	Law enforcement must complete a uniform crash report for any investigated crash causing death or injury, or in which damage to the property of any one individual, including the operator, in excess of $1,000, is sustained. Law enforcement must submit a copy of the uniform crash report to the Commissioner of Transportation within five (5) days of completing the investigation.
ME	29-A MRSA§2251	Must report when the crash is unintentional, occurs on a public way, with bodily injury or death to a person or apparent property damage of $1,000 or more. Reported to State Police, or Sheriff or Deputy Sheriff of location of accident, or to police in the municipality of the accident.
MA	MGL c.90 Sec. 26	Must report any crash causing death, personal injury, or combined vehicle/property damage in excess of $1,000. Reported to Registry of Motor Vehicles and police department having jurisdiction.
NH	RSA 264:25	Must report any crash causing death, personal injury, or combined vehicle/property damage in excess of $1,000. Reported to Department of Motor Vehicles and local police.
RI	RI Gen L § 31-26-6	Must report any crash causing death, personal injury, or combined vehicle/property damage in excess of $1,000. Reported to Department of Motor Vehicles.
VT	23 V.S.A. § 1129	Must report any crash resulting in injury or total property damage of at least $3,000. Reported to Department of Motor Vehicles.

What are the ADS considerations for the NE States around crash reporting?

National context: According to NHTSA[31], a "crash" means "any physical impact between a vehicle and another road user (vehicle, pedestrian, cyclist, etc.) or property that results or allegedly results in any property damage, injury, or fatality." Two noteworthy components about this definition are that (1) unlike most states, NHTSA does not include a minimum property damage threshold for what constitutes a property damage crash leaving it open to any collision being defined as a crash and thus potentially reportable, and (2) NHTSA expressly includes the term "allegedly" within its crash definition to more broadly include a subject vehicle's contribution (i.e. steering, braking, acceleration, or other operational performance) to another vehicle's physical impact with another road user or property.

[31] NHTSA Incident Reporting for ADS. https://www.nhtsa.gov/sites/nhtsa.gov/files/2021-08/First_Amended_SGO_2021_01_Final.pdf

In many jurisdictions across New England and across the country, crash reports or summaries of crash reports are considered public record and can be made available to others upon request or by completing a public records request. Crash reports are commonly used by insurance companies to further investigate, negotiate, and settle insurance claims. Crash reports may also be used in court cases, subject to rules of evidence. Whether a crash report is admissible or not in court, copies of crash reports do often in every state get submitted to the state's transportation agency responsible for managing the state transportation system and overseeing transportation safety. The crash reports provide statistics for the state transportation agencies to make informed transportation safety decisions and develop transportation safety plans, including federally required transportation safety plans to address identified transportation safety problems.

The ANSI D16 is the American National Standard which identifies, defines, and classifies the specific terminology associated with motor vehicle traffic crashes. Additionally, Model Minimum Uniform Crash Criteria (MMUCC) guidelines cooperatively developed and updated by NHTSA, the Governor's Highway Safety Association, states, and other safety advocates identify a voluntary minimum set of motor vehicle crash data elements and their attributes that states should consider collecting and including in their crash reports and in their state crash data system. The MMUCC conveys the minimum data elements using terminology from the ANSI D16 that a state's crash report form should have on it for nationally common data collection.

Refinement of the MMUCC guidelines are ongoing. As presented by NHTSA in August 2021, overall national alignment to MMUCC is just under 50%, with individual state alignment to MMUCC ranging from 21% - 83%. To increase individual state and national alignment for the next edition of MMUCC (6th Edition that NHTSA expects will get published in 2024), NHTSA will be conducting a comprehensive evaluation of the MMUCC program that will include:

- Developing and conducting a study on the feasibility of the MMUCC data elements and attributes
- Addressing opportunities for improvement discovered through the study
- Identifying opportunities to better align with what (and how) states are collecting data
- Identifying if there is a need for standardized training

The process NHTSA is taking to hear from states and other stakeholders to improve the 6th MMUCC Edition and increase national alignment towards MMUCC creates a great opportunity for states, including the NE states, to get engaged with NHTSA and play a proactive role towards shaping the future of crash reporting standards and best practices across the country, which will include better crash reporting standards and guidelines for ADS-equipped vehicle related crashes. Presently, the current version (5th Edition) of MMUCC that was published in 2017 recommends states include on their crash report form a dynamic element for ADAS and ADS that includes three attributes: (1) whether there is an "Automation System or Systems in Vehicle" (e.g. ADAS, ADS), (2) specifically what "Automation System Levels in Vehicle" (SAE Levels 1-5), and (3) what "Automation Systems Levels Engaged at Time of Crash."

According to NHTSA, in August 2021, only 4.4% of States are completely or partially aligned with the MMUCC 5 dynamic element for ADAS and ADS on state crash reports. Various improvements and refinements to the dynamic ADAS and ADS element and attributes are being considered as part of the MMUCC 6 update. Ultimately, whatever gets included for ADAS and ADS in MMUCC 6 should also be

coordinated with efforts in states to update ADAS and ADS information as part of vehicle registration and renewals so that a baseline of ADAS and ADS information gets shared with investigating law enforcement and insurance upon crash to assist law enforcement with understanding how to properly investigate or respond to ADAS-equipped and ADS-equipped vehicle crashes.

Further, with NHTSA's Standing General Order for incident reporting for ADS, NHTSA obtains notification of real-world crashes associated with ADS and Level 2 ADAS vehicles from manufacturers and operators. NHTSA anticipates using this information to investigate crashes that raise safety concerns about ADS and Level 2 ADAS technologies. NHTSA will also be able to use this information to determine whether any enforcement actions, including recalls, are warranted. Prior to the implementation of the Standing General Order, NHTSA's sources of timely crash notifications related to ADS were limited and generally inconsistent.

Outside of New England and within the context of law enforcement coordination around ADS, most states that permit ADS operations on public roadways (even if just for testing) have laws that require ADS operators to coordinate with local law enforcement but prohibit local government and political subdivisions from regulating ADS. There is some variation with some states requiring interaction with law enforcement in the case of a crash and others requiring a law enforcement interaction plan prior to testing. In New England, many states require ADS-equipped vehicles to comply with traffic and motor vehicle safety laws and have first responder interaction plans. Also, there are not preemptive laws prohibiting regulation of ADS by local governments at this time.

ADS Implications: In the ADS context, due to the novelty and potential of the technology, there is significant public interest and attention being paid to the safety of ADS-equipped vehicles. As a result, there is a strong desire among state and local governments that allow testing and deployment of ADS-equipped vehicles on public roads and among federal safety regulators to closely track vehicle performance to identify any technological glitches and patterns of malfunction. However, getting significant access to ADS data is very complicated, oftentimes requiring non-disclosure agreements or not being accessible given concerns that ADS manufacturers and providers have around proprietary information and the context of such reporting from an investment and consumer trust perspective.

There are also several policy considerations at stake. Should crash reporting for ADS-equipped vehicles require automatic reporting, capitalizing on the inherent technology in use? Should these reports be protected as confidential to prevent unfair competitive advantages and disadvantages? How does such information impact insurance rates and coverage? This is an issue that will require continued evaluation and tracking, especially with NHTSA now requesting incident reporting through its standing general order.

The greatest consideration for consistent and uniform data requirements is the potential for the use of crash data in automatic reporting and the potential for that data to be shared across state jurisdictions. If automatic reporting becomes mandatory, manufacturers will want one standard to be built into the vehicle, rather than the standards of six individual states, or 50 states. This creates another opportunity for NHTSA and states to consider as part of the next and future MMUCC updates.

New England Considerations: The NE States have the opportunity to align new laws, regulations, policies, and practices in each state to address the complex nature of the crash records question around

ADS operation and across modes and use cases. This includes the important considerations in balancing the public interest in disclosing safety information versus protecting confidential and proprietary information related to vehicle systems. Ensuring greater consistency of ADS information and updating fields included on crash reports across the NE states, and nationally, will ultimately ensure better and more consistent data for ADS-related crashes, which will help NHTSA, states and industry improve ADS safety. Any broadly sharable data will likely need to be aggregated to a prescribed level to ameliorate proprietary and privacy concerns as is being done for geo-location data collected from cell phones that is used for transportation planning.

Additional issues that need to be considered from a policy, legal and regulatory perspective for ADS-Equipped Vehicles?

Development and Enforcement of Traffic Laws

As enforcement via digital means, including cameras and license plate readers, is anticipated to grow, particularly to address complicated issues like curb management, it will be necessary to make sure existing laws allow for the issuance of violations via electronic and likely paperless means.

The development and enforcement of traffic laws is an area of ADS operations that holds a lot of promise, and yet has been elusive to date. Many involved in the policymaking domain have suggested that ADS-equipped vehicles will be pre-programmed to follow motor vehicle laws to a fault. In contrast, other policy makers wonder how motor vehicle laws will be enforced if there is no operator to recognize that the ADS-equipped vehicle has been signaled to stop for a violation. These two lines of thought reflect divergent views on the challenges of ADS-equipped vehicles and traffic enforcement.

Traffic enforcement against ADS-equipped vehicles may be challenging and training for law enforcement will be needed given there may be no “operator” to pull the vehicle over and issue a citation against. As an example of how such a scenario may play out, will a law enforcement officer be able to put an electronic “hold” on the ADS until the traffic stop is completed? Addressing this scenario likely involves a combination of technology and a new motor vehicle citation regime. State administrative agencies will need to adopt regulations to administer these new enforcement regimes. Further, NHTSA will likely need to adopt federal regulations pursuant to its FMVSS authority to mandate uniform technological systems for these approaches.

The issuing of the citation is less technologically difficult. If the cognizant authorities in the home state have adopted a definition of operator that includes ADS as operators, the law enforcement officer can issue the citation electronically and release the “hold” on the ADS-equipped vehicle. These citations would be transmitted electronically to the cognizant authorities, and the owner of the vehicle would be informed of the violation and directed to pay the fine.

Over the long-term, there may be considerations around whether traffic speeds are nationalized to allow for easier programming of ADS-equipped vehicles. However, such an approach would likely receive considerable objections.

Information Sharing

Few states outside of New England have data and privacy laws, however the number is expected to grow, and some states have legislation about the data storage and sharing capacities of ADS-equipped vehicles. A few states require information sharing in the event of a crash. One state notes ADS-equipped vehicles store collision data and the state specifies how that data should be stored. Some states have laws requiring disclosure to a consumer about the information being collected. Other states have laws specific to the collection of biometric data, which applies to ADS-equipped vehicles that use facial scans and similar techniques to collect data. Notably, California, Virginia, and Colorado all have privacy laws that include biometric indicators and geolocation in the definition of personal information.

In New England within the context of ADS, data remains mostly unaddressed, with only Rhode Island and Vermont having guidance for information sharing. These states have different laws with Rhode Island requiring information sharing in the event of a crash and Vermont requiring information sharing practices related to ADS testing.

Information sharing policies are important for consumer transparency, equity, and to avoid liability. Recently in Illinois, plaintiffs were able to bring a class action against Subaru for collecting their biometric data without consumer consent[32]. More states are creating privacy and data sharing laws and the NE States will want to consider whether laws around data sharing, privacy, and cybersecurity are warranted for ADS testing, deployment, and full scale commercial operations.

Open Records Laws

One of the concerns limiting information sharing between the public and private sector around ADS testing and deployment is the inconsistent approach to open records laws across the country. Open records laws are important for ensuring transparency when projects are undertaken by public entities using public funds. However, due to the ongoing investment into the development of ADS-equipped vehicles and early development stages of the technology, there are important considerations around protecting trade secrets and proprietary information for the ADS technology, market strategy, and data analysis and use. The NE States also take varying approaches to requirements around open records laws, including when exemptions are recognized.

In **Connecticut**, a public record is defined as recorded data in any format related to the conduct of the public's business and prepared, owned, used, received, or retained by a public agency. Connecticut allows anyone to request public records without stating their purpose for requests. Connecticut does provide an exemption for trade secrets.

[32] Giron v. Subaru, No. 2021CH05971 (Circuit Court of Cook County, Illinois). https://s3.amazonaws.com/jnswire/jns-media/1f/1e/11645550/giron_v_subaru.pdf

In **Maine**, public records are defined as any written, printed, graphic, or electronic data compilation possessed by the state or its agent from which information can be obtained and is prepared for a transaction of public or governmental business. Maine provides a number of exemptions around confidential or personally identifying information.

In **Massachusetts**, a public record is defined broadly as any record made or received by a government entity or employee unless expressly exempted by a statute or common law. Massachusetts does provide an exemption for trade secrets, commercial, or financial information voluntarily provided to an agency for use in developing governmental policy and upon a promise of confidentiality, but this does not apply to information received as part of a government contract or condition or receiving a government benefit.

In **New Hampshire**, public records are defined as any information in any form held or produced by a public body in furtherance of its official function. New Hampshire does not provide an express exemption for trade secrets.

In **Rhode Island**, public records are considered all documents in any form that relate to the business of a government agency. Rhode Island does recognize exemptions for trade secrets and commercial or financial information that is determined to be privileged or confidential.

Image Source: Vermont Agency of Transportation

In **Vermont**, public records include documents in any form that are produced or acquired during public agency business. Vermont provides an exception for trade secrets, which are defined as confidential business records or information which a valid commercial concern warrants keeping secret.

Through its testing guidelines[33], Vermont recognizes the issues around open records laws and has developed the following process:

"*The Agency of Transportation shall immediately notify the Applicant of any request or demand for information of the Applicant, so that the Applicant may seek an appropriate protective order or otherwise*

[33] Vermont Automated Vehicle Testing Permit, Guidance and Application. https://vtrans.vermont.gov/sites/aot/files/planning/documents/planning/VT%20AV%20Testing%20Guidance%20and%20Application101520.pdf

defend any right it may have to maintain the confidentiality of its information under applicable State law. The Applicant shall have only three (3) business days from the date of the AOT's receipt of any such records request to seek a protective order or otherwise defend its information. Again, the Agency is obligated to review the responsive records independently. Should the Agency deem any information to be exempt from disclosure under the PRA, the Agency will not release such information to the public under the PRA. However, nonexempt information will be released unless the Applicant files for an appropriate protective order."

The guidance goes on to provide that:

"*The Applicant may include an optional Confidential Information Attachment to the Automated Vehicle Testing Permit that discloses confidential information that the Applicant determines is necessary to adequately address a requirement in the permit application. Any documents included with the Attachment should be clearly marked as "Confidential Information" on each page by the Applicant. With the exception of the Confidential Information Attachment, the Automated Vehicle Testing Permit Application will not be considered Confidential Information by the Agency and will be made available to the public by publishing it on a website or by other means. In the event a public records request is made for the Confidential Information Attachment, the General PRA Process described above will apply*."

The NE States should coordinate around exemptions related to information gathered for the purposes of supporting and evaluating ADS testing. In the short-term, this issue is important for public and private collaboration around potential safety concerns. However, as safety standards are implemented by NHTSA, there will be less pressure on information sharing from a safety perspective, but there will be interests in standardizing information sharing around operations to assist with long-range transportation planning and modeling by states and local governments. State DOT interest will also come in the form of law enforcement coordination as discussed above. Coordinating around this issue now and developing a multi-state approach will reduce barriers for ADS testing and deployment.

Image Source: Courtesy of Maine Department of Transportation

4.0 Key Project Findings and Recommendations

This section of the report includes the key findings and recommendations for the NE States to consider. Each of these findings considers the different phases of the Project, including regular engagement with the technical committee, stakeholder engagement, and the policy, legal, and regulatory analysis. Before finalization, the recommendations were also shared for comment and feedback with stakeholders that participated in the outreach portion of the Project, including both industry and national organizations.

The goal of the key findings and recommendations is to inform future ADS policy, legal, and regulatory coordination for the NE States. A draft memorandum of understanding ("MOU") is also included in this Section 4 that is focused on implementing steps for continued coordinated actions by the NE States around ADS testing and deployment in the region. The MOU seeks to provide a foundation for coordinated action among the NE States to continue the work that has been done by the region to date, and to focus efforts on the priority recommendations discussed below. The MOU is intended to be executed by all the NE States at the secretary or commissioner level at each state's DOT.

ESTABLISHING ADS POLICIES, LAWS, AND REGULATIONS
Coordinate around the passage of ADS legislation and consider when legislation is warranted and a productive use of resources to advance the safe testing and deployment of ADS in the region. A priority focus is incorporating the concept that a "person" shall include a non-human in the context of ADS-equipped vehicles.

DATA
Support the standardization of ADS focused data exchange between the public sector and industry, including a more consistent approach to protecting data that may be considered proprietary, confidential, or trade secrets.

COORDINATION
Develop a multi-state regulatory approach to ADS testing and deployment that is deliberate around different use cases. Proposed tools include a Memorandum of Understanding signed by each state and exploring the creation of an ADS regional entity to coordinate and streamline processes for ADS deployment.

OUTREACH AND EDUCATION
Proactively educate the public and stakeholders about ADS technology and its potential benefits. Outreach should focus on the capabilities for different types of ADS-equipped vehicles through use cases and expected responsibilities for human monitoring, if any.

PILOTS/DEPLOYMENTS
Draft and approve a regionally focused ADS operations permit prioritizing on-demand ridehailing services, commercial freight, and purpose-built vehicles for local goods movement and delivery.

Below is a condensed summary of the key findings by topic area. This is followed by a detailed description of the identified key findings and recommendations from all phases of the Project. They are organized and color coded by topic area and are further broken down by recommended near-term (next 1-2 years) and mid-term (next 3-5 years) action items.

4.1 Establishing ADS Policies, Laws, and Regulations

Findings

- Factors to Consider for ADS Integration - Evaluating ADS technologies based on a variety of factors such as modes of transportation, use cases, operational design domains, functional design specifications, and the extent upon which a human driver may or may not be expected to stay engaged and take over, or operate, an ADS-equipped vehicle are important for states to consider when identifying statutory and regulatory opportunities, and barriers, to the deployment of ADS.
- Role of Existing Governance Structures - Existing policy, legal, and regulatory governance structures will likely continue to have a dominant role in the regulation of ADS-equipped vehicles. However, when dealing with vehicles equipped with a Level 4 (High Driving Automation) or Level 5 (Full Driving Automation) ADS, there may be challenges to existing regulatory structures for vehicle operations that warrant proactive planning and consideration.
- Cooperative Path Towards Commercial Deployment – Both the public sector and industry reasonably desire a safe, efficient, and clear path towards ADS full scale commercial deployment. However, more consistent and collaborative solutions between government, at all levels, and industry is needed around issues like safety, data collection and sharing, and infrastructure considerations. Collaboratively addressing these issues presents an important and essential opportunity between government and industry to ensure public safety, and reassure public trust and adoption for ADS technologies, including supporting informed decision-making by lawmakers.
- Avoiding Unnecessary Requirements - The path forward from the perspective of industry considers the government not adding unreasonable, unnecessary, or duplicative layers to the deployment process, including being mindful of regulatory processes already in place at the federal level. At the same time, the path forward from the government perspective entails industry being open to providing government with safety metrics or data access, based on reasonable and focused requests, determined necessary to ensure public safety, reassure public trust, supporting transportation planning, and resource allocation. Government will need to be mindful of not compromising the proprietary integrity of ADS industry players.
- Role of Federal Government to Oversee ADS - Broad statutory definitions give NHTSA extensive authority to issue safety standards for vehicles originally manufactured with ADS, and/or equipment that enables vehicle operations using ADS. While NHTSA's jurisdiction to regulate vehicles with ADS appears clear, federal preemption over existing standards is normally predicated upon the implementation of federal standards, which has yet to be done by NHTSA for ADS. This is seen as one of the reasons states are seeking to pass laws and regulations.
- Role of State Governments to Oversee ADS Operations - Although the design and construction of the ADS itself within a vehicle is a federal responsibility, state governments do and can have a role to legislate, regulate, and issue polices for many other aspects of ADS operations on public roadways. For now, this includes, but is not limited to: licensing and training human drivers; registering and titling ADS-equipped vehicles; setting of insurance rules on limits and liabilities; creating requirements for ADS-equipped vehicle inspection; coordinating information sharing

requirements; and, developing responsibilities and processes for testing and deploying ADS technologies on public roadways.

- Considerations for Passing State ADS Legislation – Each state should carefully consider whether and the extent upon which the passage of comprehensive state legislation and/or regulation is needed at this time to support more seamless approaches to testing and deployment of ADS-equipped vehicles when considering: 1) the ADS industry is relatively still in the development phase of ADS technologies, which are constantly evolving; and, 2) the legislative process typically lags behind technology development, and laws can quickly become obsolete as technology changes or advances. Additionally, the federal government will continue to regulate the design and construction of ADS installed in vehicles under its jurisdiction over vehicle safety. It is anticipated that any state-specific laws or regulations interpreted to deal with the design or construction of the ADS itself within vehicles will likely be subject to federal preemption.
- Right Sizing State Approach for ADS Oversight - While ADS technologies continue to evolve, limited or targeted policy, legal, or regulatory actions may be the prudent governmental approach for states to take at this time. This would include actions focused on coordinating with industry and other states to develop seamless ADS testing requirements on public roadways and to develop more uniform approaches or pathways towards deployment that ensures public safety, but also supports innovation. Developing a coordination-focused agreement process or policies at the executive level between states is recommended and could include, but not be limited to, amending existing compacts related to vehicle operation across state lines.
- Coordination with Freight Industry - The freight industry has a long history of being regulated and working with federal agencies on data reporting and safety compliance, making it more familiar to government regulation than ADS companies focused on introducing new passenger subscription services or localized goods delivery that is arguably not focused on interstate commerce. States can work with freight industry stakeholders to understand their varying perspectives on regulation while distilling regulatory needs to those that are essential and clear for ADS operations, including focus on law enforcement coordination and platooning. Opportunities to merge regulations with the likely emergence of “hub” delivery models are ripe.
- Insurance for ADS-equipped Vehicles - The ADS industry perspective regarding the topic of insurance is that existing liability and insurance laws for motor vehicles in states are currently flexible enough to apply to ADS-equipped vehicles. Other stakeholder perspectives captured as part of this Project indicate that additional insurance requirements are warranted at this early deployment stage, especially higher insurance minimums to properly accommodate new perceived risks that come with ADS operations, especially in mixed operational environments with human and ADS operated vehicles. The differing insurance perspectives by stakeholders, including the differing insurance approaches by states will require coordination with a focus on new possible risks and liabilities stemming from ADS-equipped vehicles as discussed in Section 3. Regardless of what insurance rules and minimums may be, the regulation of insurance requirements for ADS-equipped vehicles will likely remain a state responsibility. While the ADS industry does not see the need for complete uniformity for insurance rules given that states now have differing insurance approaches, there seems to be broad consensus across the different stakeholder groups that greater consistency for adopting ADS insurance approaches across state lines supports better harmonization and increased adoption of ADS technologies nationally.

Insurance to accommodate ADS is also a candidate for new collaborative-focused risk sharing models between the public and private sector.

Recommendations

Licensing, registration, and insurance are key state responsibilities that states should focus on updating to accommodate ADS-equipped vehicles in the short-term and medium-term. Although the state transportation agencies in each state may not have direct oversight over each of these issues, it is recommended that the state transportation agencies (e.g. State DOTs) in each state play an active role to help coordinate these efforts with the respective agencies, Governor's Office, and legislature in each state. Having one central agency for industry and other stakeholder groups to coordinate with regarding these matters is a request from industry and a best practice recommendation from USDOT[34].

Short-Term (1-2 years)

- The NE States should develop a common set of definitions for "operator" and/or "driver" in the context of ADS-equipped vehicles used for both testing and deployment. Consideration should be given to modifying existing state statutes and regulations, and/or adding new ones to reflect that an operator or driver can be either a natural person or a non-natural person, including corporate entities, and that age, testing, and other existing licensing requirements are not applicable to non-natural persons.
- The six NE states should develop a common registration regime for testing and deployment focused on information gathering, operational awareness, law enforcement education, and information sharing between the ADS operator and states. The common registration regime for the NE states should be informed by the different evolving use cases and transportation modes being contemplated and deployed for ADS operations.
- The NE states should develop a uniform approach to law enforcement coordination. Such coordination should be focused on the operational design domains for ADS and include applicable state and local level authorities.
- The NE states should work towards aligning insurance requirements for ADS testing and deployment. This could include considerations around use cases for ADS and new tensions that models like passenger subscription services and local goods delivery may place on existing insurance regimes. Rather than establishing insurance limits based on arbitrary numbers, minimums should be established that are connected to ensuring the safety of the motoring public while avoiding burdensome requirements that are not connected to risk from operations and unnecessarily impact ADS-equipped vehicles.
- With a focus on risk mitigation and to promote testing in the New England region, NE states can explore pooled insurance mechanisms to support testing and deployment within the region. Existing models to look at include the Owner-Controlled Insurance Program that is used for large public works projects. The goal of such an approach would be to address the potential increased costs for insurance in the New England region due to challenging operational domains and weather, in addition to demonstrating to potential ADS operator partners that the region

[34] U.S. Department of Transportation. (2017). *Automated Driving Systems: A Vision for Safety 2.0*. U.S. Department of Transportation. https://www.nhtsa.gov/sites/nhtsa.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

understands the benefits of risk sharing to promote the potential positive benefits of ADS for the New England region.

Medium-term (3-5 years)

- Develop a new regulatory approach for the licensing or certification of human operators within the context of ADS-equipped vehicles. This regulatory approach will need to consider the different levels of automation of associated driver or operator responsibilities and the anticipated human interactions with the ADS. State and regional coordination with industry and federal government is essential to develop this approach.
    - For Level 3 - Conditional Automation, the existing driver licensing regime is anticipated to still be needed due to the driver or operator still needing to be ready to take back control of the vehicle at all times. However, the NE States can coordinate around developing a driver education program and updating driving tests that incorporate learning and testing for operation of ADS and interaction with ADS-equipped vehicles. The focus of education applies to all levels discussed below.
    - For Level 4 – High Driving Automation, a licensed driver is anticipated to only be required when a vehicle is operating outside of the designated operational design domain. This presents an opportunity to rethink when licenses should be required, especially if fleets of carsharing vehicles with Level 4 ADS are designated to operate only within an approved operational design domain, also known as ADS-designated vehicles. Some states outside of the New England region take the approach that the ADS is considered to be licensed to operate the vehicle and a licensed driver is not required to be present in the vehicle when the ADS is engaged.
    - For Level 5 – Full Driving Automation, a licensed driver is not anticipated to be needed. However, when and if ever such level of ADS is available for any use case remains uncertain. Even without a licensing requirement, states may still want to ensure drivers or operators understand vehicles' capabilities and training for how to respond in emergency situations.
- Develop a more consistent or uniform vehicle registration regime that tracks evolving use cases with focus on ADS and considers requirements such as discreet markings signifying use case, operational design domain, whether fleet or individually owned, whether the vehicle is an ADS dedicated vehicle or an ADS dual mode vehicle, and (if applicable), whether or not a human operator at any time may be expected to monitor environment or intervene by taking over ADS operations. Ultimately, having better information about the capabilities and limitations of ADS equipped vehicles as part of the vehicle registration process will provide states and law enforcement with more clarity around how to best oversee ADS operations, including crashes on public roadways.
- With regard to vehicle inspections, the NE States should consider the development of self-certification requirements to ensure that ADS-equipped vehicles are able to comply with all applicable traffic and motor vehicle safety laws.
- Continue to coordinate around insurance requirements through national and regional testing, and update requirements based on operational data.

4.2 Data

Findings

- Further information around what data will be collected by ADS, including both outside and inside the vehicle, is needed to better evaluate what consumer protection laws may be needed.
- Liability for IOOs like state DOTs may come with reporting of infrastructure deficiencies from ADS-equipped vehicles by putting infrastructure owners on notice of an existing safety issue. Considering exemptions and reasonable timelines for addressing such notices is warranted.
- Data sharing laws or practices are unlikely to be successfully coordinated until the data collection and transmission is standardized between states and vehicle operators, and proprietary data can be protected. Crash report forms in particular should be more consistently formatted or standardized across state lines so that law enforcement, states, industry, and NHTSA can better understand crashes involving ADS-equipped vehicles. The NE States should work together with law enforcement, Governor's Highway Safety Association (GHSA), the ADS industry, and NHTSA to ensure that the next Model Minimum Uniform Crash Criteria (MMUCC) update (version 6) and subsequent updates provides adequate coverage for capturing crashes involving ADS-equipped vehicles.

Recommendations

Short-term (1-2 years)

- Update public records laws to include uniform approach to considerations around data that may be considered proprietary, confidential, or trade secrets when considering ADS information sharing requirements between ADS operators and states.
- Establish a information sharing framework focused on collaboration between public sector and industry that mutually benefits both, including the sharing of information collected from the operation of ADS on public roads and travel data to support modeling and forecasting completed as part of long-range transportation planning.

Medium-Term (3-5 years)

- Align new legislation in each state to address the complex nature of the crash records reporting around ADS operation and across modes and use cases. This includes the important considerations in balancing the public interest in disclosing safety information versus protecting confidential and proprietary information related to vehicle systems.

4.3 Pilots / Deployments

Findings

- Safety concerns (whether founded or unfounded) around ADS-equipped vehicles continue to be a barrier to increased deployment on public roads. Collaboration around safety, risk mitigation, and operational design domain identification presents an opportunity for the public and private sector.
- Multi-step approval layers and varied definitions on types of ADS operation are barriers to ADS deployment. Industry stakeholders have clearly identified the need for a path to full scale

commercial deployment. For the NE region and its vision of seamless operations across state lines, clarity on ADS operational types and determination of roles and responsibilities for testing and deployment will be important.

- Testing environments with differentiating topography, varied road geometries, and harsh weather conditions are important for determining ADS technology viability (and considered as such by private industry). This presents an important opportunity for the NE States to support the maturation of ADS. It remains unknown when ADS technology will be ready to operate in such environments.
- Law enforcement should be notified at the outset of ADS operations. Requiring operators of ADS-equipped vehicles to submit a law enforcement interaction plan to a state agency (e.g. state transportation agency like the State DOT), which would then be responsible for making this plan available to law enforcement, would allow law enforcement to be notified in advance of ADS-equipped vehicles operating in a state.
- Without an approval or notification process for ADS operations within a state or region, public agencies may not know whether companies are testing or operating on public roads, thus leading to potential liability and a missed opportunity around coordination with the private sector to support the safe and effective operation of ADS-equipped vehicles.

Recommendations

Short-term (1-2 years)

- Complete analysis to declare regional corridors to be ADS testing and/or deployment ready. With ongoing development of electric vehicle implementation plans by states, this presents opportunity to collaborate around ongoing electric vehicles implementation strategies and to align with alternative fuel corridor designations for ADS. Corridors may start off as only ADS Testing Ready, but they can transition to ADS Deployment Ready following successful testing and operational data analysis to support designation. Corridors can identify and encourage particular use case operations, including freight, bus rapid transit, or other potential ADS services.
- Develop more consistent or uniform approaches to crash reporting for ADS with a focus on testing and deployment.
- Develop coordinated regulations focused on on-demand ridehailing services with focus on cross-state operations and with consideration of incorporation of ADS ridehailing services[35].
- Develop regionally focused testing permit with the following considerations[36]:
    - Consider the AAMVA road testing guidelines for ADS-equipped vehicles, which are primarily administrative in nature rather than technical
    - Consider the Pennsylvania Department of Transportation Automated Vehicle Testing Guidance (or other accepted best practice guidance), which is a combination of administrative and technical requirements for ADS testers and others

[35] The California CPUC provides a use case for ridehailing regulations and the regulation of ADS used for providing on-demand passenger services. https://www.cpuc.ca.gov/regulatory-services/licensing/transportation-licensing-and-analysis-branch/autonomous-vehicle-programs

[36] The following list is taken or adapted from Autonomous Vehicle Testing Guidance for State & City DOTs (safeautonomy.blogspot.com) and is intended to provide a baseline for discussion.

- Consider requiring ADS testers to provide a statement of areas of intended operation and level of ADS technology in a manner that does not compromise any claimed trade secrets as to operations and also flexible from a geographic operational perspective
- Consider requiring ADS testers to conform to the SAE J3018 or other industry accepted standards for safe road testing, including safety driver training and protocols
- Consider defining how safe testing should occur when contemplating the safety driver and the vehicle system as a whole, including confirmation of how the stated level of technology will be monitored and verified to support public safety
- Consider requiring ADS testers to have a credible safety management system approach in place before ADS testing begins on public roads
- If ADS testing takes place without continuously monitoring safety driver, including chase or remote, consider requiring ADS testers to conform to industry-consensus safety standards for the ADS-equipped vehicle itself and operations (e.g., per ISO 26262)

Medium-term (3-5 years)

- Coordinate legislative updates for the region focused on the following:
  - Vehicles Exclusively Operated by ADS for All Trips: Consider adopting legislation focused on ADS for purpose-built vehicles not designed to have human drivers or operators, such as certain goods delivery vehicles. Such legislation may consider eliminating vehicle requirements like pedals, side view mirrors, and windshield wipers.
  - Traffic Violations: Assuming a “person” is redefined as described above, to include both natural and non-natural persons, legislators may wish to amend their statutes to increase fines for non-natural persons to provide for meaningful deterrence. Legislators may also wish to include provisions for suspensions and revocations for repeat offenders. That being said, such fines should be correlated to provable concerns and not arbitrary or a means to arbitrarily target emerging technologies.
  - Distracted Driving: Distracted driving laws are now commonplace. These laws prohibit texting and handheld cell phone use for all drivers, as well as operation of other handheld devices. However, for vehicles equipped with a Level 4 ADS or a Level 5 ADS, a person formerly considered a driver may not be engaging in the operation of the vehicle, and potentially should be able to text, watch a movie, or engage in other screen related activities - provided that they would not have any need whatsoever to take over. When a vehicle is equipped with a Level 3 ADS, policymakers should not allow hand held texting or calling because even when a vehicle is in an automated driving mode, that mode may require the driver to take over.
  - Platooning: State statutes require that motor vehicles being driven on a highway in a caravan be operated so as to allow sufficient space between vehicles or a combination of vehicles to enable any other vehicle to enter and occupy the space without danger. These laws may need to be modified if state officials choose to allow or promote platooning. Platooning may be conditioned on certain technological and physical conditions and safety standards related to safe operational distances and number of vehicles allowed to platoon.

4.4 Outreach and Education

Findings

- Significant interest, and both excitement and trepidation, has been seen with public outreach and education around ADS-equipped vehicles. Public outreach and education are a priority for the federal government, states, industry, and national organizations focused on ADS.
- The NE States should proactively and collaboratively explore ways to educate the public and stakeholders about ADS technology and its potential benefits. Outreach should focus on the capabilities and safety systems being implemented for ADS technologies to facilitate a clear understanding of the ability for vehicles to operate in different operational domains, including expected responsibilities for human monitoring. This includes outreach and education being focused on both the general public, and decision-makers, including elected officials and legislators.

Recommendations

Short-Term (1-2 years)

- Work with existing regional and national organizations, within which the NE States are engaged, to present the findings and recommendations from this report.
- Identify partner organizations, including academic institutions, within the New England region to develop a workshop focused on legal, operational, and policy issues associated with the deployment of ADS, including the issues discussed in this report.
- Plan and host an industry demonstration day with a focus on an identified ADS testing and deployment ready corridor.

Medium-Term (3-5 years)

- Invest in the development of a New England regional ADS focused outreach and engagement strategy, including outreach and engagement with decision-makers and elected officials at state and local levels, those living in the New England region, businesses in the New England region, and students in the region as the next generation of drivers (or, potentially not!).
- Identify opportunities for technical assistance for states and local governments around the integration of ADS-equipped vehicles into the transportation, including policy, legal, and regulatory considerations.

4.5 Coordination

Findings

- Consistency is needed for requirements, laws, and regulations adopted by the New England region to support the testing, limited deployment, and full scale commercial operation of ADS. A key part of establishing this consistency is communication, which the NE States already have a strong foundation for through the ADS-focused working group.
- Strong federal leadership is desired to foster industry collaboration and community engagement. A uniform national policy to authorize the safe testing, deployment, and full scale commercial

operations of ADS is essential to avoid the current inconsistencies and varying state approaches around policies, laws, and regulations that lead to uncertainty and reluctancy to deploy ADS technologies, especially seamlessly across state lines. This also includes coordinating resources and best practices for ADS operations for national dissemination.

- In line with the goals of this Project around promoting the seamless operation of ADS across state lines within the region, determining how existing frameworks for reciprocity (i.e. driver's license compacts) evolve for ADS will be important. Existing compacts present an opportunity to develop new frameworks focused on reciprocity and cross-state operation of ADS.
- While goals and vision for ADS deployment may differ across the NE States, there is a common objective to see the region be a leader for the deployment of ADS to meet regional transportation needs. A regional entity that is completely focused on coordination and understands the ADS approaches of each NE state with a focus on collaboration would help to further ADS testing and deployment, and it could circumvent the conflicts and gaps in expertise and resources that often arise when existing agencies are tasked with regulating new technologies. Such an entity can also lead coordination with states outside of the region, local governments, and industry as well.
- More resources are needed from the federal government to support regional efforts such as this Project that will help inform the development of a multi-state approach to ADS operations that considers safety, risk, and liabilities, and strategies for risk mitigation, for states and infrastructure owner operators that support new innovative mobility solutions.

Recommendations

The following recommendations seek to provide additional actions for the NE States to achieve the important goal of regional coordination around the testing, deployment, and full scale commercial operation of ADS. The purpose for unifying, harmonizing, and coordinating ADS policies, laws, and regulations is to enable seamless operations of ADS equipped vehicles across all jurisdictional boundaries and to attract, speed up, simplify, safeguard, and improve adoption of ADS-equipped vehicles in New England. The NE States have a strong foundation with an identified common vision for the operation of ADS-equipped vehicles in New England. The next step is working together to align resources and coordination towards actions to implement the vision.

Short-Term (1-2 years)

- Agree to and execute a memorandum of understanding focused on coordination around testing and deployment of ADS-equipped vehicles in the New England region.
- Develop coordinated testing goals to inform development of a multi-state approach for ADS. This framework needs to differentiate between different use cases, including, but not limited to, commercial freight, local goods delivery, and passenger movement via on-demand fleets and transit.
- Coordinate within USDOT, including NHTSA, FHWA, FTA, FMCSA, Volpe, pooled funds and consortiums, and other ADS focused organizations, for funding and implementation opportunities. Through such collaboration, the NE States can continue to engage in information sharing, continue to evaluate and refine identified best practices for ADS operations on public roads, and identify companies willing to test in the region.

- Coordinate and engage in information sharing, including the findings and recommendations of this Project, with other regional and corridor focused efforts around ADS testing and deployment.
- Explore the use of identified interstate compacts to coordinate implementation of laws and recommendations to support the multi-state operation of ADS-equipped vehicles across state lines. This will require coordination with Congressional delegations for any amendments determined necessary and requiring Congressional approval.
- Closely monitor federal legislation and rulemakings focused on ADS, and coordinate engagement with Congressional delegations and submissions of comments to USDOT, to inform development of ADS policies, regulations, and standards and ensure the New England focus is included in final rules, regulations, and procedures.
- Track mergers and acquisitions of companies developing ADS not only to understand marketplace, but to also understand how such transactions may impact existing or future testing or deployment approvals, including from safety management and risk consideration perspective.

Medium-Term (3-5 years)

- Review and refine existing fleet regulations across the New England states as a potential means of targeting the largest share of anticipated ADS-equipped vehicles operating on public roads without states relinquishing significant sovereignty over the registration process. This recommendation focuses on the expected growth of on-demand subscription services via ridehailing as a near-term use for ADS deployments.
- Invest in the creation of a **regional coordinating entity** among the New England States to manage the New England region ADS program. (Note: This entity could coordinate regional efforts around Connected Vehicles as well, which are not covered in this report.) While the region has already invested in the New England Connected and Automated Vehicle Coordination Group, this coordinating entity would move the focus on ADS from research to implementation.

  With such a proposal, there are important governance and jurisdictional considerations that will need to be analyzed and discussed. The purpose of the proposed entity is not to absorb any existing authority of the NE States (i.e. licensing or registration), but instead to ease and streamline coordination for the testing and deployment of ADS in the region. This entity may be a new entity that is created or can be actions that an existing entity, such as The Eastern Transportation Coalition, takes on. Examples of other entities with a coordination and supporting role around the integration of technology focused solutions include the Colorado Smart Cities Alliance, Urban Movement Labs, and Smart Belt Coalition.

  Proposed responsibilities for such an entity include:

  - Develop and coordinate implementation of operational approach supporting ADS testing and deployment across NE States, including supporting and coordinating legislative efforts in the region
  - Conduct outreach and coordination with ADS providers around proposed use cases for testing and deployment that align with the operational goals adopted by the NE States
  - Administer the testing and deployment process adopted by the NE States, including coordination around registration, information sharing, and law enforcement coordination

- Manage public outreach and education for ADS-equipped vehicles with focus on ADS experience through testing and deployment
- Coordinate regional partnerships focused on ADS between industry, academic institutions, federal government, and other interested stakeholders
- Implement digital mapping of cross-state corridors identified by the NE States as "Automated Operation Corridors" to prioritize and support initial testing and deployment across state lines; this effort can include analysis of anonymized geo-location data to also identify use of corridors that would inform use cases for ADS-equipped vehicles; this can either be done by the NE States or in partnership with industry
- Support long-range transportation planning by the NE States and municipal planning organizations in the region to ensure a consistent approach towards next generation mobility solutions like ADS
- Invest and coordinate resources to move towards the adoption of uniform requirements for the deployment of ADS in the region leveraging and coordinating data review from testing projects within one or multiple NE States
- Provide technical assistance for local governments seeking to test and deploy ADS-equipped vehicles

Image Source: Courtesy of Connecticut Department of Transportation

4.6 Sample Memorandum of Understanding focused on ADS Regional Coordination

MEMORANDUM OF UNDERSTANDING

Advancing Testing and Deployment of ADS-Equipped Vehicles in New England through Coordination, Partnerships, Outreach, and Education

This MEMORANDUM OF UNDERSTANDING ("MOU") is entered into as of _____, 20____ by and between the [INSERT ENTITIES – proposed to be state departments of transportation].

RECITALS

The New England region ("Region"), comprising of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont (collectively, the "NE States"), has expended significant resources to coordinate discussion and research towards the establishment of a collaborative vision for realizing the operation of vehicles equipped with automated driving systems ("ADS-equipped vehicles") in the Region.

The Region is committed to safety on its roadways and increasing mobility options for those living, working, and doing business in the NE States.

ADS-equipped vehicles offer important opportunities to increase safety, improve mobility, reduce emissions, and support economic growth in the NE States and the Region as a whole.

The proximity of the NE States to each other provides an important and valuable multi-state operational domain for ADS-equipped vehicles, in addition to opportunities for international ADS operations with the location of the Canadian border.

The NE States have established a vision for ADS deployment that focuses on the seamless operation of ADS-equipped vehicles across New England and surrounding regions of the United States and Canada. The mission of the collaborative efforts of the NE States is to share resources and information, and work collaboratively with neighboring transportation agencies and other stakeholders to facilitate the deployment of ADS-equipped vehicles for freight and passenger movement.

The Region is mode agnostic and seeks to support the safe testing and deployment of all use cases for ADS-equipped vehicles, including commercially operated fleets of vehicles for passenger services focused on demand responsive mobility, or ridehailing; on-road commercial vehicles focused on the movement of freight on highways with focus on specific corridors; purpose-built fleet vehicles without any in-vehicle operator for local goods delivery; and public transportation.

The NE States acknowledge the challenging operational environment of the Region, which also presents the opportunity to support the maturation of ADS technologies, gain consumer trust, and assist with the development of a national operational strategy for ADS.

The NE states agree the coordination of resources around the safe ADS deployment is in the best interests of each state and the Region as a whole, including to educate, cultivate, and advance the ability for ADS-equipped vehicles to operate safely in all operational domains, including all-weather and regions with varying infrastructure. In addition, there is a need to have operational structures in place that are adaptable to accommodate advancing ADS technologies and to avoid overregulation.

It is agreed that in addition to coordination between the NE States, collaboration is also needed among local governments, businesses, educational and research institutions, nonprofit organizations, and ADS manufacturers to support the safe deployment of ADS in the Region and in consideration of a future-forward mobility ecosystem that merges innovation, workforce training, land use and development, infrastructure investments, public transportation, and health and safety.

The NE states are invested in reducing operational barriers to ADS through coordination with each other and collaborating around partnership opportunities with ADS providers to support the development of use cases that incentivize enhancing mobility in the Region and support a path to the safe full scale commercial deployment of ADS-equipped vehicles.

NOW THEREFORE, the NE States hereby direct the following actions to be taken in support of advancing testing and deployment of ADS-equipped vehicles in the Region:

The NE States agree to continue to pool resources towards the implementation of the multi-state regional vision for the seamless operation of ADS-equipped vehicles across New England.

The NE States agree to explore the establishment of a regional entity focused on coordinating ADS testing and deployment in the Region. The potential role for such an entity includes the following:

- Develop and coordinate implementation of operational approach supporting ADS operation across NE states, including supporting and coordinating legislative efforts in the region
- Administer and coordinate the testing and deployment process adopted by the NE States, including coordination around registration, information sharing, and law enforcement coordination, and any approvals determined necessary by the individual states
- Manage public outreach and education for ADS-equipped vehicles with focus on ADS experience through testing and deployment
- Coordinate ADS focused regional partnerships between industry, academic institutions, federal government, and other interested stakeholders
- Provide technical assistance for local governments seeking to test and deploy ADS-equipped vehicles

The NE States agree to collaborate around the development of a uniform approach to address the following ADS operational topics within the next 2 years, which list may be added to or subtracted from as work is completed by the NE States:

- Licensing and Registration
- Insurance
- Safety Management
- Information Sharing and Crash Reporting

- Law Enforcement Coordination, including local and state
- Protection of information determined to be proprietary or trade secrets
- Platooning

The NE States agree to closely coordinate future legislative activity with the goal of passing complementary legislation on ADS if such legislation is determined necessary.

The NE States agree to collaboratively monitor federal legislation and rulemakings, and to pool resources for submitting comments to ensure the interests of the NE states and Region are considered in the continued development of federal ADS regulations and programs.

The NE States agree to coordinate to establish an outreach and engagement strategy focused on consumer and decision-maker education of ADS technology and capabilities.

The NE States agree this MOU will terminate with regard to a party or the NE States on the earlier of: (i) written notice by a party or all the NE States seeking to terminate the MOU; or (ii) five (5) years. The NE States may extend the term of this MOU by written agreement.

All notices under this MOU shall be in writing and shall be given by electronic mail (e-mail) or U.S. mail. E-mail shall be documented by the sending party with transmission receipts and the transmissions will be deemed received on the date of transmission with delivery confirmation. Transmissions by U.S. mail shall be deemed to have been received forty-eight (48) hours after deposit in the U.S. mail in registered or certified form with postage fully prepaid. The contacts for each of the NE States for purposes of this MOU are the following, which contact should be timely updated by a party as needed:

Name: _____
Phone: _____
Email: _____

Name: _____
Phone: _____
Email: _____

Name: _____
Phone: _____
Email: _____

Name: _____
Phone: _____
Email: _____

Name: _____
Phone: _____
Email: _____

Name: _____
Phone: _____
Email: _____

No third-party beneficiaries are created or intended by this MOU. This MOU may be executed in counterparts, each of which shall constitute an original, but all of which together shall constitute one and the same instrument.

IT WITNESS WHEREOF, the following New England States have signed this Memorandum of Understanding.

By: _____

Name: _____
Title: _____
Agency: _____

By: _____

Name: _____
Title: _____
Agency: _____

By: _____

Name: _____
Title: _____
Agency: _____

By: _____

Name: _____
Title: _____
Agency: _____

By: _____

Name: _____
Title: _____
Agency: _____

By: _____

Name: _____
Title: _____
Agency: _____

5.0 Conclusion

The viability of proposed use cases for ADS is now coming into clearer focus. In the short term, these use cases include on-demand passenger services operating as fleets, purpose-built vehicles designed to not have an operator and deploying at low-speeds, and heavy-duty commercial freight operations. As the technology continues to mature, it is important to manage legislative efforts while being mindful of the pace of technology development and existing federal jurisdiction around vehicle safety requirements.

In the short term, these use cases likely have minimal impacts on the status quo for vehicle regulation for personally owned vehicles. Instead, it is recommended that the NE States focus legislative resources on managing fleet operations, including on-demand passenger services, local goods delivery using purpose-built vehicles, and commercial freight operations. Such efforts should include coordination around legal issues with the goal of risk identification and mitigation while being mindful that gray areas will arise through increased ADS integration at different levels of automation.

Over the medium to long term, considerations around federal versus state roles and responsibilities over safety and vehicle operations will inevitably arise as higher levels of ADS scale onto public roads. Additionally, continued public and private coordination will be important around untested legal issues like privacy, integration of ADS guided purpose-built vehicles into the transportation system, and liability around information sharing - both from vehicle to state DOT and vice-versa.

The NE States have been national leaders in laying a foundation to implement their vision of “seamless operation” across state lines. With this report, the NE States have building blocks to focus their discussion and resources towards developing a policy, legal, and regulatory approach that supports the safe testing and deployment of ADS. Through the research for this Project, proposed implementation tools such as the execution of a Memorandum of Understanding by the NE States focused on coordination and the potential leveraging of a regional coordinating entity around ADS testing and deployment have been suggested to support next steps for the NE States.

With this Project, the NE States have taken the important first step in moving their vision of seamless multi-state regional operation of ADS-equipped vehicles towards implementation.

Acronyms / Abbreviations

ADAS	Advanced Driver Assistance Systems
ADS	Automated Driving System
ANPRM	Advanced Notice of Proposed Rulemaking
C/AV	Connected and Autonomous Vehicle
DDT	Dynamic Driving Task
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMVSS	Federal Motor Vehicle Safety Standards
FTA	Federal Transit Administration
HACV	Highly Automated Commercial Vehicles
IOO	Infrastructure Owner Operator
IRP	International Registration Plan
MOU	Memorandum of Understanding
NCHRP	National Cooperative Highway Research Program
NECAV	New England Connected and Automated Vehicle Coordination Group
NETC	New England Transportation Consortium
NHTSA	National Highway Traffic Safety Administration
ODD	Operational Design Domain
PDD	Personal Delivery Devices
SAE	Society of Automotive Engineers
TETC	The Eastern Transportation Coalition
TRB	Transportation Research Board
USDOT	United States Department of Transportation
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle

Coordinating State Policies, Laws, and Regulations for Automated Driving Systems across New England

APPENDIX

June 30, 2022

Prepared for:
New England Transportation Consortium

Prepared by:
Stantec
Texas Transportation Institute
Fort Hill Companies

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

List of Appendices

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Appendix A

Annotated Literature Review

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Safety	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines **(Sept. 2020)**	Define "remote driver" in statutes (p. 42). **Manufacturer should submit safety plan when applying for a testing permit on public roads** (p. 24). "Identification of a motor vehicle as an ADS-equipped vehicle is necessary for law enforcement...identifying a vehicle via a license plate may not be the optimal method to identify a vehicle equipped with ADS" (p. 54). **Crash reporting should happen whenever there are crashes or accidents involving AVs, no matter who is at fault** (p. 56). **Law enforcement/first responders need to understand how to safely interact with AVs** (p.62).	p.42; p.24; p.54; p.56; p.62
AAMVA, "Guidelines for Testing Drivers in Vehicles with Advanced Driver Assistance Systems" **(Aug. 2019)**	This paper focuses on vehicle technologies found in SAE Level 0, 1, and 2 vehicles. This report provides information and recommendations on updating driver license testing systems. Advanced Driver Assistance Systems (ADAS) assist the driver but do not perform the driving function like a high-level automated vehicle. ADAS are designed to help drivers with tasks like staying in their lane, parking, braking, crash avoidance, and blind spot reduction (p. 2). Safety critical technologies include: Back-up warning technologies (p. 7); blind spot monitor and warning (p. 9); camera technologies (p. 11); curve speed warning (p. 15); detection technologies (p. 16); forward collision warning system (p. 18); high speed alert (p. 20); lane departure warning (p. 21); parking sensors (p. 23); rear cross-traffic alert (p. 24); automatic emergency braking systems (p. 26); lane keeping assist (p. 29); automatic reverse breaking (p. 28); left turn crash avoidance (p. 30).	p. 2; p. 7; p. 9; p. 11; p.15; p.16; p.18; p.20; p.21; p.23; p.28; p.29; p.30
USDOT, "Automated Vehicles Comprehensive Plan" **(Jan. 2021)**	**Ensure privacy and data security** – The U.S. Government will use a holistic, risk-based approach to protect the security of data and the public's privacy as AV technologies are designed and integrated. This will include protecting driver and passenger data.	p. 3

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
Eno Center for Transportation, "Beyond Speculation: Automated Vehicles and Public Policy" **(May 2017)**	**"Congress should make AV technologies eligible for federal safety programs to improve transportation operations"** (p. 21). "States should have the ability to choose technological solutions to solve transportation safety problems, provided they can demonstrate the greatest improvement in crashes, injuries, and fatalities for the federal dollar." (p. 21)	p.21
Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems" **(Jan. 2015)**	AV testing is not a linear progress from design to test track to public tests. "Testing programs are iterative, including frequent software and hardware modifications, and occasional failures are to be expected. Thus, ensuring AV testing safety starts with test driver selection and training and depends heavily on the manufacturer's safety management process throughout the development and testing procedures." (p. 138). Good AV testing programs start with good test driver selection and training" (p. 139). Another aspect of safety is safety culture. **"A clear management process to make safety-related decisions is critical to maintaining the safety of the AV testing program."** (p. 139). Third-party certification (p. 139-140). **Deployment regulations are meant to ensure public safety, but safety evaluation before deployment is difficult because there are no documents for AVs to rely on.** (p. 140)	p. 138; p.139; p.140
Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force" **(Nov. 2016)**	During HAV testing where an operator is present or remote, there are two potential drivers – the operator and the ADS. Unless prohibited by legislation, the ADS is the driver then the ADS is engaged. The operator is the driver when the ADS is not engaged. **"Approval to test should require that the operator be able to intervene in situations where the ADS experiences a system interruption or other problem, rendering the ADS unable to safely perform the dynamic driving task, and the vehicle is unable to come to a minimal risk condition on its own."**	p.19

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
TRB, "Strategies to Advance Automated and Connected Vehicles" **(April 2018)**	**In the near-term, traffic law enforcement will be more complex but may be rendered obsolete as full penetration of AVs and CVs is reached.** This will potentially cause police department pushback initially because they do not want to deal with the challenges of a more complex enforcement landscape. (p.14)	p.14

Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana" **(Oct. 2016)**	Based on a 2012 Arizona House Bill, “vehicles must meet certain safety standards: they must be able to easily switch from and to human control, the autonomous vehicle mode must be visibly indicated when engaged, and the vehicle must be capable of alerting the operator in the case of autonomous vehicle technology failure” (p.31). “Autonomous vehicle operation must be consistent with federal safety laws that require the installation and use of devices such as safety belts, airbags, headrests, etc.” (p.61). From NHTSA: “Autonomous vehicle operators should possess a driver’s license endorsed with autonomous vehicle specifications, or a separate autonomous vehicle driver’s license should be issued. Such a document should attest to the operator's proficiency in the safe operation of the vehicle, as proven by the successful completion of an autonomous vehicle manufacturer-certified training program and ensuing examination, or that the licensee has completed a certain minimum number of hours operating an autonomous vehicle. State DMVs should approve the course prior to awarding an autonomous vehicle driver’s license.” – (p.22-23). FL HB 1207 in 2012 – Manufacturers are responsible for designating operators, who must be physically present in the driver’s seat and intervene as needed – p.27. DC DMV – a human operator/driver must be present in the vehicle and ensure that the vehicle operates in accordance with all applicable laws (p. 28). California – “The CDMV issues AVTP Manufacturer’s Testing Permits (MTP) (CCR 227.16). Manufacturers are specifically prohibited from operating autonomous vehicles without one. The permit is valid for one year, and it allows for one year of testing 10 vehicles with 20 driver/operators for a $150 fee. Additional testing is offered in increments of 10 vehicles and 20 driver/operators.” – p. 29. Hawaii HB 1461 – “The operator does not necessarily have to be physically present in the car. The operator is specified as the person who “causes the autonomous technology of an autonomous vehicle to engage” and monitors the operation to ensure that it takes place safely” – p. 35	p. 31, p.61, p.22-23, p.27, p.28, p.29, p.35

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
Bryant Walker Smith, "How Governments Can Promote Automated Driving" **(April 2017)**	Lack of enforcement of speed limits, distracted driving laws, intoxicated driving laws, seatbelt laws, and vehicle inspection laws can cause perceived disadvantages or diminish advantages to using/owning an AV which could be physically restricted into abiding by these statutes. Therefore, increasing enforcement on traditional drivers and vehicles will help remove this disparity. (p.124-126)	p. 124-126
Report of the Massachusetts Autonomous Vehicle Working Group **(Feb. 2019)**	MA has EO 572 that defines an AV testing approval process. It requires a safety driver behind the wheel that can take control of the vehicle. [p 19]. Testing in California - checklist of "acknowledgements" for safety (p. 61). "The regulations [in Michigan] also covers the testing of fully autonomous vehicles with no steering wheels, pedals, or any provision for human control…**The new legislation allows both traditional automakers and tech companies to operate driverless ridesharing services."** (p. 62). "[In Arizona AVs] may be operated only by an employee, contractor, or other person designated or otherwise authorized by the entity developing the self-driving technology." (p. 69-70). "[In Nevada] companies applying to test must submit an application to the Department along with proof of at least 10,000 miles driving experience, a complete description of the autonomous technology, a detailed safety plan, and plan for hiring and training test drivers" (p. 71). "Florida Statutes Section 316.85 **allows for the operation (testing and deployment) of AVs on public roads without an "operator" physically in the vehicle."** (p. 72).	p. 19; p. 61; p. 62; p. 69-70; p. 71; p. 72
Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation" **(Dec. 2020)**	Build knowledge for a safety assurance framework – "**DOT should encourage research and seek input from industry stakeholders to inform the development of a national AV safety assurance framework.** Above all, to provide the necessary leadership and to facilitate meaningful progress on the testing and deployment of AV technology in the United States, it is important that DOT stay abreast of the latest advancements in AV technology."	p. 2

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
TRB, "A Look at the Legal Environment for Driverless Vehicles" **(Feb. 2016)**	"**Searches of driverless vehicles themselves, as opposed to mere surveillance of their movements, also may raise interesting legal issues.** Automobiles represent "effects" under the Fourth Amendment to the United States Constitution, and their owners and possessors generally can claim a reasonable expectation of privacy as against physical intrusions by the government. Therefore, a police officer's entrance into and search of a vehicle amounts to a "search" that requires a warrant or warrant exception." (p. 45-46).	p. 45-46
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development" **(Updated April 23, 2021)**	**Federal government is traditionally responsible for vehicle safety aspects, while states are responsible for establishing traffic violations [p. ii, p. 8].** Cybersecurity threats may include hacking critical vehicle software; **it's currently uncertain whether federal vehicle standards should require vehicle technology to report/stop hacking activity as well as the level of information car buyers should have on cybersecurity issues.** [p. ii, p. 17]. Systems that allow vehicles to communicate with each other and other infrastructure offer portal for unauthorized access to data generated by vehicles and the vehicles themselves [p. 4-5]. Existing definitions for "driver" and "operator" may need to be revised to indicate control of the vehicle in an AV setting [p. 11]. **The report highlights the 2018 pedestrian death in Arizona being determined by NTSB as caused by inadequate safety culture at Uber and insufficient oversight from Arizona DOT in the vehicle testing. NTSB subsequently recommended that states require and evaluate applications from AV software developers before granting testing permits for AVs** [p. 12].	p. ii; p. 8; p. 17; p. 4-5; p. 11; p. 12

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway" **(Nov. 2020)**	“Both countries have similar procedures for obtaining permission to perform experiments. One must send in an application, which is then evaluated by a national agency (the Swedish Transport Agency and the Directorate of Public Roads at the Norwegian Public Roads Administration, respectively). In order to obtain a permit, the applicant must prove that they meet a number of requirements, including traffic safety, vehicle control, and emergency procedures (Lov, 2017; SFS, 2017). **In Norway, the applicant must prove that he or she has control of the vehicle at all times; if the technology can handle all driving situations, there is no requirement for a person to sit behind the wheel** (Lov, 2017; TU, 2017b).” (p. 6)	p. 6
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles" **(2018)**	District of Columbia enacted the Autonomous Vehicle Act of 2012 (p. 7-17). NHTSA and the ULC both endorse several basic design features in AVs used for testing or deployment. These include a device that allows for quick disengagement from automated mode; a device that indicates to others whether the vehicle is operating in automated mode; and a system to warn the operator of malfunctions (p. 7-19). Operator requirements - NHTSA, Michigan, Nevada (p. 7-20-21). California - AV driver test (p. 7-21). Connecticut, Colorado, Texas legislation defining "driver", "operating system" and "dynamic driving test" (p. 7-21 through 7-23)	p.7-17; p.7-20-7-21; p. 7-21-7-23
Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation with Smart Regulation" **(March 2017)**	**Self-certification should be continued** (p. 15, 16,17, 21)	p. 15, p. 16; p. 17; p. 21

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0" **(Oct. 2018)**	USDOT relies on a self-certification approach to safety rather than type approval (p. ix). **OEMs should demonstrate safety through voluntary safety-self assessments** (p. 22). "**To ensure public safety, first responders and public safety officials need to have ways to interact with automated vehicles during emergencies**." (p. 33). "To educate, raise awareness, and develop emergency response protocols, automated vehicle developers should consider engaging with the first responder community when developing and testing automation technologies." (p. 33). Federal Motor Carrier Safety Administration – how are existing rules impacted between human operator versus computer operator (p. 10)	p. ix; p. 22; p. 33; p. 10
USDOT "Automated Driving Systems 2.0 A Vision for Safety" **(Sept. 2017)**	"Entities are encouraged to develop validation methods to appropriately mitigate the safety risks associated with their ADS approach." (p. 9). **Voluntary safety self-assessment recommended** (p. 16). "**States should develop procedures for entities to report crashes and other roadway incidents involving ADSs to law enforcement and first responders**." (p. 21)	p. 9; p. 16; p. 21
Douglas Gettman, J. Sam Lott, Gwen Goodwin, and Tom Harrington "Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations" **(Oct. 2017)**	NHTSA - "automobile manufacturers and AV developers can submit a written assertion of their safe design" (p. 48). Vehicle focused methodologies (p. 49). Systems focused methodologies (p. 48). **"Safety Program – All public transit operating agencies down to the smallest bus operator who deploy AV technology will be required to establish a rigorous safety assurance program"** (p. 68). "NHTSA is expecting AV technology to be offered by the manufacturer as safety certified for designated levels of operation (such as L4 fully automated driving) on designated classifications of roads within defined area boundaries (i.e. inside the geo-fence network)." (p. 68)	p. 48; p. 49; p. 68

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving" **(July 2017)**	There is a discussion of how the existing driver of today's laws relates to autonomous vehicles, and how the law should be changed to reflect a "driverless" vehicle under the heading "Reconcile" on p. 9; under the heading "Harmonization versus customization" on pp. 9-10; and under the heading "Certainty versus flexibility" on p. 10. There is a discussion on reporting requirements under the heading "Monitoring" on p. 6.	p. 9; p. 9-10; p. 6
National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act" **(Aug. 2019)**	This Model Law does not apply to circumstances where a safety operator is in place. See pp. 11-12. This Model Law does address roadworthiness by ensuring that automated vehicles meet minimum roadworthiness standards. See pp. 2, 20	p. 11-12; p. 2; p. 20
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape" **(July 2019)**	According to the report, various states handle this differently with most requiring a safety operator. Several states require mandatory reporting, including Michigan, Tennessee, and Texas.	
Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit" **(June 2017)**	There are few concrete observations in the report, other than generalized emphasis on the need for safety to be a key consideration.	

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Vehicle Registration / Inspection	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines" **(Sept. 2020)**	**"The application process for test permits is intended to provide sufficient background information for jurisdiction and law enforcement personnel to interact with the manufacturer and its vehicle(s)."** (p. 22-24, see writeup for full list of information that should be included when applying for a test permit). Jurisdictions don't usually require a vehicle to be titled until it is sold, this doesn't need to change for AVs (p. 27). "A jurisdiction that titles ADS-equipped vehicles used for testing should register these vehicles in a manner consistent with its titling process for ADS-equipped vehicles, which could be its normal titling process or titling exception process unique to ADS-equipped vehicles." (p.29). **Jurisdictions should create requirements for permanent labeling on the rear and sides of an AV to better identify vehicle capabilities and improve safety.** (p. 55)	22-24; 27; 29; 55
Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems" **(Jan. 2015)**	**The California law set the DMV as the organization responsible for writing the new sections of the California Code dealing with AVs, not the DOT.** The DMV set up a state-wide committee with potentially affected agencies like the California Department of Insurance, CA DOT, and the CA Highway Patrol. (p. 138). "The only argument in favor of marking test vehicles is to indicate to other road users that the vehicle may do something unexpected....since one of the purposes of testing on public roads is to capture system performance under normal traffic, there should be no reason to identify these vehicles conspicuously." (p. 140). **For deployment, if the AV must already behave in a normal manner, there is no reason to have markings on the vehicle and there is no law enforcement need for markings. For vehicle registration for AV deployment, the vehicle registration should indicate "if a vehicle possesses AV technology, the operational scenarios for which the AV technology was designed and certified, and whether the AV is capable of operation without a licensed driver in the vehicle." (p. 142-143)**	p. 138; p. 140; p. 142-143

Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force" **(Nov. 2016)**	"If an HAV is being used for testing purposes and the vehicle is a fully self-driving vehicle without an operator physically present in the vehicle, the vehicle shall be marked in a manner as determined by the Department in consultation with the Pennsylvania State Police (PSP) and the HAV Tester." (p.25). **HAVs used for testing must be properly registered and titled.** (p.25)	p.25
TRB, "Strategies to Advance Automated and Connected Vehicles" **(April 2018)**	**Licensing changes could be very disruptive, with conventional driver's licenses and AV/CV licensing both being accommodated for years to come.** Additionally, the specific level(s) of automation a driver would be allowed to operate would need to be determined and potentially broken out into multiple levels of licensing. (p.14). Fully autonomous vehicles (level 5) which will potentially not require any human rider to be licensed, could create an unexpected shortfall in revenue from licensing fees. (p.14).	p.14
Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana" **(Oct. 2016)**	Nevada – "All approved autonomous vehicles require a license plate upon registration issued by the Department to certify the vehicle is autonomous." – p. 27. California – "Special registration of autonomous vehicles is not needed by the CDMV" – p. 30	p.27, p.30

Bryant Walker Smith, "How Governments Can Promote Automated Driving" **(March 2016)**	"[G]overnments can update existing vehicle registration databases to include information about a vehicle's automation capabilities. This information may be useful in a variety of contexts, including administration of safety-based incentive programs, collection of relevant safety data, and enforcement of traffic safety laws. Consider, for example, a state that permits users of automated vehicles to text while in those vehicles. **If the registration database is properly updated (and perhaps coordinated), a police officer will be able to determine if a texting driver is acting lawfully by quickly running her license plate number."** (p. 115-116)	p. 115-116
TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies" **(2017)**	**Information on new driver training and licensing requirements (p. 4). "State legislatures would likely be the entities to codify new training and licensing criteria for operators of AV Level 3 through Level 5, incorporating any applicable federal standards.** Commercial vehicle driver/operator license requirements would likely be addressed at the federal level." [p.31]. "The agency responsible for implementation of revised licensing and training requirements would vary by state." (p. 31)	p.4; p.31
Report of the Massachusetts Autonomous Vehicle Working Group **(Feb. 2019)**	**Ohio - AVs up to level 3 and then AVs level 4-5 have separate registration requirements with DriveOhio (p. 68, p. 69). "When autonomous vehicles are eventually made available for public use [in Nevada], motorists will be required to obtain a special driver license endorsement and the DMV will issue green license plates for the vehicles." [p 72]. In Tennessee, "AVs are exempted from traditional licensing requirements" [p 79]**	p. 68; p. 69; p. 72; p. 79

Polichronis Stamatiadis, Nathan Gartner, Yuanchang Xie, and Danjue Chen, "Strategic Planning for Connected and Automated Vehicles in Massachusetts" **(May 2018)**	"**Driver training and licensing requirements will depend largely on the level of automation.** For level 3 CAVs, the operator must be able to recognize when she or he can engage automated driving functions and, if automated driving is on, when to take over vehicle control…Training will have to be expanded to reflect the operator's dual role, monitoring the roadway/vehicle conditions and driving the vehicle when needed. Level 3 CAV operators will have to be attentive to V2V and V2I warning messages in the vehicle. In the future, driver training and testing materials may need to be expanded to include these aspects." [p 44] **"For levels 4 and 5 CAV automation, driver licensing in the traditional form may be unnecessary. However, if the rider of a CAV is expected to intervene in an emergency, he or she still needs to be trained to do so. In addition, the owners of the vehicles will have to be educated about purchasing safe vehicles, the basics of their operation, and their maintenance requirements."** [p 44]	p. 44; p. 44
Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies" **(March 2017)**	Sample policy for vehicle registration - p. 82. Sample policy for licensing, p. 83	p. 82; p. 83
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development" **(Updated April 2021)**	States are traditionally responsible for driver-related aspects of vehicle regulation such as licensing and registration [p. ii].	p. ii

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding" **(Aug. 2019)**	San Francisco awarded Postmates a municipal permit to operate sidewalk robots in the city, limited operation to certain zoned streets and prohibiting tests on potential high-injury corridors. [p. 10]	p. 10
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles" **(2018)**	NHTSA's 2016 policy guidance document Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety, **confirmed the model state policy articulated in the 2013 policy that vehicle registration should remain a state responsibility, (p. 7-6) that the state should appoint a committee who should investigate existing registration requirements (among other things) and that Highly Automated Vehicles should be identified as such at registration. (pp. 7-6, 7-7, 7-10)** Examples of Florida, North Dakota, and Tennessee legislation (p. 7-17; p. 7-25; p. 7-20)	p. 7-6; p.7-7; p. 7-10; p. 7-17; p. 7-25; p 7-20
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0" **(Oct. 2018)**	State and local governments should "adapt policies and procedures, such as licensing and registration, to account for automated vehicles." (p. 18)	p. 18

USDOT "Automated Driving Systems 2.0 A Vision for Safety" **(Sept. 2017)**	**"NHTSA does not expect that States will need to create any particular new entity in order to support ADS activities, but States may decide to create some of these entities if the State determines that they will be useful."** (p. 22). States could request "Identification of each ADS that will be used on public roadways by VIN, vehicle type, or other unique identifiers such as the year, make, and model; and Identification of each test operator, the operator's driver license number, and the State or country in which the operator is licensed" from entities testing on public roads (p. 23). Best practices for legislatures - provide licensing and registration procedures" (p. 21)	p. 22; p. 23; p. 21
Bryant Walker Smith "Select Legal Considerations for Shared Autonomous Driving" **(July 2017)**	There are brief discussions about the role of registrations under the heading "Restricting" on pp. 7-8 and under the heading "Building from today's law" on p. 8.	p. 7-8; p. 8
National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act" **(July 2019)**	**Creation of a standardized registration regime is a key component of this Model Law.** See pp. 12-15.	p. 12-15

Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit" **(2017)**	**There was a strong consensus between the states that registration should be standardized across the states, with Maine and Connecticut wanting to have autonomous capabilities noted on the registration.** See p. 7.	p. 7

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Insurance / Liability	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines" **(Sept. 2020)**	Regulators should monitor current legal trends to ensure that insurance limits stay relevant. **There should be sufficient coverage available for third-party liability in scenarios where there is no distinction between property damage and personal injury. Jurisdictions with high liability insurance requirements for vehicles used for public transport should use similar considerations when creating liability insurance requirements for test vehicles that are designed for public transport.** (p. 31)	p. 31
Eno Center for Transportation, "Beyond Speculation: Automated Vehicles and Public Policy" **(April 2017)**	NHTSA "defines a vehicle's driver as whatever – as opposed to whomever – is doing the driving" (p. 11). **"Congress should pass legislation allowing NHTSA to issue system certifications to the technology in self-driving vehicles." (p. 12) – standards should change to address each level of automation. "NHTSA should support the harmonization of state tort laws that explicitly align liability with the certifications and roles of the ADS and the licensed human driver." (p. 14).** "States should create stakeholder working groups to oversee the development of laws." (p. 14)	p.11; p.12; p. 14
Virginia Reeder, Scott Schmidt "Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector" **(July 2019)**	"With respect to on-road testing, OEMs will need authorization from road jurisdictions that may require legislation and regulation. Part of that legislation–regulation would likely include definitions and limits on liability." (p.6)	p.6

Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force" **(Nov. 2016)**	"When the ADS is not engaged, then the human operator, if seated in an HAV with traditional vehicle controls – steering wheel, pedal, brake pedal, etc. – is no different from a driver of a standard vehicle. That person, who by law will be a licensed driver, will be subject to all applicable "rules of the road," as if they were driving a non-HAV." (p.20). **"Determining who is responsible for traditional criminal and civil liability in an HAV accident situation will either be determined on a case-by- case basis or would need to be addressed with an explicit legislative directive."(p.20)**	p.20
Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana" **(Oct. 2016)**	Car insurance premiums are based on the driving record, driver experience, and distance driven per year. Driverless vehicles don't have this information so the way car insurance premiums are done will need to change. (p.19). An AZ House Bill from 2012 included a clause saying the vehicle must be insured at $5M to qualify for testing. -p. 31. An Illinois House Bill includes submission of evidence of $5M in insurance, safety bond, or self-insurance to apply for a permit for testing (p.36)." There are conflicting views on the degree of automation that will be catered for and there is no direct assessment of where liability will be placed and how it will be accounted for. The insurance industry will have to address and resolve this issue before the onset of public use of autonomous vehicles. At the moment, almost all autonomous vehicle legislation requires a driver to be in the driver's seat of an autonomous vehicle and provide $5m in liability insurance." (p.19). Idaho SB 1108 – "It differs from other bills in other states in that it requires $1m liability insurance from the testing entity prior to testing, which is $4m less than what most states mandate." (p.35). **"Legislative options mentioned in Rand Report 443 include passing a statute limiting tort, passing legislation requiring insurance companies to adopt the "no-fault" system in which crash victims recover damages from their own insurance company rather than from the other party in the crash, or legislation requiring that the driver remains the responsible party irrespective of the level of automation of the vehicle." (p. 53-54).**	p.19, p.36, p.19, p.35, p.53-54

I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report" **(Dec. 2017)**	**"By requiring higher minimum levels of insurance, some safety risk can be mitigated. However, state agencies are also interested in promoting competition among industry players and higher minimum insurance requirements may disadvantage smaller companies."** [p 5]	p. 5
Bryant Walker Smith, "How Governments Can Promote Automated Driving" **(March 2016)**	"Raising insurance minimums can help consistently internalize the costs of crashes, which in turn can help automated driving compete fairly with conventional driving" (p.130). **"Insurers must be able to demonstrate to regulators that their proposed or actual rates are not 'excessive, inadequate, or unfairly discriminatory.' These arguments can turn on concrete data, which may be lacking for new applications such as automated driving and usage-based insurance. A dearth of these data could frustrate insurers seeking either to satisfy regulatory requirements or merely to accurately price their own risks.** A state conducting a legal audit should consider whether existing law obscures the data or distorts the economics of automated driving." (p.130-131)	p.130; p.130-131
TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies" **(2017)**	If an AV is in crash, there is diminishing argument to place fault on the human driver in the vehicle, especially considering the case of level 5 AVs where potentially none of the passengers would be designated as the driver and the vehicle may even be unoccupied. **Therefore, a no-fault approach to auto insurance makes sense.** This alleviates the concern that AV manufacturers have on being pursued for any incidents involving their vehicles, which could potentially slow growth. **On the other hand, there is some concern that without the market pressure of liability AV manufacturers will not be committed enough to safety.** The no-fault insurance approach both clarifies liability and reduces manufacturer liability but is disruptive to the existing insurance ecosystem and has been shown to increase insurance costs in the US where it has been adopted. [pp 68-71]. **No-fault insurance statutes would not include commercial trucking which uses different kinds of insurances and are regulated by different statutes.** [p 69]	p. 68-71

Report of the Massachusetts Autonomous Vehicle Working Group **(Feb. 2019)**	"Companies need only to carry minimum liability insurance policies to operate [in Arizona]… in addition, the vehicle owner must submit proof of financial responsibility, in an amount and on a form established by the Director of the Arizona Department of Transportation." [p 69]. "[Virginia] does not require a bond for automation testing." [p 70]. "Companies must provide evidence of an insurance policy, or self-insurance, worth $5,000,000 (compared to the $25,000/$50,000/$20,000 for a human driven car) [to test AVs in Nevada]" [p 71]. "[In Connecticut] Each vehicle must be registered, and have insurance coverage of at least $5M." [p 76]. In Texas, AVs are required to "be insured just like other cars." (p. 78). In Tennessee, "the autonomous system is considered the operator of the vehicle for the purpose of determining liability in the event of a collision or violation of traffic laws." [p 79]	p. 69; p. 70; p. 71; p. 76; p. 78; p. 79
Georgia House Autonomous Vehicle Technology Study Committee. "Report of the Georgia House Autonomous Vehicle Technology Study" **(Dec. 2014)**	When establishing liability after a vehicle accident, it is likely early that the performance of the ADS will be held to the same standards as the human driver. As systems become more advanced, autonomous vehicles will likely be held to higher safety and driving standards. (p. 4). Strict liability on the driver would commercialize automated vehicles quickly, but "collisions that could possibly occur when a human operator does not take control of the autonomous vehicle swiftly." (p. 4). **"If autonomous vehicle manufacturers have to comply with 50 different standards for development, then the inconsistent state regulations could be another factor for liability."** (p. 8).	p. 4; p. 8

Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies" **(March 2017)**	"Civil litigation surrounding AVs will follow current accepted practices related to vehicle crashes and evolve towards a critical examination of self-driving technology and its capabilities. **Glancy et al. (2016) also suggest that V2I may expose governments to litigation if defective programming leads to crashes."** [p 22]. "**Changing insurance requirements may consist of insuring oneself against injury, insuring like current ride services, and basing policies on telematics data due to its expanding availability** (Glancy et al., 2016). **It may also become common for vehicle owners to take on cyber insurance to protect them against hacking.** Another possibility is that CVs will make the assignment of fault very difficult or necessitate a change to the current system as well. **An alternative option for AV insurance could resemble a national compensation program." [p 22]**	p. 22

TRB, "A Look at the Legal Environment for Driverless Vehicles" **(Feb. 2016)**	There is a well-established body of civil liability law that prescribes legal liabilities of manufacturers and operators of traditional automobiles (p. 31). “Personal injury lawsuits against manufacturers and sellers of driverless vehicles—whether framed in negligence, strict liability, or other theories— likely will draw to some degree from decisions in prior cases involving products such as conventional vehicles and their components, GPS devices, autopilot functions on airplanes, and aeronautical charts.” (p. 33-34). “A proliferation of driverless vehicles eventually will lead to an “upward” shift in the locus of civil liability for everyday accidents, away from drivers and toward the manufacturers of these devices.” (p. 35). In terms of civil law - “Presently, the main issue before policymakers concerns whether to avoid this anticipated gradual change through the near-term enactment of statutes or promulgation of regulations that preempt or otherwise limit tort lawsuits associated with driverless vehicles." (p. 41). **“Given the shift in responsibility to the commercial marketers of driverless vehicles, one would also expect that the insurance burden (to the extent they choose to insure) would also shift to commercial policies covering dealers, OEMs, and others.” (p. 53).** “Whether rating driverless cars under a personal liability regime or a products liability regime, insurers will be challenged by lack of data. Testing data and simulations are helpful, but they are a poor substitute for actual data generated by the driving of these vehicles in the hands of the public.” (p. 60).	p. 31; p. 33-34; p. 35; p. 41; p. 53; p. 60
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development" **(Updated April 2021)**	States are traditionally responsible for driver-related aspects of vehicle regulation such as automobile insurance. USDOT’s 2018 report reiterated traditional roles and guided states to consider implementing minimum requirements for AV test drivers. [p. 8, p. 10]	p. 8; p. 10

Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway" **(Nov. 2020)**	Detailed discussion of the liability concerns and options the Swedish government and Volvo were grappling with in an effort to develop AV testing use case. (p.6)	p. 6
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles" **(2018)**	**Determining fault in a crash might require access to a vehicle's proprietary data. "Legislators and agencies need to evaluate carefully whether mandating access to proprietary data is fair and/or necessary.** If this problem is solved now among the stakeholders, it can save everyone time and money later on. If responsibility is legislated to be mainly on the manufacturers and the federal government, manufacturers may avoid the insecurity of a state-by-state-legal liability patchwork." (7-11). Michigan 2016 AV bill SB 996 (p. 7-18, 7-19). Texas 2017 SB 2205 (p. 7-22). "Several states impose special insurance requirements on C/AVs before they can be tested or deployed on public" roads. (p. 7-23). California testing requirements (p. 7-28). Finland's testing rules (p. 7-34). Sweden 2016 goals for HAVs (p. 7-35).	p. 7-11; p. 7-18; p. 7-19; p. 7-22; p. 7-23; p. 7-34; p. 7-35
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0" **(Oct. 2018)**	**"Compliance with the Federal safety standard does not automatically exempt any person from liability at common law, including tort liability for harm caused by negligent conduct, except where preemption may apply. The Federal standard would supersede if the effect of a State law tort claim would be to impose a performance standard on a motor vehicle or equipment manufacturer that is inconsistent with the Federal standard."** (p. 6)	p. 6

USDOT "Automated Driving Systems 2.0 A Vision for Safety" **(Sept. 2017)**	**States could request that entities testing on public roads show "Inclusion of evidence of the entity's ability to satisfy a judgment or judgments for damages for personal injury, death, or property damage caused by an ADS in the form of an instrument of insurance, a surety bond, or proof of self-insurance could provide increased safety assurance to the State."** (p. 23). States should "begin to consider how to allocate liability among ADS owners, operators, passengers, manufacturers, and other entities when a crash occurs" (p. 24).	p. 23; p. 24
Araz Taeihagh and Hazel Si Min Lim. "Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks" **(2018)**	"No clear legal framework exists that outlines how liability is apportioned between third parties responsible for designing AV systems – the manufacturer, supplier, software provider or the software operator – making the identification and separation of the various components that caused the malfunction difficult" (p. 110). Public ethics questions around liability and software (p. 110). "In the US, the federal government delegates most of the responsibility in determining liability rules to state governments…. NHTSA urges states to consider liability allocation, to determine who must carry motor vehicle insurance and to consider rules allocating tort liability. So far, most states have taken the first step towards a control-oriented strategy to address liability risks by revising the definitions of AVs." (p. 111). UK liability strategy (p. 111).	p. 110; p. 111
Bryant Walker Smith "Select Legal Considerations for Shared Autonomous Driving" **(July 2017)**	There are brief discussions about the role of insurance under the heading "Restricting" on pp. 7-8 and under the heading "Harmonization versus customization." on p. 10.	p. 7-8; p. 10

National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act" **(July 2019)**	This Model Law retains any mandatory insurance requirements in place as otherwise required by state statute. See p. 10.	p. 10
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape" **(July 2019)**	Some of the state write ups have references to required insurance (see Florida, Iowa, Louisiana, Maryland, Nebraska, North Carolina, Oregon, Texas). There is also an entire section dedicated to “Liability and Insurance” on pp. 12-13. **The key takeaway is that there will be a lot of disruption in the insurance space, as some states allow manufacturers to self-insure while other states make the owner (rather than the operator) liable.**	p. 12-13
Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit" **(2017)**	There was broad consensus that state’s new to address insurance issues. Full section in summary document. See page 8.	p. 8

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Data Sharing	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines **(Sept. 2020)**	**Drivers need to be aware of the privacy/data sharing policies of the manufacturer and any third party with access to the data** (p. 73). Jurisdictions should "Conduct a thorough review of jurisdictional laws pertaining to the collection and dissemination of data" (p. 74). AV manufacturers and operators should submit crash-related data to the jurisdiction to expand AV data. **Information should include instances of a crash, disengagements by the user or by the system, when users are unexpected prompted to take over in manual mode, and manufacturers' analysis of the crash.** (p. 56).	p. 73; p. 74; p. 56
USDOT, "Automated Vehicles Comprehensive Plan" **(Jan. 2021)**	Ensure privacy and data security – **"The U.S. Government will use a holistic, risk based approach to protect the security of data and the public's privacy as AV technologies are designed and integrated. This will include protecting driver and passenger data as well as the data of passive third parties— such as pedestrians about whom AVs may collect data— from privacy risks such as unauthorized access, collection, use, or sharing."** (p.3).	p.3
Eno Center for Transportation, "Beyond Speculation: Automated Vehicles and Public Policy" **(April 2017)**	**"NHTSA should explicitly define that the ownership of the vehicle's data corresponds to the operator of the vehicle" (p. 16). "Congress should explicitly require the AV industry to protect the privacy of vehicle owners." (p. 16). "Congress should define AV developers' limited liability for crashes that result from a security breach" (p. 16). "Cities and states should establish data sharing agreements to enhance local transportation planning and operations." (p. 17).** "States and cities should update laws that prohibit and punish any deceiving or disabling of AV communications." (p. 17).	p. 16; p. 17

Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems" **(May 2018)**	A key question when considering AV testing program metrics was the threshold for reporting crashes to the DMV. "A high rate of AV crashes during testing could indicate a problem with the manufacturer's testing policies or training." "However, there may be scenarios in which the AV would not be considered at fault for the crash, such as when the AV is hit from behind, but some aspect of the AV behavior may have contributed to the crash. **Since the safety of the testing program relies on the combination of the AV technology and the test driver, all crashes that would typically be reportable under the normal DMV rules should continue to be reportable under the AV testing program, whether or not the AV system was engaged at the time of the crash. On the other extreme, reporting could include not just crashes but crash surrogate events, near misses, or system failures requiring immediate driver intervention."** (p. 140). Should the DMV require the EDR data to be submitted in the event of a crash? **For EDR data to be useful, it would need to be standardized.** "Rather than requiring raw EDR data, evaluators would be better served by a crash report containing summarized driving data (including a timeline of AV speed, brake activation, AV system state, and test driver interventions) along with the test driver's narrative of the crash."	p.140
Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector" **(July 2019)**	"About 40 cities are using the Mobility Data Specification, developed by the City of Los Angeles. This specification requires that mobility companies share data in real time." [p. 3] "Florida DOT has developed an enterprise-wide information technology strategy to manage its data sharing; this strategy is termed as the Reliable, Organized, Accurate Data Sharing (ROADS) initiative." [p. 4] "Vehicles themselves will likely need to provide operations data to jurisdictions to support management of SM and road usage, and they will need to record safety data related to pre- and post-crash conditions." [p. 5] "OEMs will… have the responsibility to ensure the cybersecurity of any vehicle-related data and transmissions." [p. 5] TNC's are looking to the public sector to develop data standards, but also worry that such standards could "stand in the way" of the data's utility value. [p. 6].	p. 3; p. 4; p.5; p.6

Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force" **(Nov. 2016)**	"What data should be collected, and can be collected, under applicable federal and state laws, regulations or policies? What does the Commonwealth, and ultimately, the public, need to know to ensure that testing is proceeding properly? What data ultimately will prove that testing was a success?" (p.14). On a semi-annual basis, organizations must submit data to PennDOT. Mandatory testing data includes total number of miles traveled by engaged HAVs in PA; total numbers of hours engaged HAVs operated on PA trafficways; and size of HAV fleet testing in PA. **Voluntary testing data includes a list of PA counties where engaged HAVs were tested and percentage of testing in PA that occurred on limited access trafficways. Mandatory safety data includes the number of reportable crashes in PA involving an HAV and the number of reportable crashes where the HAV was deemed at fault. Voluntary safety data includes the number of disengagements.(p.29-30). Companies will inform PennDOT of any reportable crash involving an HAV within 24 hours.** If the crash occurred on a PA Turnpike Commission road, the Turnpike Commission must be informed as well. (p.30-31).	p.14; p.29-30; p.30-31
Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana" **(Oct. 2016)**	"Generally, insurance companies assume ownership of the data collected in their EDRs. V2V and V2I data are also likely to be stored somewhere, but who owns it, with whom will it be shared, how will it be made available, and how will it be used? There are likely to be many who would like to gain access to the data such as trial lawyers, law enforcement, researchers, industry, or other insurance companies" (p.54). According to NHTSA, "The vehicle must be able to record sensor data for at least thirty seconds before a crash involving another vehicle, a human person, or an object while in autonomous vehicle mode. The data can be extracted in an unalterable format (read-only), and the recorder should retain the data for three years from the day of the crash. Manufacturers are responsible for notifying purchasers in writing of the kind of information collected in the vehicle's internal database." (p.36).	p.54, p.36

I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report" **(Dec. 2017)**	"Agencies must also determine their scope of responsibility [with data]; many agencies have chosen to leave app development to third parties and simply provide data to these entities. Data latency was also a key issue highlighted through the presentations. Agencies discussed some innovative data sharing approaches, such as Virginia DOT's SmarterRoads.org data portal and Florida DOT's Data Integration and Video Aggregation System (DIVAS)." [p 5]. **Requiring too much data be shared can result in a large financial burden to store that data. Regulators should consider what they need to know and work backwards from those needs to define data requirements. [p 7]. When considering data sharing of individual user's information, there needs to be defined legal responsibility to protect the privacy of the public. [p 16].**	p.5; p.7; p.16
Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities" **(June 2020)**	"Cities should not underestimate the importance of new mobility data, and should therefore ensure that access to data is included in policies, codes, contracts, pilot programs, etc. **Mandatory data sharing requirements for mobility providers…would ideally exist at the state level. In the absence of statewide data sharing laws, cities should require data sharing as part of permitting right-of-way use." (**p.18). Portland example of mobility data sharing provisions (p.18-19).	p.18, p.18-19
TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies" **(2017)**	**When it comes to CVs there is a need to clarify what data will be available from CVs to the government entities that own the infrastructure it communicates with.** "The assumption is that DSRC data (basic safety message 1 and 2) will be freely accessible to state and local agencies and other stakeholders." (p.77).	p. 77

Report of the Massachusetts Autonomous Vehicle Working Group **(Feb. 2019)**	"[Pennsylvania] requests semi-annual submission of a simple "Data Collection Form" (p. 67). "Companies are not required to track crashes or disengagements or to report any information [in Arizona]." [p 69]. "Governance in Nevada requires that no later than 7 months after a company is issued a permit, it must provide reports of the number of motor vehicles that occurred in the first 6 months and the highest, lowest, and average amount paid for bodily harm occurred in crashes, and the same information for property damage." (p. 71). "The only data sharing requirements [in Washington DC] are that initial applicants are required to undergo training certification in AV operation from a self-driving car dealership or manufacturer." [p 75]. "[In Connecticut] Testing companies must provide non-confidential information to the secretary and the task force that the secretary and task force deem to be appropriate for measuring the performance of the pilot program." [p 76].	p. 67; p. 69; p. 71; p. 75; p. 76
Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies" **(March 2017)**	**"Privacy concerns over the collection and use of data fall into two categories: the government's ability to access an individual's location and personal data, and the private, commercial use of personal data (Kohler and Colbert-Taylor, 2015)… AV users have the reasonable expectation of privacy in their vehicles including for trips, location, and communications" [p 23].**	p. 23

TRB " A Look at the Legal Environment for Driverless Vehicles" **(Feb. 2016)**	"Among their privacy consequences, driverless vehicles will collect a tremendous amount of information regarding their users' movements, information that law enforcement may want to obtain without a search warrant. It is anticipated that these efforts will be challenged by defendants and others who regard such efforts as impermissible under the Fourth Amendment to the United States Constitution" (p. 44-45). **Drivers Privacy Protection Act – "This federal statute protects an individual's personal information contained in motor vehicle registration and licensing records held by state motor vehicle departments (DMVs).** Disclosure of DMV personal information without the written consent of the subject of the information is prohibited unless an exception applies. This federal law regulating the privacy of DMV vehicle records will apply to owners of driverless vehicles licensed and registered by state departments of motor vehicles." (p. 63) Fair information practices and personal information protection from privacy breaches (p. 63)	p. 44-45; p. 63; p. 63
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development" **(Updated April 2021)**	An unknown is to what extent various parties of AVs (vehicle owners, operators, manufacturers, insurers, etc.) have access and rights to data generated by automated vehicles [p. ii]. Issues on data collection include storage and access to vehicle testing crash data, data ownership, and consumer privacy. **At the time of the report there were no laws in place precluding reselling of data to third parties. [p. 5].** H.R. 3388 would have required manufacturers to develop data private plans, while S. 1885 would have required NHTSA to establish on online database on the types of PII collected for both AV and non-AV vehicles. [p. 18].	p. ii; p. 5; p. 18

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding" **(Aug. 2019)**	Public agencies perceive the amount of information shared by AVs to be inadequate for further planning purposes. [p. iv]. **Leveraging AVs as data-collectors can be a motivation for cities to work with AV companies and get feedback on traffic flow and patterns in the area.** [p. 18].	p. iv; p. 18
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles" **(2018)**	NHTSA's 2017 policy document for highly automated vehicles, Automated Driving Systems 2.0 A Vision for Safety, recommends that "Entities engaged in testing/deployment are encouraged to establish a process for data collection and validation to establish crash causes leading to fatalities/injuries. ADS data recommended to be stored and available for retrieval for crash reconstruction." (p. 7-10). Statements by NHTSA and USDOT from 2013 and 2015 attempt to distinguish the function and regulation of EDR data, a matter of state law, from that of CAV data which was considered proprietary to the HAV developers/manufacturers. (p. 7-11, 7-12). Michigan's SB 996 covers the SAVE Project (p. 7-18). Nevada and DC - EDRs (p. 7-19-7-20). By 2017, Sweden, the UK, Singapore and Australia had contemplated the regulation of data at some level either in guidance policies, goal statements, or introduced legislation. By 2018, laws had not been passed in these countries. (pp. 7-35 through 7-41).	p. 7-10; p. 7-11; p. 7-12; p. 7-18; p. 7-19; p. 7-20; p. 7-35-7-41

Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation" **(March 2017)**	**The risk in data sharing with the state government is that corporate proprietary data may be exposed in state open records requests.** (p. 11-12).	p. 11-12
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0" **(Oct. 2018)**	The private sector should identify opportunities for voluntary data exchanges. (p. 30).	p. 30
USDOT "Automated Driving Systems 2.0 A Vision for Safety" **(Sept. 2017)**	"If communications with an operations center, collision notification center, or vehicle communications technology exist, relevant data is encouraged to be communicated and shared to help reduce the harm resulting from the crash." (p. 13). **"Currently, no standard data elements exist for law enforcement, researchers, and others to use in determining why an ADS-enabled vehicle crashed.** Therefore, entities engaging in testing or deployment are encouraged to establish a documented process for testing, validating, and collecting necessary data related to the occurrence of malfunctions, degradations, or failures in a way that can be used to establish the cause of any crash. **Data should be collected for on-road testing and use, and entities are encouraged to adopt voluntary guidance, best practices, design principles, and standards issued by accredited standards developing organizations such as SAE International"** (p. 14).	p. 13; p. 14

Araz Taeihagh and Hazel Si Min Lim. "Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks" **(2018)**	**"Multiple issues regarding informational privacy remain unclear: the exact reasons why information is being collected, the types of information being collected, accessibility to the information and the permissible duration of information storage have not been clarified"** (p. 113). **"V2V and V2I communications allow information to be transmitted between AVs for safety reasons, but they also expose the vehicle's movements and geographical location to external networks, from which people can access to locate an AV user" (p. 113). "Another issue is the use of EDRs for ascertaining the exact causes of accidents, as this data may be sold to third parties such as insurance companies and used against drivers" (p. 113). "Other cited risks to informational privacy are the possibility of using this information to harass AV users through marketing and advertising, to steal users' identity, profile users and predict their actions, concentrating information and power over large numbers of individuals"** (p. 113).	p. 113
Douglas Gettman, J. Sam Lott, Gwen Goodwin, and Tom Harrington "Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations" **(Oct. 2017)**	Cybersecurity: "The Security and Privacy in Your Car Act prescribes vehicle manufacturers to detect, report, and stop hacks that interfere with personal data or vehicle control." (p. 86).	p. 86
Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving" **(July 2017)**	There is a discussion on reporting requirements under the heading "Monitoring" on p. 6.	p. 6

National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act" **(July 2019)**	**No self-reporting requirements are imposed.** They are delegated to other areas of statutory or regulatory law. (See p. 23).	p. 23
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape" **July 2019**	There is an entire section on “Data privacy and security” on p. 15. Key takeaway is that there is no consensus federally or at the state level.	p. 15
Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit" **(2017)**	There was significant discussion about data collection and recorders. See page 8.	p. 8

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Governance Issues	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines	**A lead agency should be chosen within each jurisdiction to address AV testing and deployment.** (p. 17). "Skills testing, licensure, and rules of the road compliance rest with the jurisdictions. Jurisdiction skills testing and licensure of an ADS are difficult to implement without federal standards. A jurisdictional certification process at this time could create a false sense of security and create liability for the jurisdiction" (p. 34). Jurisdictions need to address: ": Is the driver of a vehicle with automated features engaged still responsible for the operation of that vehicle even if they are not performing the DDT?" (p. 60).	P. 17; p. 34; p. 60
SDOT, "Automated Vehicles Comprehensive Plan" **(Jan. 2021)**	"The U.S. Government will adopt—and promote the adoption on an international level of—flexible, technology-neutral policies that will allow the public, not the Federal Government or foreign governments, to choose the most economically efficient and effective transportation and mobility solutions" (p. 4). "Exemptions and waivers are key near-term tools for safely enabling research, testing, and demonstration projects, as well as deployment, and U.S. DOT will continue to exercise these authorities where appropriate and consistent with all applicable legal requirements." (p. 10). Update existing regulations to remove unnecessary barriers – conduct rulemaking and research to adapt existing FMVSS to remove unintended and unnecessary barriers to the introduction of novel vehicle designs and features enabled by ADS (p. 11-12).	p. 4; p. 10; p.11-12

Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems" **(May 2018)**	With traditional vehicles, the DMV ensures public safety through driver licensing. However, in the California regulations, SAE Levels 3-5 vehicles would not require a driver to remain attentive. **NHTSA has the authority to enforce recalls or impose fines, so the only mechanism to ensure AV safety in deployment is an AV deployment permit.** (p. 141).	p.141
Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector" **(July 2019)**	"OEMs… seek consistency of regulatory requirements between states and other local jurisdictions." [p. 6]. "The public sector should play the role of steward of the private sector as AVs become reality" [p. 6].	p. 6
I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report" **(Dec. 2017)**	[recommended] that states identify a champion as a first step in CAV implementation." [p 3]. **"In Maryland, the decision not to enact legislation provided much needed flexibility and efficiency in the DOT's approach and their use of the Expression of Interest form allows all stakeholders a single point of entry."** [p 5]. "The DOT established a cross-agency Connected and Autonomous Vehicles Working Group in 2015 led by the Maryland Motor Vehicle Administration. **The MVA was deemed the appropriate lead agency because its mission is focused on safety and its key statutory responsibilities include driver education and driver and vehicle licensing."** [p 8].	p.3; p.5; p.8

Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities" **(June 2020)**	"At the federal and state level, regulations have focused on safety, testing, data collection, insurance, liability, and licensing. Local regulations have focused on how AV technology is integrated into city transportation systems." [p 50]. "As of 2019, thirty-seven states have adopted regulations related to AVs… twelve states authorize the use of AVs without a human driver in the vehicle." [p 51].	p. 50; p.51
Bryant Walker Smith, "How Governments Can Promote Automated Driving" **(March 2016)**	**"Governments, particularly in cooperation with each other, can use their purchasing power to expand the market for advanced driver assistance and advanced emergency intervention systems…these policies could help to create economies of scale for vehicle makers and their suppliers and to encourage the quicker introduction of advanced systems into less expensive vehicles." (p.118-119). Formalizing a robust statutory or regulatory exemption authority could provide developers with prospective certainty without reducing the flexibility available to them under current enforcement discretion. [p 132].**	p.118-119, p. 132
TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies" **(2017)**	"A subsidy strategy for CV technologies will provide a specific price signal that will encourage the adoption of the technologies. With the issuance of the NHTSA NPRM, the subsidy may only be needed for retrofits. However, subsidizing this technology will, by design, accelerate that adoption, which will be disruptive even for many unrelated segments of the economy. Subsidies will likely require authorization and legislation at their respective levels that create barriers to implementation." [p 75]. If dedicated CV/AV lanes are to be realized within the current structures of managed lanes, the bond covenants may need to be modified to permit this new user group, especially if they are allowed to use the roadway at a special toll rate. [p 80]. CVs and AVs should NOT be the recipients of preferential parking programs. [pp 83-85].	p. 75, p. 80, p. 83-85

Report of the Massachusetts Autonomous Vehicle Working Group **(Feb. 2019)**	**Chapter 4 (pp 14-17) lays out the current landscape of roles and responsibilities in regards to AV governance. This is useful as a potential template and for its content.**	p. 14-17
Georgia House Autonomous Vehicle Technology Study Committee. "Report of the Georgia House Autonomous Vehicle Technology Study" **(Dec. 2014)**	"One primary suggestion is to avoid unnecessary obstacles for the development of the autonomous vehicle technology (for example, by not imposing requirements that assume automation level 3). **It is important to pass flexible legislation that would allow the technology to easily move between development stages and, eventually, from the "lab" to the market without having to pass new legislation and with as few regulatory changes as possible" (p. 7).** To best promote AVs in Georgia, a pro-business climate with low taxes and minimal registration is needed (p. 11).	p.7; p.11
Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation" **(Dec. 2020)**	Reform regulation to allow for AV deployment at scale. (p. 2). USDOT should create a new vehicle class within the FMVSS for AVs (p. 3). "Clarify applicability of "make inoperative" prohibition" (p. 3) USDOT should improve the exemption petition process (p.4). "To provide for meaningful AV deployments, the U.S. Congress should enact legislation to increase the existing cap on temporary exemptions that can be granted to AVs." (p. 5). "DOT should embrace innovative regulatory approaches that are appropriately matched to the current pace of technological advancement." (p. 5). **"The U.S. Congress should enact legislation to clarify federal and state roles related to AVs. The federal government should maintain responsibility for the design, construction, and performance of motor vehicles, while states should continue to oversee licensing of human drivers, registration, insurance, and traffic laws." (p. 7) Promote industry standards (p. 10).**	p. 2; p. 3; p. 4; p. 5; p. 7; p. 10

CAT PLR Working Group, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share" **(July 2019)**	"Unlike a traditional DOT planning process, where a state might have a "Highway Improvement Plan" and an "Asset Management Plan", the need for a CAV/CAT Policy Framework—the context for the state's eventual CAV/CAT plan-- seems to be approached slightly differently in each state, and there is no real "box" to fit it in to. Core elements vary, a potential reflection of various levels of authority that the project had or the impetus driving the initiative to begin with." (p. 3).	p.3
Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies" **(March 2017)**	"First, regulators and standards organizations should develop common vocabularies and definitions that are useful in the legal, technical, and public realms. Second, the United States should closely monitor efforts to amend or interpret the 1969 Vienna Convention, which contains language similar to the Geneva Convention but does not bind the United States. Third, NHTSA should indicate the likely scope and schedule of potential regulatory action. Fourth, U.S. states should analyze how their vehicle codes would or should apply to automated vehicles, including those that have an identifiable human operator and those that do not. Finally, additional research on laws applicable to trucks, buses, taxis, low speed vehicles, and other specialty vehicles may be useful." [p 23]. **Pages 80 to 84 have draft language for a state bill (Smith 2014) which covers basic legal definitions, a structure for further regulating CAVs, registration, licensing, and modifications to the rules of the road.**	p. 23; p. 80-84

TRB " A Look at the Legal Environment for Driverless Vehicles"	“Driverless vehicles will develop a complicated, multifaceted relationship with federal and state criminal law and procedure. These devices may lead to the recognition of new crimes, even as they reduce the overall number of traffic infractions and other crimes committed with automobiles. They also may enhance the surveillance capabilities of the government, even as they diminish the number of traffic stops that, today, represent the most common form of interaction between police officers and the general public.” (p. 41). “State law systems will continue to govern most civil and criminal liability issues, as well as vehicle licensing, insurance, land use, and privacy matters. Unless states adopt driverless vehicle laws that override local regulation, local ordinances will govern many aspects of everyday use of driverless vehicles, such as speed limits, parking, ride-services, and the like.” (p. 69).“Federal regulation will provide national standards for driverless vehicles, particularly with regard to safety and environmental impacts. Then state laws will build state licensing and registration standards that incorporate federal standards…Then state legislatures and regulatory agencies would adopt compatible state laws and regulations with regard to such matters as licensing driverless vehicles for road use within each state, insurance of driverless vehicles, and the like. Once state law permits driverless vehicles on state roadways, local ordinances will regulate ordinary aspects of how driverless vehicles are used locally, such as parking, speed limits, and the like.” (p. 70).	p. 41; p. 69; p. 70
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development"	Key issues for legislation not passing in the 115th Congress included altering traditional divisions of vehicle regulation between federal and state governments, how many pilot tests should be permitted, detail in addressing cybersecurity threats, and access to data between various parties. [p. ii, p. 15-16]. H.R. 3388 and S. 1885 both would have included establishment of advisory panels for AV safety and vehicle standards, either through NHTSA or a new committee/council. [p. 18]. "State governments have a role with respect to vehicle and pedestrian safety, privacy, cybersecurity, and linkage with advanced communications networks.” [p. 19].	p. ii; p. 15-16; p. 18; p. 19

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding"	Government involvement in sidewalk AV delivery robots is more limited because passengers are not transported on the vehicles, meaning companies can avoid or circumvent any existing AV regulations for transporting passengers. San Francisco is an example of a city that banned sidewalk robot devices out of concern for pedestrian safety. [p. 9-10]. Cities' immediate role with AV testing and pilots is to permit or prohibit AV operations (when not already preempted by state law). Massachusetts' system is unique in allowing each municipality to opt-in and approve AV testing – this system may discourage AV companies to operate in the state due to the need to apply for approval with each city about a testing location. The State of New York retains approval rights for AV testing but has allowed municipalities (i.e. New York City) to oppose AV testing. [p. 10-11]. In some cases of state preemption, AV operators must apply for a permit with the state to test and deploy on public roads, but they do not have to get permission from local municipalities (only provide notification). [p. 17].	p. 9-10; p. 10-11; p. 17
Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway"	Presents 4 modes of regulation (p. 2). Presents 4 regulatory design factors necessary for effective regulation (p. 2-3). High level discussion of variation in AV laws in US and the evolution of traffic laws and efforts to harmonize AV laws in the EU. (p. 3-4). Though Norway and Sweden's effort to create AV regulation have differed, both countries referenced the Geneva and Vienna Conventions to which both countries are signatories, that require that a human driver be in control of a vehicle, thus acting as a barrier to self-driving cars. (p. 5).	p. 2; p. 3; p. 3-4; p. 5
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles"	States requiring the creation of a study group to oversee testing, pilots or deployment, or research product to gather more information: Washington (2017), Wisconsin (2017), North Dakota (2015). (p. 7-24 through 7-25). The U.S. House's 2017 failed Safely Ensuring Lives Future Deployment and Research in Vehicle Evolution Act (Self Drive Act) H.R. 3388. (p. 7-3). NHTSA's model state policy (from 2016 policy guidance document Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety, enumerates separate roles for HNTSA and for states (p. 7-6; 7-10).	p. 7-24; p. 7-25; p. 7-3; p. 7-6; p.

Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation"	Infrastructure should be updated and modernized via P3s. (p. 14). Congress should invest in future technologies (p. 24).	p. 14; p. 24
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0"	USDOT has the “authority to establish motor vehicle safety standards that allow for innovative automated vehicle designs" (p. ix). NHTSA – safety authority over ADS-equipped vehicles and equipment, also has the ability to set federal safety standards for ADS equipped vehicles (p. 6). “Under Federal law, no State or local government may enforce a law on the safety performance of a motor vehicle or motor vehicle equipment that differs in any way from the Federal standard” (p. 6). Ways that state, local, and tribal governments can prepare for automation: “Review laws and regulations that may create barriers to testing and deploying automated vehicles; Adapt policies and procedures, such as licensing and registration, to account for automated vehicles; Assess infrastructure elements, such as road markings and signage, so that they are conducive to the operation of automated vehicles; Provide guidance, information, and training to prepare the transportation workforce and the general public.” (p. 18).	p. ix; p. 6; p. 18
USDOT "Automated Driving Systems 2.0 A Vision for Safety"	NHTSA responsibilities: “Setting Federal Motor Vehicle Safety Standards (FMVSSs) for new motor vehicles and motor vehicle equipment (with which manufacturers must certify compliance before they sell their vehicles)” (p. 20); Enforcing compliance with FMVSSs (p. 20); Investigating and managing the recall and remedy of noncompliance and safety-related motor vehicle defects nationwide (p. 20);Communicating with and educating the public about motor vehicle safety issues" (p. 20). States’ responsibilities: “Licensing human drivers and registering motor vehicles in their jurisdictions”; “Enacting and enforcing traffic laws and regulations”; “Conducting safety inspections, where States choose to do so”; “Regulating motor vehicle insurance and liability” (p. 20).	p. 20

Araz Taeihagh and Hazel Si Min Lim. "Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks"	US - “The responsibilities of the federal and state governments were clarified in the “Self Drive Act” in late 2017, which establishes NHTSA as the “preeminent regulating body” and allows states to enforce new standards on AVs only if they are “identical” to what is prescribed by federal law. It seems with AVs, the legal competence of the federal government will grow while that of state governments’ shrinks.” (p. 108). UK roles and responsibilities (p. 108). “In the US, the federal government delegates most of the responsibility in determining liability rules to state governments…. NHTSA urges states to consider liability allocation, to determine who must carry motor vehicle insurance and to consider rules allocating tort liability. So far, most states have taken the first step towards a control-oriented strategy to address liability risks by revising the definitions of AVs” (p. 111).	p. 108; p.111
Douglas Gettman, J. Sam Lott, Gwen Goodwin, and Tom Harrington "Impacts of Laws and Regulations on CV and AV Technology Introduction in Transit Operations"	Workforce - section 13c of the Federal Transit Act (p. 55). AV Taxis/TNCs - “local level concern(ing) the full compliance with federal law and regulatory requirements for public transit services when providers are using federal funds” (p. 68). Federal anti-discrimination laws to protect public transit users: Title VI of the Civil Rights Act (FTA regulations) protects racial minorities, Americans with Disabilities Act (FTA regulations) protects physically disabled (p. 85). Buy America impacts what vehicles can be deployed (p. 85). Safety assurance roles and responsibilities (p. 47-48).	p. 55; p. 68; p. 85; p. 47-48
Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving"	This entire paper is about approaches to legislation.	
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape"	Each state write up has its own approach to legislation, oversight, and responsibilities. Most states have adopted a laissez faire approach to regulation.	

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Local Coordination	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines	Jurisdictions should have the authority to fine, suspend, or revoke any permit if the permit holders violate permit or safety conditions. Jurisdictions should also consider imposition of further penalties (p. 25). For regular motor vehicle safety inspections, jurisdictions should not be expected to create new AV-specific safety inspection programs. (p. 25). Traffic regulations are specific to each jurisdiction. “Jurisdictions will need to examine their traffic laws to identify laws that may not be relevant or appropriate for ADS-equipped vehicles and amend them as necessary" (p. 67).	p. 25; p. 25; p. 67
Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector"	“elected officials leading these entities would be looking for some early wins and wanting to show how these investments would be able to benefit the community” [p. 7]. “Cities and local agencies will look to the state and federal governments for leadership and guidance in data standards and collection, including for legislation that protects the data from discovery in court. Some expressed a preference for the state and federal governments to consider an opt in–opt out policy approach for data sharing that provides the flexibility of joining.” [p. 7].	p.7
Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force"	In Pennsylvania, both the Department of Transportation and the Pennsylvania Turnpike Commission can prohibit or restrict testing during extreme weather, emergencies, special events, or from a local request. (p.31).	p.31

Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities"	“Despite this patchwork of federal and state regulation there is still an important role for local regulation of AVs. At this early stage of the technology, most local regulation has come in the form of pilot programs.” [p52]. Examples - Portland, OR, and Chandler, AZ, p. 52.	p. 52
Report of the Massachusetts Autonomous Vehicle Working Group	“[In Ohio] Companies must inform DriveOhio of plans to test an AV without a human operator, including the routes or areas where testing will occur, and the designated operators. The company and DriveOhio will also coordinate on providing notification to relevant municipalities where testing will occur.” [p 69]. Connecticut process - p. 76.	p. 69; p. 76
Anita Kim, Dan Bogard, David Perlman, Ryan Harrington. "Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles "	“If manufacturers want to sell vehicles only intended for automated operation, with no way for human occupants to drive the vehicle, they are likely to have difficulty certifying to requirements for a foot-actuated service brake control (517.135), a designated seating position for the driver (571.207), a steering wheel (a requirement for completing tests specified in 571.126), and certain controls and displays.” (p.11) Low speed vehicles have fewer requirements than conventional light and heavy duty vehicles and may be an easier path to certify an AV through FMVSS (p. 11).	p. 11

Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation"	“The current patchwork of AV laws and regulations at the state level presents challenges for manufacturers seeking to test and deploy AVs in multiple states. AV testing and deployment across state lines could be significantly improved if states coordinated with each other and sought to ensure consistency of AV laws and regulations. A federal grant program could be established to provide funding to states that agree to work together to harmonize policies that govern the testing and deployment of AVs. In addition, a unified approach to AV licensing and registration should be encouraged.” (p. 7) Align state traffic laws – “. To the extent possible, states should be encouraged to harmonize traffic laws and regulations, particularly those that apply to the operation of AVs on public roads." (p. 8).	p. 7; p. 8
CAT PLR Working Group, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share"	“Whether establishing a working group, advisory committee, or responding to a legislative inquiry, it is important to have a recognized entity that is perceived to carry weight when it presents its findings and recommendations.” (p. 1).	p. 1
TRB " A Look at the Legal Environment for Driverless Vehicles"	“In some contexts, driverless vehicles eventually may lead to the reassignment of criminal liability from its current bearer to someone (or something) else, or to the replacement of low-level sanctions with other methods of deterrence and punishment.” (p. 42).	p. 42

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding"	Municipal and regional governments are constrained by existing federal and state laws. States have taken the lead in establishing regulatory oversight with respect to liability, safety requirements, and state law enforcement. [p. iv]. Some state laws preempt municipalities for further regulation on AVs, which may include barring AV testing on public roads or prohibiting special taxation. [p. iv]. Some transit agencies have participated in partnerships between cities and AVs to help test their worthiness in complementing transit systems and improving service. [p. iv]. Public sector staff often perceived a lack of adequate coordination between the public organization and AV companies during testing partnerships. [p. 9]. 15 cities in Massachusetts formed the Massachusetts AV Coalition through support of the Metropolitan Area Council (APC) in response to state policy. Rules of the coalition require each member to submit maps of streets that are open for testing. The coalition aims to balance considerations of local control with needs for facilitating AV testing. [p. 11-12].	p. iv; p. 9; p. 11-12
Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway"	See general discussion of flexibility and context responsiveness in regulatory design (p. 2-3).	p. 2-3
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles"	Texas (2017) and Tennessee (2017) state AV laws preempt local governmental entities from regulating AVs. (p. 7-25). Cities including Boston, Coure d'Alene, Idaho, Pittsburgh have regulated AVs through city ordinances, either through agreements or code amendments. (p. 7-31)	p. 7-25; p. 7-31

National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act"	This Modal Law anticipates that automated vehicles will still be subject to compliance with traffic laws. (See pp 21-23).	p. 21-23
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape"	Several states' regulatory schemes require that AV testing and deployment regimes comply with all motor vehicle laws (see Arizona, Florida, Minnesota, Nebraska, North Carolina, Washington DC.	
Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit"	There was a detailed discussion regarding the tole of law enforcement. It is reposted in the word document for ease of access. See p. 8.	p. 8

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Public Outreach / Education	
Robyn D. Robertson, Heather Woods-Fry, Ward G.M. Vanlaar, Marisela Mainegra Hin , "Automated Vehicles and Older Drivers in Canada"	Older adults have limited knowledge but are interested in educating themselves on LSDVs (p. 196). Increased safety benefits for all drivers, increased mobility benefits for older drivers, concerns over risky behaviors from drivers in LSDVs (driving drunk, sleeping, driving distracted, etc.) (p. 197). Education: Safety – how LSDVs keep drivers safe in a crash, how LSDVs resist hacking or react to technology failures; Performance – how LSDVs perform in extreme weather or traffic; how do drivers take over control (p. 197-198). Almost half of participants expressed interest in a hands-on learning experience (simulator or closed course). Some participants expressed interest in classroom setting learning experience (to then apply to hands-on training) (p. 198).	p. 196, p. 197; p. 198
Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems"	In safeguarding public interest, “The primary challenges for the DMV included how to document that the technology has reached a maturity sufficient for public road testing and that the manufacturer is performing the public road testing without taking unnecessary risks.”	p. 138
TRB, "Strategies to Advance Automated and Connected Vehicles"	Resources, expertise, and staff from existing public outreach/education programs (such as seat belt usage, sharing the road with cyclists, or risks of impaired driving) can be leveraged and expanded to accommodate AV/CV public education. (p.15).	p.15

Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana"	“One of the obstacles autonomous vehicles face is that people generally like to drive and be personally in control of the vehicle. While they are in control of the vehicle, they feel safer than if the vehicle were being driven by someone else. This may also apply to transferring control to a machine unless it has demonstrated that it is trustworthy or autonomous operation is reserved for safer operating conditions such as stop/start operation on a congested highway.” (p.50).	p.50
I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report"	The Department of Aging is a key stakeholder (if there is one in the state) but is frequently overlooked. The elderly stand to gain a lot from CAVs but are also likely to not understand the technology. [p 20].	p.20
NCHRP, "Strategies to Advance Automated and Connected Vehicles"	Resources, expertise, and staff from existing public outreach/education programs (such as seat belt usage, sharing the road with cyclists, or risks of impaired driving) can be leveraged and expanded to accommodate AV/CV public education. (P.15)	p. 15
Bryant Walker Smith, "How Governments Can Promote Automated Driving"	“Contrary to some assertions, automated vehicles are not yet demonstrably better than human drivers across a full range of driving conditions. Suggesting (without demonstrating) otherwise risks raising public expectations unrealistically high. At the same time, the considerable dangers of conventional driving are not sufficiently appreciated by the public or addressed by policymakers. In short, the public should be concerned about automated driving but terrified about human driving.” [p 137]. An official website to educate the public on AV technologies and clearly states what a government is doing to promote, anticipate, and regulate AV technologies. [p 136].	p. 137; p. 136

TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies"	Education on AV from the public sector is likely to better received rather than advertising from private companies. [p 36]. Outreach should try to reach transportation disadvantaged people. Demographic characteristics of people who tend to become transportation disadvantaged include seniors (especially those that are frail, have disabilities, and/or are low income); persons with physical, mental, or cognitive disabilities; families in or near poverty; youth and others who cannot or do not drive; and recent immigrants or non-English speakers. “Consumers should see coordinated efforts, especially at the local level, by municipal transportation departments, MPOs, transit agencies, and other transportation service providers, public and private. Messaging at the state level should concentrate on how these efforts contribute to overall system efficiency and increase access to transportation options. …public agencies should assuage the fears and/or doubts of consumers and potential consumers through non-biased, fact-based information.” [p 38]. Starting in 2012, the Florida DOT provides funding and staff resource support for outreach, education, testing, and research of CV/AV technologies. “FDOT has spent $1.6 million in 2016 on consultant contracts to help achieve these goals, of which about $400,000 has gone to education and outreach efforts.” [p 39].	p. 36, p. 38, p. 39
Report of the Massachusetts Autonomous Vehicle Working Group	“In advance of permitting regional testing, the Working Group recommends that the C/AV Committee, led by MassDOT and the Executive Office of Public Safety and Security (EOPSS), provide educational outreach materials to first responders and law enforcement, and conduct workshops for the jurisdictions which have opted in to permit AV testing." (p. 22).	p. 22

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding"	Lyft's private AV testing in partnership with Aptiv in Las Vegas gives riders a prompt in the smartphone application asking for consent to be picked up in an AV sedan. [p. 8]. Pittsburgh worked with a cycling advocacy group to survey residents about their comfort level in AVs operating on city streets. Massachusetts has include residents in the planning process and public forms on AVs. San Jose used a pop-up exhibition for passersby to provide feedback on AV operations. [p. 15]. Shifting strategies on parking and related infrastructure in anticipation of automatic vehicles can be politically contentious at the local level as cities work with businesses and residents on planning priority items. [p. 20].	p. 8; p. 15; p. 20
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles"	In 2017, the U.S. Senate Committee on Commerce, Science and Transportation contemplated and possibly released bipartisan principles for self-driving vehicle legislation that included guidance on educating the public about self-driving vehicles. (pp. 7-2; 7-3).	p. 7-2; p. 7-3
Urbanism Next "A Framework for Shaping the Deployment of Autonomous Vehicles and Advancing Equity Outcomes"	"Barriers caused by systemic racism, sexism, ableism, classism, ageism, and homophobia frequently exclude people from engagement processes. Public meetings and other traditional forms of engagement have privileged those who not only have the time and resources to attend, but also those who feel comfortable and safe in public meeting spaces and who feel empowered to make their voices heard—leaving many people out." [p 4]. "When it comes to AVs, the public should ultimately decide whether there is a place for these types of vehicles in their communities and, if so, where." In order to achieve this, the public needs to be adequately informed on all aspects of the technology and be aware of different applications that can benefit the community. [p 5]. Engagement best practices (p. 6-7).	p. 4; p. 5; p. 6-7

Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation"	NHTSA and Administration should continue public outreach on benefits of AVs (p. 14).	p. 14
USDOT "Automated Driving Systems 2.0 A Vision for Safety"	“Entities are encouraged to develop, document, and maintain employee, dealer, distributor, and consumer education and training programs to address the anticipated differences in the use and operation of ADSs from those of the conventional vehicles that the public owns and operates today” (p. 15).	p. 15
Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving"	There is a brief paragraph on “Educating” on pp. 6-7.	p. 6-7
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape"	There is a brief paragraph on “Educating” on pp. 6-7.	p. 6-7

Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit"	There are summary statements on the need to educate the public about AVs and the need to educate police on enforcement matters.	

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Use Cases and Governance/Regulatory Structures	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines	LSAVs - "An exemption through NHTSA or Transport Canada is necessary to bring vehicles into U.S. and Canadian markets. Jurisdictions may also not have an existing registration process in place to accommodate this vehicle type. It is important to recognize, as well, that certain low-speed automated shuttles may not be FMVSS compliant. The safety and crashworthiness of these vehicles when used in mixed traffic on public roads is unproven, and any jurisdiction considering accommodating on-road applications of these vehicles should do so only after careful consideration…. jurisdictions should require low-speed automated shuttles to meet the same registration, titling, and permitting requirements for testing as other AVs." (p. 75-76).	p. 75-76

USDOT, "Automated Vehicles Comprehensive Plan"	Occupant-less low-speed vehicles – “Unlike other vehicle categories that must meet a wide array of FMVSS, these vehicles are only required to meet the requirements of FMVSS No. 500, “Low Speed Vehicles (LSVs),” which poses far fewer regulatory barriers to deployment. Therefore, a manufacturer could implement this use case by either designing a compliant vehicle or seeking an exemption, similar to what NHTSA recently granted to Nuro (85 FR 7826, February 11, 2020).” (pg. 18). "A passenger vehicle capable of conditional driving automation is a potential application of ADS in the existing ownership model (i.e., individual ownership rather than a fleet service). In this application, the ADS would be capable of performing the complete dynamic driving task (DDT) within a specific set of conditions, and the driver would be expected to be ready to take back control when the system requests it" (p. 19). "Passenger Vehicle Automated Driving Systems – “A purpose-built, dedicated ADS vehicle with no manual driving controls is available for purchase by consumers, or as part of a dedicated fleet used to provide on-demand mobility services. The vehicle is to be used within a geo-fenced area, when weather and roadway conditions are suitable for safe operation. The vehicle is operated entirely by the Automated Driving System with no ability for the occupants to take control of the vehicle" (p. 20). Several automated trucking companies are developing Level 4 ADS that will be used on commercial motor vehicles and heavy-duty trucks (p. 21).	p.18; p.19; p.20; p. 21
Eno Center for Transportation, "Beyond Speculation: Automated Vehicles and Public Policy"	Florida: defined AVs and permits operation (p.9); North Dakota legislative management study (p. 9); Utah DOT testing program for platooning (p. 9); Tennessee framework for charging a per-mile fee (p. 9); Michigan comprehensive AV legislation, testing on public roads without a driver, truck platooning, and self-driving rideshare (p. 9); Arizona executive order (p.9); Massachusetts executive order, AV working group (p.9); UN updating code to include AV technologies (p.9); Australia National Transportation Commission guidelines (p. 9); California liability draft legislation (p. 12); FAA (p. 14); Auto-ISAC cybersecurity (p. 15); NHTSA 2016 voluntary cybersecurity guidance (p. 15). Oregon, Tennessee, FAST act - infrastructure (p. 18); USDOT connectivity pilot program (p. 20).	p.9; p.12; p.14; p.15; p. 18; p.20

Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems"	Low-speed driverless shuttles “will most likely operate on dedicated infrastructure including segregated roadway lanes or special lanes along pedestrian ways” (p. 143). Driverless valet parking systems – “With some valet parking systems, although the driver exits the vehicle, continuous remote monitoring will be required using a key fob or mobile device until the vehicle has finished parking, and with other systems, the vehicle only reports back if there is a problem. In addition, some valet parking systems work only in certain parking lots or structures with infrastructure cooperation and strict restrictions on access. The requirements for these types of systems should be lower than for systems that perform the parking maneuver on a street side, in traffic, and without continuous remote monitoring.” (p. 143).	p.143
Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force"	PennDOT and the Pennsylvania Turnpike Commission reserve the right to restrict platooning to select roads and highways. It should be restricted to two commercial vehicles or three passenger vehicles. (p.36).	p.36
Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities"	Specific recommendations for city regulators in regards to AV technology [p 52]: Adopt city policy governing city’s priority in integrating AVs on public right-of-way; Broaden definition of services that are authorized to use drop-off/pickup zones to include AVs; Authorize reduction of parking requirements if pickup/drop-off area is provided; and delegate authority to designate right-of-way.(p.52). Local policy example from Portland, OR, on pages 53-54.	p.52, p. 53-54

Bryant Walker Smith, "How Governments Can Promote Automated Driving"	Existing roadway and vehicle laws may currently prohibit full expressions of automated driving such as minimum following distances (that effectively prohibit effective platooning) and requiring operators to have at least one hand on the steering wheel. (p.104). Laws and regulations that originate from the developer / private sector are more likely to be both useful and succeed. (p. 105-106). 5 steps governments can take to prepare for all levels of governance (p.113-114). Governments should consider a “bottom-up” approach to AV legislation by undertaking a legal audit to identify and analyze every statute and regulation that could apply adversely or ambiguously to automated driving rather than a “top-down” approach which usually doesn’t properly engage with existing legislation” [pp 119-120]. “a government seeking to reconcile an existing legal regime with automated driving technologies and applications might choose among several drafting approaches. It could wholly revise an existing regime such as the vehicle code with a view toward addressing both automated and conventional driving. It could expressly restrict the existing regime to conventional driving and develop an entirely new regime to apply to automated driving. Or it could develop a hybridized package that uses definitions, interpretive guidance, clarifications, and other mechanisms to map the existing regime onto automated driving. The choice of approach may depend on the results of the legal audit, the maturity of the relevant technologies, and the priorities of the jurisdiction” [p 123].	p. 119-120; p. 113-114; p.117-118; p.119-1120; p. 132; p.126
TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies"	Some existing legislation on truck following distances may effectively disallow efficient platooning of CVs, especially trucks. Though NHTSA does not recommend specific regulation of level 2 automation, the case of platooning could be different. [p 79].	p.79

Report of the Massachusetts Autonomous Vehicle Working Group	Legislators should include “sunset clauses” to CAV regulation for elements or entire regulations that may be waived or eliminated as the technology develops. [p 23]. PA SB 427 and HB 1637 (p. 67). Ohio Executive Order, May 2018 (p. 68). VA - no applications/permits needed for AV testing, (p. 70). 2011 - Nevada AB 511, 2013 SB 313, AB 69 (p. 71). NY - 2017 SB 2005 (p. 75). CT pilot AV testing program (p. 76).	
Polichronis Stamatiadis, Nathan Gartner, Yuanchang Xie, and Danjue Chen, "Strategic Planning for Connected and Automated Vehicles in Massachusetts"	“State DOTs could consider new legislation to establish standards for safely testing CVs/AVs on public roads and to establish testbeds to be used under different conditions.” [p x].	p. x
Anita Kim, Dan Bogard, David Perlman, Ryan Harrington. "Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles "	Use cases/vehicle concepts considered include highway automation, driverless valet, truck platooning, aftermarket highly automated vehicles kit, conventional vehicle with a highly automated ORM add-on kit, highly automated conventionally designed vehicle, highly automated vehicle with advanced design, highly automated vehicle with novel design, riderless delivery motorcycle, driver delivery vehicle (light duty and heavy duty), low speed highly automated vehicle with conventional design, low speed highly automated vehicle with advanced design, low speed driverless delivery vehicle. (p. 5-6).	p. 5-6

Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies"	This source provides a summary of what state legislation on CAV covered at the time. Pages 36-49 have tables that briefly summarize all bills (enacted, proposed, and failed) across the US. Enacted and proposed state legislations have addressed defining drivers, manufacturers insurance, compliance with safety laws via testing, data storage for a period of time, incident reporting, vehicle components, operational requirements, operator requirements, vehicle conversion and liability requirements, mobile communications and data privacy requirements, licensing, safety, insurance, assigning responsibilities for developing registration and/or certification processes for AVs, manufacturer product liability, steering wheel requirements, deference to potential federal legislation, and protections for auto manufacturers whose products are retrofitted for autonomous operation. [p 50].	p. 36-49; p. 50
Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities"	Private AV companies consider the existing paths in local and state regulations to permit AV testing and deployment of AVs in commercial service when picking launch markets. AV pilots are mixed in terms of launch in locations with easy or complex physical environments for testing. [p. 8-9]. Approaches for regulation ride hailing and taxi vehicles may be used as a starting place by cities and states creating frameworks for regulating AVs, particularly as private TNCs have been testing AVs themselves and look towards automation on their vehicles in the long-term. [p. 19]. AV-specific taxes have been discussed but not implemented at any example cities at the time of the report [p. 25-26].	p. 8-9; p. 19; p. 25-26
Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway"	Structural comparison of Swedish and Norwegian regulatory process (figure 2)	Figure 2

Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape"	Several states regulate platooning trucks differently than consumer AVs (see Alabama, Arkansas, Indiana, Louisiana, Minnesota, North Dakota).	

Appendix A

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
	Infrastructure Considerations	
AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines	"Jurisdictions can play an important role in encouraging the joint use of connected and AVs through the development of infrastructure. Jurisdictions can support the combined use of connected and automated technologies by facilitating communication between jurisdictional and local officials concerning the intersection of automated and connected vehicle technologies and including both automated and connected vehicle technologies in a jurisdiction's transportation planning efforts" (p. 77-78).	p. 77-78
Eno Center for Transportation, "Beyond Speculation: Automated Vehicles and Public Policy"	"Congress should develop a per-mile charge fee system on vehicles that are operating with a non-human certification" (p. 18). "States and localities should invest in robust "state of good repair" programs that facilitate the semi-automated features already available on some cars" (p. 19). "The Federal Communications Commission should maintain the existing spectrum for connected vehicles" (p.20). "NHTSA should continue to work closely with the automotive industry on standards for V2V and V2I communications" (p. 20).	p. 19; p.20
Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems"	For LSAVs, infrastructure considerations include "s boarding gates at loading zones, curbs to provide physical segregation, central monitoring and oversight, and passenger-accessible emergency stop buttons." (p. 143).	p.143

Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector"	Manufacturers are currently designing vehicles that can accommodate a wide range of potential road infrastructure conditions; automated driving system (ADS). [p. 4]. ADS development is difficult, especially for roadwork zones. [p. 4]. Public agencies can help accelerate development and deployment of AVs across all infrastructure categories: lane markings, traffic signals and signs, construction zones, intersection crosswalks, and speed bumps. [p. 4]. “AVs will need to access critical infrastructure information such as work zones, etc.” [p. 5]. “Standardization of infrastructure [is] important as well as development of specialized (AV-specific) infrastructure in limited geographic zones to support initial deployments of L4 use cases.” [p. 5].	p.4; p.5
Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana"	“At the moment most development related to autonomous vehicles is on sensors in the vehicles and the translation of that information into appropriate operation of the vehicle.” (p.51). "Regarding accommodating change in highway infrastructure (e.g., new alignment or construction zones), probably the most achievable way for autonomous vehicles to respond is for them to have the ability to interpret and respond to information on Variable Message Signs (VMS) or Highway Advisory Radio.” (p.51).	p.51
Bryant Walker Smith, "How Governments Can Promote Automated Driving"	Top ten elements of infrastructure preparation for autonomous driving: maintenance of roadways, design policies, implementation of design policies, roadway personnel, management of data, vehicle registration database, DSRC, wireless communication networks, congestion management tools, neighborhood infrastructure (p. 114-117).	p.114-117

TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies"	The value of data collected from CVs could be used to offset the large financial investment needed to implement and maintain connected infrastructure. [p 77]. "The DOT would need to collaborate with a number of administrations and offices, such as NHTSA, FHWA, USDOT ITSs Joint Program, state DOTs, and local agencies that plan to deploy CV technology on their roadways." [p 77]. "Technical viability of CV infrastructure is also affected by the development of competing technologies, such as the use of cellular and satellite communication methods to circumvent the need for installed infrastructure. The DSRC-based CV infrastructure that NHTSA has been pursuing may become simply a tool that local DOTs use to gather macro-level data on transportation systems, and not be actually relevant to individual CVs." [p 78]. AASHTO and the V2I Deployment Coalition is running a sort of "pilot program" with DOTs to retrofit traffic signals to transmit Signal Phase and Timing (SPaT) messages and maintain that functionality for 10 years starting in 2020. [p 77].	p. 77, p. 78
Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation"	Prepare roadway infrastructure for AVs – "DOT should revise the Manual on Uniform Traffic Control Devices (MUTCD) to include items that will support and facilitate AV deployment. States should be encouraged and even incentivized to update their infrastructure consistent with any AV-related MUTCD update." (p. 11).	p. 11

TRB " A Look at the Legal Environment for Driverless Vehicles"	“Most transportation experts expect that driverless vehicles will initially have minimal impact on infrastructure requirements, since driverless vehicles will initially operate in mixed traffic on existing roadways shared with conventional, human-driven vehicles.” (p. 78). The report suggests eventually designating dedicated lanes for AVs. “Providing such segregated driverless vehicle lanes might be a way to incentivize the purchase of driverless vehicles, just as access to carpool lanes has incentivized purchases of electric vehicles.” (p. 78). “To the extent that driverless vehicle operation will depend on connected vehicle V2I communications, additional communications infrastructure will likely be required” (p. 79). “In the absence of connected vehicle technologies, or alongside them, sensor reflectors or beacons added to existing signage infrastructure are likely to enhance some driverless vehicle operations.” (p. 79).	p. 78-79
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development"	Infrastructure considerations for AVs include advanced telecommunications links along with improved pavement and signage markets (which need to be near-perfect for AVs to read). Electric AVs will also require increased availability of refueling stations [p. 6]. Connected vehicles have a need to communicate either through radio frequencies or cellular-based technology. [p. 13-14]. “The Federal Highway Administration (FHWA) is expected to play a significant role through its administration of the Manual on Uniform Traffic Control Devices (MUTCD), which sets standards for all traffic control devices, including signs, intersection signals, and road markings.” [p. 21]. State compliance with MUTCD is voluntary, with not all states uniformly applying the standards from the FHWA manual. Differentiation in various laws and design on traffic control devices from state-to-state make standardization of AV technologies on vehicles more difficult for manufacturers. [p. 22].	p. 6; p. 13-14; p. 21; p. 22

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding"	Actions municipalities can take include modifying curb uses, installing connected traffic lights, and incentivizing design of structures amenable to AVs. [p. iv]. Las Vegas' pilot connected the automated shuttle to traffic signals along the route through "smart lanes" [p. 5; p. 21]. Current technology on AVs requires high-resolution maps of roads that their routes operate and driving the route numerous times to measure and record the route through the vehicle's sensors. [p. 7]. Curb management and curb space designs for loading and unloading zones are infrastructure considerations for cities piloting AVs to service passengers in a similar manner to public transit. [p. 20].	p. iv; p. 5; p. 21; p. 7; p. 20
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0"	"Support safe testing and operations of automated vehicles on public roadways." (p. 21) "Learn from testing and pilots to support highway system readiness." (p. 21) "Build organizational capacity to prepare for automated vehicles in communities" (p. 21).	p. 21
USDOT "Automated Driving Systems 2.0 A Vision for Safety"	"States are encouraged to maintain a good state of infrastructure design, operation, and maintenance that supports ADS deployment and to adhere to the Manual on Uniform Traffic Control Devices (MUTCD)" (p. 20).	p. 20
Dentons, "Autonomous Vehicles: US Legal and Regulatory Landscape"	There is an entire section on telecommunications and connected infrastructure (pp. 10-11). It is almost exclusively on connection vehicles.	p. 10-11

Tara Simler, Eric Jackson, James Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit"	There was consensus that AV infrastructure needs to be standardized and that there is a critical role to be played by the MUTCD, AASHTO, municipalities, and national organizations. See p. 8.	p. 8

Reviewed Document	Observations / Notes from Reviewed Document	Page(s) in Reviewed Document
Pilot / Testing vs. Commercial Deployment		
Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems"	Third-party safety certification would be an appropriate model of certification before public road testing of AVs. Currently, OEMs can self-report, with NHTSA's Voluntary Safety Self-Assessment. A third-party certification would provide an independent verification that an OEM is following stated policies. However, third-party certification would require the formation of a new US certification industry while giving competitive advantage to European manufacturers who use this system in the EU. (p. 139-140). "Certification that a vehicle meets the minimum behavioral competency requirements and was designed using a process that considered functional safety would be unavoidably subjective until specific AV standards are eventually developed. This situation poses challenges for any certification process." Like testing, requiring third-party certification would essentially require the development of a new US certification industry. (p.142).	p.139-140; p.142
TRB, "Strategies to Advance Automated and Connected Vehicles"	AV testing is not illegal by default, but by explicitly making it legal it can signal to companies that they are welcome in the state. This can help facilitate future commercial deployment. However, by putting bounds on testing or restricting certain testing protocols, the opposite can be achieved with AV developers moving testing to less restrictive states. Legalization of testing is a first step policy and should be enacted as early in the process as possible (in the next 2 years). (p.12). Public funding of testing efforts is more effective for CV rather than AV. Public involvement in CV development allows agencies to gain critical technical expertise, institutional knowledge, and guide how specific connections work and where they are communicated. CV technology has the potential for the most impact (safety and pollution) when it can connect not only V2V, but also V2I which means that infrastructure development needs to keep stride with and work in tandem with CV development. Collaborative testing should begin as early in the process as possible (in the next 7 years). (p.13).	p.12; p.13

Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana"	Platooning – “Truck platooning is also being investigated and initial results indicate that fuel savings of up to 5 percent for the leading truck and up to 10 percent for the trailing truck can be achieved” (p. 55). “Platooning makes overtaking, weaving, and entry and exit to freeways difficult. Effective platooning also assumes that the propulsion and suspension systems of vehicles in the platoon always function faultlessly.” (p.55).	p.55
NCHRP, "Strategies to Advance Automated and Connected Vehicles"	AV testing is not illegal by default, but by explicitly making it legal it can signal to companies that they are welcome in the state. This can help facilitate future commercial deployment. However, by putting bounds on testing or restricting certain testing protocols, the opposite can be achieved with AV developers moving testing to less restrictive states. Legalization of testing is a first step policy and should be enacted as early in the process as possible (in the next 2 years). [p 12]. Public funding of testing efforts is more effective for CV rather than AV. Public involvement in CV development allows agencies to gain critical technical expertise, institutional knowledge, and guide how specific connections work and where they are communicated. CV technology has the potential for the most impact (safety and pollution) when it can connect not only V2V, but also V2I which means that infrastructure development needs to keep stride with and work in tandem with CV development. Collaborative testing should begin as early in the process as possible (in the next 7 years). [p 13].	p.12, p.13

TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies"	Requiring a driver in-vehicle for testing has caused at least one company (unnamed) to relocate testing to another state (also unnamed). Due to reliance on mapping, this is expected to cause the company to be less likely to deploy in the state they stopped testing in. The private company said they would have preferred a graduated system that allowed for testing without a driver after proving other tests had been successful. [p 23].	p. 23
Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation"	USDOT should establish a national AV pilot program. “Such a program would not only provide a venue to advance DOT research objectives relating to AVs, but also provide AV developers that choose to participate with an alternative pathway to AV testing and deployment. A focused pilot program carried out under DOT’s oversight could increase public exposure to the technology and provide the DOT with the data that it will need to create new safety regulations for AVs.” (p. 4).	p. 4
CAT PLR Working Group, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share"	“The evolution of test beds from protected, off road settings to those on the roadways themselves has been essential for future deployment. Policies that prepare for this and encourage partnership and collaboration with the private sector and academia on both automation and connectivity help enhance long term outcomes.” (p. 2).	p. 2
Congressional Research Service "Issues in Autonomous Vehicle Testing and Development"	NHTSA’s approval for Nuro’s exemption for federal safety standards appears to be because the testing is for delivery only and does not introduce human passengers to the vehicle. Nuro is allowed to operate low-speed vehicles without seating, a passenger cabin, manual controls, rearview mirrors, windshields, or backup cameras in its testing setting for as many as 5,000 vehicles during a two-year period. At the time of the report, GM was seeking a similar two-year exemption for testing electric Chevrolet Bolt vehicles [p. 11].	p. 11

Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding"	The report distinguishes testing as “AVs driving on public roads without any passengers” and pilots as “initial passenger AV services” [p. 10]. Geographically constrained testing still must be allowable under state regulations, and it creates additional burden for cities to establish standards and objectives for AV companies to meet at each phase. [p. 13-14].	p. 10; p. 13-14
Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway"	Norway has adopted new legislation that allows experiments with self-driving vehicles on public roads. Sweden has an ordinance but no legislation in place (p. 5-6). Beginning with transit, both countries have developed regulations using a phased approach that began with testing and used those results to implement increased general use. (P. 6-7).	p. 5-6; p. 6-7
Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles"	Extended discussion of California’s 2017 amendments to its testing and deployment requirements including its mandatory submission of certification to the state’s DMV, its definition of HAV as SAE 3-5, its allowance of vehicles with no human driver, its public reporting requirements. (7-25 through 7-29); submission requirements for deployment include identification of the ODD for the VA, accessible data, proof of test and validation, proof of vehicle suitability for all uses being applied for. (7-21 through 7-31).	p. 7-25 - p.7-29; p. 7-21 - p. 7-31

Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation"	Washington state is good example of how to inform regulatory framework from test results. (p. 13, 26, 28, 29). California stifled knowledge and therefore good regulatory framework by overregulating testing (11, 12, 26,27).	p. 13; p. 26; p. 28; p. 29; p. 11; p. 12; p. 26; p. 27
USDOT, "Preparing for the Future of Transportation: Automated Vehicles 3.0"	Considerations for state commercial vehicle enforcement agencies – "Compatibility between intrastate and interstate commercial motor vehicle regulations…Continued application of roadside inspection procedures" (p. 22). Safety risk management testing phases to full commercial integration: development and early-stage testing, expanded ADS road testing, limited to full ADS deployment (p. 37-39).	p. 22; p. 37-39
Robert Waschik, Catherine L. Taylor, Daniel Friedman, Jasmine Boatner, "Macroeconomic Impacts of Automated Driving Systems in Long-Haul Trucking"	"The limited number of pilot tests for long-haul trucking still use a test driver at the wheel and operate only under favorable conditions." (p. 7).	p. 7
Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving"	Testing is specifically addressed under the heading "Testing versus deployment" on p. 10. In particular, the author notes the need to legally define the two categories, even though the line between the two will be very arbitrary, to promote testing and protect the public under deployment, these being two different public policy goals with different approaches.	p. 10

For a complete list of sources, please refer to Appendix B, Literature Review Bibliography.

Appendix B

Literature Review

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix B

Background

This literature review is part of a larger project supporting the development of a consistent and implementable operational framework for Automated Vehicles ("AVs") for the six states that make up the New England Transportation Consortium ("NETC"). To define and describe "Automated Vehicle," this document refers to the Society of Automotive Engineers (SAE) International's "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles" which defines and categorizes levels of automation currently available or in development for motor vehicles:

"This SAE Recommended Practice describes motor vehicle driving automation systems that perform part or all of the dynamic driving task ("DDT") on a sustained basis. It provides a taxonomy with detailed definitions for six levels of driving automation, ranging from *no driving automation* (level 0) to *full driving automation* (level 5), in the context of motor vehicles (hereafter also referred to as "vehicle" or "vehicles") and their operation on roadways."[i]

This document uses the term Automated Vehicles to refer to this range of self-driving systems incorporated into vehicles. Where referring to vehicles falling within the categories of Level 4 or Level 5, the term Highly Automated Vehicles (HAVs) is used. Use of the terms AVs or HAVs does not refer to vehicles that rely on communication with other vehicles, infrastructure, or other devices to perform the driving task, which are generally referred to as Connected Vehicles (CVs).

AVs have the potential to provide generational and positive changes to most aspects of modern life. However, there are still foundational questions around the ecosystem in which AVs will operate, including considerations around levels of automation, such as:

- Will human monitoring and intervention be required, or can vehicles be expected to be fully self-driving?
- Will AVs be offered in a subscription format, or will they be personally owned?
- Will AVs have CV capabilities to communicate with other vehicles and surrounding infrastructure?
- What data will be collected by AVs, and how should it be shared to improve safety and operating environments (especially in consideration of infrastructure)?
- How will existing insurance and liability structures be challenged and need to evolve as a driver is taken out of the driver's seat of vehicles?
- As federal safety requirements are updated and adopted, who should bear the responsibility of confirming the safety of automated vehicle systems being operated on public roads?

[i] SURFACE VEHICLE RECOMMENDED PRACTICE J3016™ JUN2018 Issued 2014-01 Revised 2018-06 Superseding J3016 SEP2016 (R) Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, retrieved on April 15, 2021, https://www.sae.org/standardsdev/tsb/tsb004.pdf.

One of the most uncertain and undefined areas where change can be expected is the regulatory environment for the operation of AVs on public roads, particularly in how existing laws and regulations will transform as the "driver" transitions away from humans to the automated driving system. Legal uncertainty surrounding AVs is a result of the continued evolution of the vehicle technology and operating systems which will be responsible for monitoring and operating vehicles within a variety of operational domains across the country. Additional questions arise from potential use cases and models still under development and testing, as well as the current lack of minimum federal safety standards for AVs.

As identified through this Phase 1 literature and regulatory review, not having federal safety standards and still being in the testing and demonstration phase of AVs has led to an inconsistent legal and regulatory framework for AVs nationally. As discussed below and identified in the side-by-side comparison document, different regulatory approaches, definitions, and requirements for AVs have been implemented by states and local governments. At the state level, such approaches include:

- Regulation through enacted legislation;
- Implementation of executive orders; and
- Taking a wait-and-see approach with some states interpreting a lack of express prohibition allowing the operation of AVs on public roads.

The six New England states of focus for this project have taken various approaches to AVs that include all three of these approaches as will be discussed further as part of Task 2.

Still focusing on the broader picture, this literature and regulatory review explores what types of policy approaches and regulations have developed at both federal and state levels that NETC can consider supporting the safe testing, demonstration, and deployment of AVs. This Phase 1 review will inform the development of recommendations for a framework that supports regional coordination for the operation of AVs across the NETC region, including across state lines and with common goals and vision serving as the foundation.

Literature Review

This review documents existing research, legislative, regulatory, and policy approaches to AVs with a focus on topics of interest communicated by the Technical Committee through ongoing project meetings. As AVs have propagated over the past decade, approaches to permitting their operation on public roads, regulation, and management have developed across a spectrum of interested institutions, including local, regional, state, and federal agencies; advocacy groups and industry associations; research institutions; and private mobility companies. With a focus on foundational regulatory questions that have yet to be answered definitively for a variety of reasons discussed further herein, this review includes existing policy and regulatory approaches to AVs that identify the following:

1. Roles and Responsibilities: Relevant stakeholders and their context within the AV landscape.

2. Interests: Stakeholder (including public, private, and organizational) interests in the operation of AVs on public roads and across state lines, including where such interests are aligned or are in conflict.
3. Practices: Approaches to the regulation of AVs, which will include an investigation and analysis of policies, findings, regulations, and executive orders across states.
4. Purpose: Understanding the rationale for approaches taken around the regulation or nonregulation of AVs.
5. Procedures: Procedural approaches to allowing the operation of AVs on public roads, including approaches to permitting, public safety coordination, data sharing and reporting, public outreach and coordination, revenue considerations, and local government coordination.

Literature Review Goal

The goal of the literature review is to scan available literature from the United States at a high level to identify how states have responded to policy, legal, and regulatory questions that AV technologies have raised for the 10 topical areas identified through meetings with the project technical committee, specifically:

- Safety/Verification
- Vehicle Registration
- Insurance/Liability
- Data Sharing
- Governance Issues
- Local Coordination
- Public Outreach/Education
- Use Cases and Governance/Regulatory Structures
- Infrastructure Considerations
- Pilot/Testing vs. Commercial Deployment

Methodology

This literature review scanned 43 documents with a focus on legislative, regulatory, and policy matters for AVs, primarily assessing AV regulatory matters in the United States (though the team did include a few international examples). The reviewed documents included:

- reports from C/AV state-level working groups,
- comprehensive research published by the Transportation Research Board (TRB) National Cooperative Highway Research Program (NCHRP),
- papers published by research institutions and individual transportation researchers and advocacy groups, and
- policy and guidance documents from several state departments of transportation (DOTs), the United States Department of Transportation (USDOT), associations of states, and transportation agencies.

Findings

The findings of the literature review are summarized in detail in the master spreadsheet, where they are each listed and summarized in a master list as well as by topic area in subsequent tabs. Findings are further synthesized and summarized below by topical area.

Safety/Verification

For additional context around this topic area, researchers focused on issues such as: safety operator in driver's seat or not; remote monitoring; safety verification issues (i.e. state actively taking action or reliance on company self-certification); and law enforcement coordination. **Of the documents reviewed, 24 addressed this topic.**

Issues about coordination with law enforcement that arose in this category included the need for law enforcement to able to identify AVs for purposes of traffic law enforcement or crash reporting; and whether a search of an AV by law enforcement requires a warrant.[ii, iii] USDOT recommends involving first responders and public safety officials in the testing and development of AVs to raise awareness, education, and develop protocols for interacting with AVs during an emergency.[iv]

Practices and opinions on safety standards and compliance with them varied somewhat. There was agreement that the USDOT should continue to set safety standards and ensure that the public understands them. There was also general agreement that an AV must be able to obey traffic laws and meet roadworthiness standards. Some stakeholders support continued self-certification by vehicle manufacturers. Other writers raised the option of a third-party certification system that would provide independent verification. This system could remain inherently subjective, however, until specific AV standards are developed. Areas of uncertainty included how best to prepare car buyers for cybersecurity risks, and whether cybersecurity breaches should be reported by the vehicle technology.[v] Issues around AVs and the collection of data (that is not necessary for the operation of the vehicle) from users and occupants is also an area of uncertainty and may impact consumer trust and adoption of AVs.

[ii] Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, p. 54 and 56
[iii] A Look at the Legal Environment for Driverless Vehicles, p. 45-46
[iv] USDOT, Preparing for the Future of Transportation: Automated Vehicles 3.0, p. 33
[v] Issues in Autonomous Vehicle Testing and Deployment, p. ii, 4-5, 17

The literature revealed a range of responses to the question of whether safety drivers were required.[vi] Florida, for example, does not require that the operator be physically present in the vehicle. Pennsylvania's AV Policy Task Force recommended that there should be a test operator in the vehicle.[vii] After the Arizona fatality involving an Uber AV, the NTSB recommended that states require and evaluate applications from AV software developers before granting testing permits.[viii] In Norway, if an applicant can prove that the technology can handle all driving situations, no human person is required to sit behind the wheel.

Key Points: Safety/ Verification[ix]

- Debate around safety certification exists with some advocating for continued self-certification by manufacturers and others recommending a third-party validation system.
- Privacy and cybersecurity concerns are new issues that are evolving as the technology matures and use cases come into greater focus. Considerations around informed consent to users concerning risks and how, what, and why data being collected merges into data governance topic.
- Coordination with law enforcement from the outset of testing is recommended and standardizing protocols for crash reporting is cited often in recommendations.

Vehicle Registration

For additional context around this topic area, researchers focused on issues such as: registration requirements; role of DMV vs. state DOT; markings on vehicles; and distinctions between passenger and freight/delivery. **Of the documents reviewed, 29 addressed this topic.** Consistently across all documents, most stakeholders agreed that registration should remain a matter of state law. Several also indicated that uniformity of registration processes across a region or even across the nation were desirable. However, the literature also revealed that there were differences of opinion on whether AVs should be registered and outwardly identified as such (and if so, for what purpose). For example, a discussion on testing permits in California reported that outwardly marking test vehicles could interfere with the results showing how a vehicle performs under normal traffic circumstances, as marking AVs could cause other road users to behave differently than they normally would. However, registration of an AV for deployment should indicate whether the vehicle is equipped with AV

[vi] Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana
[vii] Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force, p. 13
[viii] *Issues in Autonomous Vehicle Testing and Deployment, p. 12*
[ix] Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway, p. 6

technologies, what operational scenarios the AV is designed and certified for, and whether the AV is capable of being driven without a licensed, human driver.[x]

The literature also produced a range of opinions about whether states should adapt existing registration processes to include AVs, or instead adopt new model registration policies designed for AVs. For example, the Uniform Law Commission model legislation requires that an AV be registered as such. This is part of the statute in the model which requires each AV be registered by an entity identifying as an AV developer, manufacturer, or technology provider.[xi] Another document points to the benefits to the state of such a process by cataloguing the many types of safety data that could be associated or collected by the vehicle.[xii]

Key Points: Vehicle Registration

- There is consistent agreement that the registration of AVs should remain a state responsibility.
- Questions remain around whether a new registration process is needed to address AVs, including considerations around vehicle markings and clear ownership for enforcement or accident purposes.
- Uniformity of registration process across states and regions is recommended.
- Licensing requirements will be impacted by the level of automation of a vehicle.

Insurance/Liability

For additional context around this topic area, researchers focused on issues such as: insurance requirements; liability based on level of automation; and distinctions between owner operated vs. subscription service model. **Of the documents reviewed, 22 addressed this topic.** Consistently across all documents, most stakeholders agreed that insurance requirements should remain a matter of state law, and many policymakers acknowledge that the party liable for a crash may no longer be a human driver but either a vehicle, manufacturer, or operator. As with most other key issue areas discussed around the regulation of AVs, most parties agree that a state-to-state patchwork of different regulations could inhibit the continued deployment of AVs. For example, if some states allow manufacturers to self-insure while others make the vehicle owner liable, vehicles might be required to be insured in several ways to cross state lines. However, consistency of ideas about how to manage changes to insurance and liability ends there. The review revealed a wide range of proposed solutions, speculations, and opinions about the way to manage these changes.

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[x] Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems", p. 140, 142-143.
[xi] National Conference of Commissioners on Uniform State Laws, "Uniform Automated Operation of Vehicles Act", July 2019, pp. 12-15.
[xii] Bryant Walker Smith, "How Governments Can Promote Automated Driving", pp. 115-116.

One theme that emerged was that insurers will face new data-related challenges with AVs and HAVs. Rate-setting formulas, for example, have been based on the driving records of human drivers. How such formulas will be impacted by a mixed environment of human driven and computer operated vehicles is still unknown. Insurers must also decide whether to rate vehicles under a personal regime or products liability regime. Regarding both questions, insurers will have no previous actual data on AVs to use in new formulas or regime they create. Test or simulation data may not be accurate enough to base new insurance schemes on.[xiii, xiv]

Regarding a limit on liability, several states are reported to anticipate using their existing insurance regulations but raising the cap on liability to $5m for AVs. However, states imposing higher minimums may disadvantage smaller companies from testing or operating in their jurisdiction.[xv] Also, how such insurance requirements transition should AVs move toward a personal ownership model is also uncertain.

Whether and how to find fault in the event of a crash are questions that AVs complicate, or arguably make easier with the availability of data from sensors and cameras assuming such data can be mandated to be shared. A state must decide whether to impose no-fault regulation or not. Under a no-fault model, each vehicle would be covered under its own policy, therefore removing the requirement to establish a liable entity under the current tort system. This might seem at first like an appropriate approach to insuring AVs. However, the lack of financial pressure in the event of a crash might also act as a disincentive for companies in their commitment to developing safety features for their vehicles.[xvi] Crash data would normally be used to help determine fault; however, because AVs store proprietary data, there is a need to address whether to mandate access to proprietary data in the event of a crash by legislators taking this approach.[xvii]

Determining the performance standards for AVs for liability purposes also raises unanswered questions. Early in the deployment of AVs, the vehicles would likely be held to the same standards as human drivers, but as their capabilities advance, the standards to which they are held could be raised.[xviii]

And finally, one researcher observed that one alternative to insurance altogether might be a national compensation program.[xix]

[xiii] Wilmot, Chester and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana", p. 19.
[xiv] TRB, "A Look at the Legal Environment for Driverless Vehicles", p. 60
[xv] I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report", p. 5
[xvi] TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies", p. 68-71
[xvii] Kara M. Kockelman and Stephen D. Boyles "Smart Transport for Cities & Nations: The Rise of Self-Driving & Connected Vehicles", p. 7-11
[xviii] Georgia House Autonomous Vehicle Technology Study Committee. "Report of the Georgia House Autonomous Vehicle Technology Study", p. 4
[xix] Bryan Gibson, Kentucky Transportation Center, "Analysis of Autonomous Vehicle Policies" p.22

Key Points: Insurance / Liability

- There is consistent agreement that the regulation of insurance requirements for AVs should remain a state responsibility, but that uniformity across state lines is needed.
- Whether existing insurance approaches or new regimes such as a national compensation program will be more appropriate for AVs is still a matter of debate.
- Investigations around fault have the opportunity to be made easier with the expected availability of sensor and/or camera footage, but the ability to collect such data will depend on whether or not the sharing of such data is mandated and not considered proprietary information.
- The initial determination of insurance rates may be impacted by lack of data around operation of AVs leading some to recommend a no-fault insurance regime for HAVs.

Data Sharing

For additional context around this topic area, researchers focused on issues such as: crash reporting; operational reports including disengagements; and infrastructure condition reporting to public agency. **Of the documents reviewed, 26 addressed this topic.** Issues identified throughout the literature included privacy of personal data, protection of proprietary and corporate data, cybersecurity, and crash data. The review revealed a wide range of opinion and tension about whether responsibility for protection should lie with a governmental entity or a corporate one, as well as unsettled questions about data ownership, collection, storage, management, and access for insurance or litigation purposes.

The review also revealed that varying laws on these issues exist at the federal, state, and local levels, but how such laws will apply to data collected from AVs has not yet been determined with certainty. Further, potential barriers for data sharing and the deployment of AVs have been identified should data sharing agreements be needed with each individual jurisdiction and how data ownership will be managed under data licensing agreements.[xx]

Two examples of efforts to create uniformity for data sharing practices come from the state of Florida, which has developed an enterprise-wide information technology strategy to manage data sharing in that state, and from the City of Los Angeles, which has created the Mobility Data Specification (used by 40 cities at the time of the writing).[xxi] Other research has identified challenges similar to the

[xx] AAMVA, "Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, p. 74.

[xxi] Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector", p. 3-6.

insurance discussion where it is still not known how much data will be collected by AVs and what data will be needed for the safe operation of the vehicles. Many potential opportunities for data sharing have been identified, including sharing data with transportation agencies around the location of potholes, for example; however, whether such data sharing creates additional liabilities around jurisdictions being on notice of major infrastructure dangers is still a matter of debate.

Key Points: Data Sharing

- The issue of data sharing is both complicated and contentious as tensions around data ownership, proprietary information, and privacy need to be navigated.
- Discussions are ongoing around potential data sharing standards that address AVs and other on-demand solutions, but also have guardrails that address the collection of data with geolocation information that can lead to the reidentification of users.
- Further information around what data will be collected by AVs, including both outside and inside the vehicle is needed to better evaluate what consumer protection laws may be needed.
- What data should be required to be shared concerning crashes, disengagements, and operating environment presents both opportunity and challenge for states and private companies.
- Currently, there are no federal laws that address data collection and sharing by AVs, including considerations around consumer protection.

Governance Issues

For this topic area, researchers identified issues such as: contracting/procurement, funding, roles and responsibilities, oversight, and approaches to legislation. Of the documents reviewed, 25 addressed this topic. This review revealed a common assumption that states and the federal governments should retain their current regulatory roles. States should regulate licensure, insurance, rules of the road, and registration. The federal government should continue to set vehicle safety standards, including the design, construction, and performance of AVs. However, since NHTSA has provided only a few standards for AVs, the literature shows a shared opinion that until such standards are fully developed, NHTSA should allow testing and operation through its exemption process to gather data and advance the technology.

Flexibility of legislation was also called for in several documents for states wishing to support AVs in their jurisdiction. Low taxes and minimal registration requirements were two specific legislative strategies suggested for states to promote AVs.[xxii]

Another theme that emerged was the recommendation that each state create an AV oversight committee or guiding body to process information about AVs and ultimately to develop a state's policy for AVs.[xxiii]

Key Points: Governance Issues

- With few federal standards for AVs, states are relying on a combination of approaches to oversee AVs in their jurisdiction.
- Because AV technology is still rapidly changing, many documents emphasize flexibility and suggest state committees track progress to inform future policies for AVs.

Local Coordination

For this topic area, researchers identified issues such as: local approval or notices; compliance with traffic laws and local regulations; powers of local government over right-of-way like curb management or fees; and preemption of local powers. Of the documents reviewed, 13 addressed this topic; even within the documents addressing local coordination many did not get into specific examples or guidance beyond recommending coordination. Some state laws preempt municipalities from further regulation on AVs and compliance with state motor vehicle regulations, which may include preventing localities from barring AV testing on public roads or prohibiting special taxation. Municipalities can still exercise land-use authority over local roads, including indirectly exercising jurisdiction through modifying infrastructures to be more amenable to AVs.[xxiv] Some guidance suggests that local jurisdictions should be able to have authority on local testing on public roads and ensure that vehicles are following local traffic rules. Key challenges for local law enforcement include crash responsibility, educating officers, and AV marking and identification. Obtaining data from AVs is also a possible coordination activity needed between local law enforcement and the state.[xxv] Two examples in the literature on coordination between state and local government are in the New England region. Connecticut requires a written agreement (to be submitted to the state) between the AV tester and the municipality which specifies operating locations, identifies required vehicle information, and hours

[xxii] Georgia House Autonomous Vehicle Technology Study Committee. "Report of the Georgia House Autonomous Vehicle Technology Study", p. 7, p. 11
[xxiii] CAT PLR Working Group, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share", p. 1
[xxiv] UC Berkeley, Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions are Responding, p. iv
[xxv] Simler, Jackson, and Mahoney, "Conference Proceedings of the Northeast Autonomous Vehicle Summit, Report Number: CT-2308-F-17-5", p. 8

of operation.[xxvi] The Massachusetts AV Coalition is an example of local control and coordination for AV test as enabled through state statutes.[xxvii] Establishing a recognized entity such as a working group or advisory committee can help carry weight in overseeing AV testing, coordinating with relevant municipalities, or responding to legislative inquiry on AVs.[xxviii] A few literature documents suggest that cities and local agencies will likely look to higher government levels for protections on complicated aspects of AVs, such as data standards and collection or geographically phased testing.[xxix] Local governments at the early stages of AV testing have regulated through pilot programs, land use plans, and city codes or ordinances to guide AV adoption.[xxx] Transit agencies and local universities have also acted as key partners in AV testing coordination between cities and testing companies; Las Vegas' phased tested of AVs from private to public roads is one example of how local coordination can create a testing plan and determine roles in operation and administration.[xxxi]

Key Points: Local Coordination

- Coordination with local governments is recommended, but there is not a common approach or recommendation for how to do so.

Public Outreach/Education

For this topic area, researchers identified issues such as: challenges around public adoption, consumer expectations around technology, tools for outreach and education, and use of simulations. Of the documents reviewed, 16 addressed this topic. The literature showed broad agreement that public understanding and acceptance of AV technology was important before they were widely deployed, and that operational understanding among AV travelers would be critical.

Specific educational needs were noted amongst older people who may benefit the most from AVs but also require more education than younger people.[xxxii] Another area to be addressed with education

[xxvi] Massachusetts Autonomous Vehicle Working Group, "Report of The Massachusetts Autonomous Vehicles Working Group", p. 76
[xxvii] UC Berkeley, Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions are Responding, p. 11-12
[xxviii] AASHTO, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share", p. 1
[xxix] Virginia Reeder, Scott Schmidt Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector", p. 7
[xxx] Marc Schlossberg, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities", p. 52
[xxxi] UC Berkeley, Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions are Responding, p. 4-5
[xxxii] I-95 Corridor Coalition, "Connected and Autonomous Vehicles Workshop Summary Report", p. 20

was the fondness for driving and unwillingness to relinquish control, a noted barrier to a working understanding of AVs amongst the general population.[xxxiii]

The review revealed several suggestions for how to provide education. One is to leverage existing safety programs to disseminate information about AVs.[xxxiv] Another is for states to provide messaging from the state level down to local levels that addresses all travelers but especially transportation-disadvantaged people. That effort should also be coordinated across transportation agencies and departments of all kinds. The state of Florida has been investing in education and outreach about these technologies since 2012. [xxxv] The Massachusetts Working Group recommended education of first responder and law enforcement in advance of permitting regional testing.[xxxvi] The cities of Las Vegas, Pittsburgh and San Jose have made limited efforts to raise awareness or gather public opinion about AVs.[xxxvii]

Recommendations also arose for NHTSA and the executive administration to support public outreach about the benefits of AVs,[xxxviii] as well as for private sector stakeholders to develop consumer education and employee training programs about the differences between AVs and conventional vehicles.[xxxix]

Key Points: Public Outreach / Education

- Public understanding and acceptance of AV technology is limited, especially among people who may benefit most from it such as the elderly or transportation-disadvantaged.
- States should proactively explore ways to educate the public about AV technology and its potential benefits.

Use Cases and Governance/Regulatory Structures

For this topic area, researchers identified issues such as: how do governance structures change based on use cases like first/last mile, goods delivery, and subscription model; partnerships with transit; or operation with government fleets. Of the documents reviewed, 14 addressed this topic. The

[xxxiii] Chester Wilmot and Marlon Greensword, "Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana", p. 15
[xxxiv] NCHRP, "Strategies to Advance Automated and Connected Vehicles", p. 15
[xxxv] NCHRP, "Strategies to Advance Automated and Connected Vehicles" p. 36, 38, 39
[xxxvi] Report of the Massachusetts Autonomous Vehicle Working Group, p. 22
[xxxvii] Daniel G. Chatman and Marcel Moran, University of California Institute of Transportation Studies, "Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding", p. 8, 15
[xxxviii] Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation", p. 14
[xxxix] USDOT "Automated Driving Systems 2.0 A Vision for Safety", p. 15

literature identified recommendations for how government can both approach law making in general as well as how to adjust policy and regulation to accommodate use cases.

Approaches to law-making included a recommendation to perform a bottom-up audit of all laws that might be affected by AV legislation (rather than a top-down approach), and the recommendation to adopt laws and regulations that originate with the developer because they are more likely to be useful and successful. Several drafting approaches were offered:

- "Wholly revise an existing regime such as the vehicle code with a view toward addressing both automated and conventional driving.
- Expressly restrict the existing regime to conventional driving and develop an entirely new regime to apply to automated driving. Or it could develop a hybridized package that uses definitions, interpretive guidance, clarifications, and other mechanisms to map the existing regime onto automated driving.

The choice of approach may depend on the results of the legal audit, the maturity of the relevant technologies, and the priorities of the jurisdiction."[xl]

Considerations for city regulators regarding AV technology include:

- adopt a city policy allowing integration of AVs in public right-of-way;
- broaden definition of services that are authorized to use drop-off/pickup zones to include AVs;
- authorize reduction of parking requirements if pickup/drop-off area is provided;
- allow operation of low-speed AVs on specific roadways along pedestrian ways;
- incentivize monitored AV valet parking with lower operating requirements than for vehicles on streets;
- implement AV-specific taxes[xli, xlii, xliii]

Considerations for states include:

- restrict platooning to certain roadways;
- restrict the number of vehicles allowed in a platoon;
- adjust regulations on following distance to allow for platooning;

[xl] Smith, Bryant Walker, "How Governments Can Promote Automated Driving", p. 105-106, 119-120, 123.
[xli] Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities", p. 52
[xlii] Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems", p. 143
[xliii] Schlossberg and Brinton, "Matching the Speed of Technology with the Speed of Local Government: Developing Codes and Policies Related to the Possible Impacts of New Mobility on Cities", pp. 25-26

- use Sunset clauses in AV legislation so that they may be eliminated as the technology develops. [xliv, xlv, xlvi]

Key Points: Use Case Regulation

- There are two approaches for incorporating AVs into existing laws – one is to revise the existing regulations about conventional vehicles to also include AVs; the second is to create a distinct set of rules and regulations for AVs while keeping what already exists for conventional vehicles.
- In the near term, city regulators should consider how AVs will change right-of-way allocation, while state regulators should consider platooning regulations.

Infrastructure Considerations

For this topic area, researchers identified issues such as: infrastructure needs, automated and connected vs. just automated vehicles, Americans with Disabilities Act considerations, and funding models. Of the documents reviewed, 17 addressed this topic; most documents focus on how local jurisdictions can be supportive through improving existing infrastructure and incorporating AVs into transportation planning efforts.[xlvii] AV technology uses roadway markings and reads the environment around the vehicle to make decisions in the moment; pavement and signage markets need to be near-perfect for AVs to work effectively, particularly on minor roads under county or municipal government jurisdiction.[xlviii, xlix] AV manufacturers themselves are responsible for creating vehicles that are responsive to local infrastructure and obey traffic laws. Public agencies can assist in AV development and deployment by improving local infrastructure that AVs utilize in operations (including lane markings, traffic signals and signs, sensor reflectors and beacons, intersections, traffic signal priority, and speed bumps).[l] Las Vegas' pilot connected the automated shuttle to traffic signals along the route through "smart lanes", providing real-time traffic information to the shuttle to improve accuracy of traffic monitoring rather than strictly relying on on-board cameras.[li] One paper suggests infrastructure for variable message signs or highway advisory radio as a mechanism for AVs to

[xliv] Pennsylvania Autonomous Vehicle Policy Task Force, "Pennsylvania Autonomous Vehicle Testing Policy: Final Draft Report of the Autonomous Vehicle Policy Task Force", p. 36
[xlv] Bryant Walker Smith, "How Governments Can Promote Automated Driving", p. 104
[xlvi] Report of the Massachusetts Autonomous Vehicle Working Group, p. 23
[xlvii] Safe Testing and Deployment of Vehicles Equipped with Automated Driving Systems Guidelines, American Association of Motor Vehicle Administrators, p. 77-78
[xlviii] *Issues in Autonomous Vehicle Testing and Deployment, p. 6*
[xlix] *Issues in Autonomous Vehicle Testing and Deployment, p. 22*
[l] Forum on Preparing for Automated Vehicles and Shared Mobility: Mini Workshop on the Roles of Government and the Private Sector, p. 4
[li] *Autonomous Vehicles in the United States: Understanding Why and How Cities and Regions Are Responding, p. 5 & 21*

interpret and respond to changing traffic conditions on highways.[lii] Infrastructure features such as loading zones and curbs with physically segregated design can improve safety for travelers using AVs in a shared fleet system, similar to bus loading areas for public transit.[liii] Standardization of infrastructure is also critical to this end (such as the Manual on Uniform Traffic Control Devices or MUTCD).[liv] State compliance to the MUTCD is currently voluntary and not all states have uniformly applied standards from the manual; improving standards for AVs in the manual and incentivizing its adoption by states may be critical.[lv, lvi] Two reports from TRB suggest dedicated lanes for AVs (similar to carpool lanes) to incentivize purchase and use (though this suggestion assumes that AVs will only follow a private ownership model).[lvii, lviii, lix] For CVs, additional communications infrastructure will be needed for vehicles, infrastructure, and persons to function in a connected environment.[lx] One report suggests that data collected from CVs could provide value that would make up for and help fund investments for CV infrastructure.[lxi]

Key Points: Infrastructure Considerations

- Local governments can help AVs by ensuring standardized infrastructure (i.e., lane markings, signage, etc.) along roadways. One recommendation is for all states to comply with the MUTCD.

Pilot/Testing vs. Commercial Deployment

For this topic area, researchers identified issues such as: what are different governance structures and liability considerations; how to inform regulatory framework from testing; challenges around commercial deployment. Of the documents reviewed, 14 addressed this topic. A number of considerations and approaches emerged for governments to consider when developing legislation or regulation for testing, demonstration or deployment policies:

[lii] Investigation into Legislative Action Needed to Accommodate the Future Safe Operation of Autonomous Vehicles in the State of Louisiana, p. 51
[liii] Development of California Regulations to Govern Testing and Operation of Automated Driving Systems, p. 143
[liv] Automated Driving Systems 2.0 A Vision for Safety, p. 20
[lv] Issues in Autonomous Vehicle Testing and Deployment, p. 22
[lvi] Policy Roadmap to Advance Automated Vehicle Innovation, p. 11
[lvii] A Look at the Legal Environment for Driverless Vehicles. Washington, DC: The National Academies Press, p. 78
[lviii] Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies, p. 79
[lix] How Governments Can Promote Automated Driving, p. 114-117
[lx] A Look at the Legal Environment for Driverless Vehicles. Washington, DC: The National Academies Press, p. 78
[lxi] Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies, p. 77

- It is important to legally define the two categories of activity (testing and deploying) since they have different public policy goals (i.e. promote testing and protect the public); [lxii]
- Create a third-party certification system to provide independent verification before public road testing begins, though this would require developing a new US certification system;
- Enact testing legislation as the first step, early in the process, and base future demonstration and deployment regulation on testing results; [lxiii, lxiv]
    - Washington State is one example where regulated test results informed the more general regulatory framework; [lxv]
    - California's efforts to regulate testing had a stifling effect on testing and therefore developing a regulatory framework; [lxvi]
- Consider permissive testing policies, like not requiring a driver in-vehicle for testing, that don't discourage companies to relocate; [lxvii]
- A USDOT national pilot program would inform the development of new safety regulations for AVs; [lxviii]
- Testing programs that evolve activities from off-road test beds to actual roadways encourage partnerships between public and private sector stakeholders and strengthen long term outcomes; [lxix]

Key Points: Pilot / Testing vs. Commercial Deployment

[lxii] Bryant Walker Smith, "Select Legal Considerations for Shared Autonomous Driving", p. 10
[lxiii] Christopher Nowakowski, Steven E. Shladover, Ching-Yao Chen, and Han-Shue Tan "Development of California Regulations to Govern Testing and Operation of Automated Driving Systems", p. 139-142.
[lxiv] Lisa Hansson "Regulatory governance in emerging technologies: The case of autonomous vehicles in Sweden and Norway", p. 6-7.
[lxv] Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation", p. 13, 26, 28, 29
[lxvi] Center for the Study of the Presidency and Congress "The Autonomous Vehicle Revolution: Fostering Innovation With Smart Regulation", p. 11, 12, 26, 27.
[lxvii] TRB, "Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies", p. 23
[lxviii] Alliance for Automotive Innovation, "Policy Roadmap to Advance Automated Vehicle Innovation", p. 4
[lxix] CAT PLR Working Group, "The CAT PLR Working Group Policy Framework Initiative – Some Initial Considerations to Share", p. 2

- Delivery vehicles may be better candidates for on-road testing if exemptions are granted because of the absence of passengers; [lxx]

- A first step should be to define what is meant by piloting/testing versus commercial deployment
- Take a methodical approach that starts with testing and builds to commercial deployment, focusing on services that might be most straightforward (e.g., goods delivery vehicles or other non-passenger services)

[lxx] Congressional Research Service "Issues in Autonomous Vehicle Testing and Development", p. 11

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Appendix C

Stakeholder Outreach Discussion Guide

This discussion guide was used for individual conversations with stakeholders representing government organizations, industry, and legal and insurance firms. It was not used for the DOT-focused workshop.

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix C

Outreach Discussion Guide

Instructions:

Thank you in advance for your time taken to complete this questionnaire to support the C/AV focused research project by the New England Transportation Consortium. In summary, this project is an assessment of opportunities and challenges related to the operation of C/AVs across state lines within the New England region. We look forward to your helpful thoughts on the questions below and appreciate you being as candid and thorough as possible in your responses.

General Information

Name: Click or tap here to enter text.

Title: Click or tap here to enter text.

Agency/Company: Click or tap here to enter text.

Confidential Responses? ☐Yes ☐No

(Note: The general information above will be used for tracking and data gathering purposes. If you would like your responses to be kept confidential, please check "Yes" above and no specific references to your agency/company will be made in any analysis documents that become a part of the final report.)

Assumptions:

1. *Continued absence of mandatory federal safety requirements for C/AVs (i.e., updating of Federal Motor Vehicle Safety Standards);*
2. *Desired regulatory state is cross-state harmonization to enable seamless operation across state lines.*
3. *Various classifications for C/AV operation needed, including considerations around heavy commercial freight, goods delivery, passenger, and subscription services.*

Questions:

1. From your organization's perspective and/or sponsored projects you've worked on, what areas related to C/AV operation should states try to harmonize, if any? Please click any of the following that apply:

☐ Licensing

☐ Registration/Titling

☐ Insurance

☐ Safety certification

☐ Operational data sharing

☐ Crash data reporting

☐ Accident investigation

☐ Law enforcement interaction plans

☐ None (i.e. states should do nothing at this time)

☐ Other: Click or tap here to enter text.

Please expand on your answers above to help provide context and reasons for any areas selected.

2. In consideration of Question 1, in what areas of the law should there by reciprocity agreements among states in consideration of wanting to avoid a “patchwork” of laws challenging operation across state lines, but also considering evolving risks and uncertainties.

3. Are there particular use cases that would lend themselves for operation of C/AVs across state lines either for passenger or goods movement based on your work? Please click all that apply.

☐ Private passenger subscription services

☐ Private shared passenger subscription services

☐ Transit partnerships

☐ Freight movement (i.e. heavy to medium sized trucking)

☐ Personal / First-Last Mile Goods Delivery

☐ Other: Click or tap here to enter text.

4. Based on your experience, research, and work in this space, do you think the terms “testing/pilot” and “deployment” capture the operation of C/AVs on public roads? Would a third category such as “demonstration” to focus on continued operations, but not yet scaled commercial deployment be helpful, confusing, or cumbersome?

5. Can you share information about efforts you’ve been involved in to codify this issue/litigate this issue/run pilots? Was this in one state? In multiple states?

For question 5 what were the challenges? What was surprisingly easy? What was more complicated than you thought it would be? Are there any reports/findings from pilot projects that you can share in support this research project?

Appendix D

State Level ADS Legislation Outside of New England

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix D

Bill Information (Bill number, date enacted, and link)

Definition of Driver / Operator (i.e. what is definition of driver or operator in statute?)

Safety / Verification (i.e. state led vs. company certification vs. general compliance with FMVSS)

Licensing / Registration (i.e. what are requirements and which agency has jurisdiction?)

Insurance / Liability (i.e. what are insurance requirements and does legislation seek to address liability?)

Data Sharing (i.e. what are information sharing requirements? any provisions around confidentiality or proprietary information?)

Local / State Coordination including Law Enforcement (i.e. are there any requirements for approval from or coordination with local governments? or are there law enforcement interaction requirements?)

Testing / Commercial Deployment (i.e. does statute cover both, only one, or not specified?)

Arizona

Bill Information	Executive Order 2018-04 ()	House Bill 2813 (Enacted 2021)
Definition of Driver / Operator	Not Addressed	"Driver" means a person who drives or is in actual physical control of a vehicle. "Fully Autonomous Vehicle" means an autonomous vehicle that is equipped with an automated driving system designed to function as a level four or five system under SAE J3016 and that may be designed to function either: (a) solely by use of the automated driving system. (b) by a human driver when the automated driving system is not engaged.
Safety / Verification	Company certification that tracks statute	Fully autonomous vehicle may operate on public roads without a human driver if: vehicle complies with FMVSS or has received an exemption; in the event ADS fails, vehicle can achieve a minimal risk condition; vehicle can comply with all traffic laws and people making the representation will be issued a citations for violations; all applicable title, registration, and licensing requirements have been met. Modifies vehicle safety requirements for fully autonomous vehicles, including mirrors, windshield wipers and windshields

Licensing / Registration	Comply with applicable law	NOTWITHSTANDING ANY OTHER LAW, A LICENSED HUMAN DRIVER IS NOT REQUIRED TO OPERATE A FULLY AUTONOMOUS VEHICLE THAT IS OPERATED IN COMPLIANCE WITH THIS CHAPTER. THIS CHAPTER DOES NOT PROHIBIT OR RESTRICT A LICENSED HUMAN DRIVER FROM DRIVING A FULLY AUTONOMOUS VEHICLE EQUIPPED WITH CONTROLS THAT ALLOW FOR THE HUMAN DRIVER TO CONTROL ALL OR PART OF THE DYNAMIC DRIVING TASK.
Insurance / Liability		
Data Sharing		
Local / State Coordination including Law Enforcement		WHEN ENGAGED, THE AUTOMATED DRIVING SYSTEM IS CONSIDERED THE DRIVER OR OPERATOR OF THE AUTONOMOUS VEHICLE FOR THE PURPOSE OF ASSESSING COMPLIANCE WITH APPLICABLE TRAFFIC OR MOTOR VEHICLE LAWS AND IS DEEMED TO SATISFY ELECTRONICALLY ALL PHYSICAL ACTS REQUIRED BY A DRIVER OR OPERATOR OF THE VEHICLE.
Testing / Commercial Deployment		

California

Bill Information	CA DMV Regulations	SB 145, 2017 (Testing on Public Roads)
Definition of Driver / Operator	“Driver” means the natural person who is operating an autonomous vehicle when it is not operating in the autonomous mode. “Dynamic driving task” means all of the real-time functions required to operate a vehicle in on-road traffic, excluding selection of final and intermediate destinations, and including without limitation: object and event detection, recognition, and classification; object and event response; maneuver planning; steering, turning, lane keeping, and lane changing, including providing the appropriate signal for the lane change or turn maneuver; and acceleration and deceleration. “Remote operator” is a natural person who: possesses the proper class of license for the type of test vehicle being operated; is not seated in the driver's seat of the vehicle; engages and monitors the autonomous vehicle; is able to communicate with occupants in the vehicle through a communication link. A remote operator may also have the ability to perform the dynamic driving task for the vehicle or cause the vehicle to achieve a minimal risk condition.	"Operator" of an autonomous vehicle is the person who is seated in the driver's seat, or, if there is no person in the driver's seat, causes the autonomous technology to engage.
Safety / Verification	CA DMV reviews and approves applications	Certification by manufacturer as to safety requirements, including compliance with FMVSS
Licensing / Registration	Application process administered by CA DMV. Excludes vehicles with a gross vehicle weight rating of 10,001 or more pounds.	Directs DMV to prepare and adopt regulations that address any testing, equipment, and performance standards.

Insurance / Liability	The manufacturer has in place and has provided the department with evidence of the manufacturer's ability to respond to a judgment or judgments for damages for personal injury, death, or property damage arising from the operation of autonomous vehicles on public roads in the amount of five million dollars ($5,000,000), in the form of: an instrument of insurance issued by an insurer admitted to issue insurance in California; a surety bond issued by an admitted surety insurer or an eligible surplus lines insurer, and not a deposit in lieu of bond; or a certificate of self-insurance.	A "manufacturer" of autonomous technology is the person as defined in Section 470 that originally manufactures a vehicle and equips autonomous technology on the originally completed vehicle or, in the case of a vehicle not originally equipped with autonomous technology by the vehicle manufacturer, the person that modifies the vehicle by installing autonomous technology to convert it to an autonomous vehicle after the vehicle was originally manufactured. Prior to the start of testing in this state, the manufacturer performing the testing shall obtain an instrument of insurance, surety bond, or proof of self-insurance in the amount of five million dollars ($5,000,000).
Data Sharing	“Personal information” means information that the autonomous vehicle collects, generates, records, or stores in an electronic form that is retrieved from the vehicles, that is not necessary for the safe operation of the vehicle, and that is linked or reasonably capable of being linked to the vehicle's registered owner or lessee or passengers using the vehicle for transportation services. Requires reporting of any collisions within 10 days and filing of disengagement reports yearly.	The autonomous vehicle has a separate mechanism, in addition to, and separate from, any other mechanism required by law, to capture and store the autonomous technology sensor data for at least 30 seconds before a collision occurs between the autonomous vehicle and another vehicle, object, or natural person while the vehicle is operating in autonomous mode. The autonomous technology sensor data shall be captured and stored in a read-only format by the mechanism so that the data is retained until extracted from the mechanism by an external device capable of downloading and storing the data. The data shall be preserved for three years after the date of the collision.

Local / State Coordination including Law Enforcement	In the event of driverless testing, law enforcement interaction plan needs to be provided to law enforcement agencies and other first responders "in the vicinity" of the operational design domains. Note: Previous version of draft regulations required written notification to local authorities within the jurisdiction where the vehicle was to be tested.	Not Addressed
Testing / Commercial Deployment	“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. Allows for testing with or without a safety driver. Limitations around transfer of interest or title of a test vehicle.	Initial focus on testing
Testing / Commercial Deployment	“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 or transporting property for a fee, or otherwise making commercially available outside of a testing program. The manufacturer of the autonomous technology installed on a vehicle shall provide a written disclosure to the purchaser of an autonomous vehicle that describes what information is collected by the autonomous technology equipped on the vehicle. With respect to a vehicle the manufacturer sells or leases to a customer, if the information is not anonymized, the manufacturer shall obtain the written approval of the registered owner or lessee of	Initial focus on testing

	an autonomous vehicle to collect any personal information by the autonomous technology that is not necessary for the safe operation of the vehicle.	

Appendix D

Florida

Bill Information	FL H 107, 2019	FL HB7027, 2016	FL HB1207, 2012	FL HB0311, 2019
Definition of Driver / Operator	Not Addressed	A person who possesses a valid driver license may operate an autonomous vehicle in autonomous mode on roads in Florida if the vehicle is equipped with autonomous technology.	A person who possesses a valid driver license may operate an autonomous vehicle in autonomous mode.	Remote Human Operator means "a natural person who is not physically present in a vehicle equipped with an automated driving system who engages or monitors the vehicle from a remote location."
Safety / Verification	Not Addressed	Not Addressed	Federal regulation supersedes any state law	AVs registered in FL must be certified in accordance with federal regulations and in compliance with FMVSS
Licensing / Registration	Not Addressed	Not Addressed	An autonomous vehicle registered in Florida must continue to meet federal standards and regulations for a motor vehicle.	A remote human operator must be licensed to operate a motor vehicle in the US.

Insurance / Liability	Not Addressed	Before a pilot, manufacturers must submit an instrument of insurance or proof of self-insurance for $5M.	Before testing, manufacturers must submit an instrument of insurance or proof of self-insurance for $5M.	Insurance requirements - primary liability coverage of at least $1M, personal injury protection benefits that meet the minimum under state law, uninsured and underinsured vehicle coverage.
Data Sharing	When a law enforcement officer issues a citation for wireless devices communications, including in an ADAS or ADS, the law enforcement officer must record the race/ethnicity of the violator and report that annually to the governor and legislature.	Not Addressed	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	This act amends law enforcement roles in interacting with drivers in an ADS or ADAS.	Not Addressed	Not Addressed	Local governments may not impose any tax or fee on an ADS.
Testing / Commercial Deployment	Not Addressed	The bill focuses on commercial deployment.	The bill focuses on testing.	Not Addressed

Testing / Commercial Deployment	No Distinction	No Distinction	No Distinction	No Distinction

Michigan

Bill Information	SB0169, 2013, (general AV operation)	SB0663, 2013, (amendment)	SB0995, 2016, (ADS, platooning)	SB0998, 2016, (torts and liability)	SB0996, 2016, (SAVE project)
Definition of Driver / Operator	"operator" means a person, other than a chauffeur, who operates an autonomous motor vehicle upon a highway or street	Not Addressed	Not Addressed	Not Addressed	Not Addressed
Safety / Verification	Not Addressed	Not Addressed	Manufacturer must be certified to comply with all applicable FMVSS	Not Addressed	Not Addressed
Licensing / Registration	Manufacturer must submit proof of insurance to secretary of state prior to testing	Not Addressed	If the platoon includes a commercial vehicle, driver with a valid driver license must be present; local government cannot impose additional requirements	Not Addressed	Not Addressed

Insurance / Liability	Insurance policy may be required, amount not specified; manufacturer is immune from civil liability if modifications are made to vehicle	Manufacturer is not liable for alleged damages unless the defect was present when the vehicle was manufactured	Manufacturer must obtain insurance of at least $10 million; manufacturer or upfitter must submit proof of insurance to state prior to testing	Manufacturer is not liable for alleged damages unless the defect was present when the vehicle was manufactured; repairer of vehicle is not liable if autonomous motor vehicle is repaired to manufacturer specifications	Not Addressed
Data Sharing	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Manufacturer shall make publicly available a privacy statement disclosing its data handling practices in connection with the applicable participating fleet.
Local / State Coordination including Law Enforcement	Not Addressed	Not Addressed	Local government shall not impose a local fee, registration, franchise, or regulation upon an on-demand automated motor vehicle network.	Not Addressed	Not Addressed

Testing / Commercial Deployment	Not Addressed	Not Addressed	Not Addressed	Not Addressed	Not Addressed
Testing / Commercial Deployment	Testing is allowed if approved by the state	No Distinction	Testing is discussed, commercial deployment is not specified	No Distinction	Manufacturer shall determine geographical boundaries for their project

Appendix D

New Mexico

Bill Information	HB 270 (Enacted 2021) / The effective date of the provisions of this act is July 1, 2022.
Definition of Driver / Operator	"autonomous motor vehicle operator" means the person who engages the automated driving system of an autonomous motor vehicle or autonomous commercial motor vehicle.
Safety / Verification	Prior to testing an autonomous motor vehicle or an autonomous commercial motor vehicle on a public highway in New Mexico, a person owning or operating such a motor vehicle shall notify the department of transportation at least five calendar days in advance of such operation on a form provided by rule by the department of at least the following information: the serial number and type of each motor vehicle to be tested; the routes to be used by the motor vehicles; the level of automated driving systems to be used by the motor vehicles; and such additional information as may be required by the department of transportation by rule.
Licensing / Registration	The department of transportation shall promulgate rules regarding the notification and regulation process provided for in Subsection A of this section, including forms to be used and information to be submitted by operators of autonomous motor vehicles and autonomous commercial motor vehicles when testing such motor vehicles on public highways in New Mexico.
Insurance / Liability	Autonomous motor vehicles and autonomous commercial motor vehicles shall meet all applicable federal motor vehicle safety standards. Additionally, autonomous motor vehicles and autonomous commercial motor vehicles shall be capable of being operated in compliance with applicable traffic and motor vehicle laws in New Mexico.
Data Sharing	The driver of a vehicle, the autonomous motor vehicle operator or the autonomous commercial motor vehicle operator, if applicable, involved in an accident resulting in bodily injury to or death of any person or property damage to an apparent extent of five hundred dollars ($500) or more shall immediately, by the quickest means of communication, give notice of the accident to the police department if the accident occurs within a municipality; otherwise to the office of the county sheriff or the nearest office of the New Mexico state police.

Local / State Coordination including Law Enforcement	No political subdivision of the state may, by ordinance, resolution or any other means, prohibit the testing or operation of an autonomous motor vehicle or autonomous commercial motor vehicle within the jurisdictional boundaries of the political subdivision solely on the basis of the motor vehicle being equipped with an automated driving system."
Testing / Commercial Deployment	"autonomous motor vehicle testing" or "autonomous commercial motor vehicle testing" means activities taken in full or in part to evaluate and assess: the automated driving system's performance of the dynamic driving task; and the automated driving system's performance with respect to applicable safety areas as defined by the federal national highway traffic safety administration for autonomous vehicle operations. "platoon" means a series of motor vehicles that are traveling in a unified manner by means of being connected with wireless communications or other technology allowing for coordinated movement.
Testing / Commercial Deployment	No Distinction

Pennsylvania

Bill Information	PA HB1958, 2017,	PA SB1268, 2016
Definition of Driver / Operator	Not Addressed	An operator must be a licensed driver, be able to take control of the vehicle, monitor the operation of the vehicle, and ensure that the vehicle will not be operated under the wrong conditions.
Safety / Verification	Not Addressed	Section 3610 - safety and control
Licensing / Registration	Not Addressed	Section 3611 – registration
Insurance / Liability	Not Addressed	Insurance in the amount of $5M, provide proof of financial responsibility for the vehicle.
Data Sharing	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	Not Addressed	Not Addressed
Testing / Commercial Deployment	Platooning for commercial deployment is discussed	Subchapter B – Testing
Testing / Commercial Deployment	No Distinction	No Distinction

Tennessee

Bill Information	SB 676, 2017 (platooning)	SB 151, 2018, (general AV operation)
Definition of Driver / Operator	person in control of lead vehicle	"Driver" is the ADS when engaged; "Operator" is the ADS when engaged.
Safety / Verification	Not Addressed	ADS must be certified by manufacturer and comply w/FMVSS or have exemption
Licensing / Registration	Notification, including plan, to operate platoon required to DOT and DPS.	if registered in TN, must be registered as ADS; ADS registration requirements met if certificate is in vehicle or available electronically through it; license not required for ADS or person operating ADS while ADS is engaged
Insurance / Liability	Not Addressed	ADS vehicles must be insured for up to 5M and comply with standard regs; liability determined by existing products liability law, common law, state or fed law; when ADS is functioning as intended, ADS is considered driver or operator for purposes of liability for personal/property injury or traffic law violation.
Data Sharing	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	Not Addressed	Owner (or person on his/her behalf) of ADS required to contact law enforcement in event of crash, ADS remains on scene, ADS owner must file report; All political subdivisions are expressly preempted from regulating ADSs or any level of AV.
Testing / Commercial Deployment	Not Addressed	Not Addressed

Testing / Commercial Deployment	No Distinction	Commercial use is allowed; testing is not addressed.

Texas

Bill Information	HB 1791, 2017 (platooning)	SB 2205, 2017, (general AV operation)
Definition of Driver / Operator	"operator" not addressed by this bill but implication is that there is a human operator present in vehicle.	"Automated Driving System (ADS)" is AV hardware & software. "Human operator" is a natural person in an AV who controls the entire dynamic driving task. Owner of ADS is operator for compliance purposes whether present in vehicle or not.
Safety / Verification	Not Addressed	Expressly addresses that vehicle must comply with federal law and federal FMVSS
Licensing / Registration	Not Addressed	The ADS is considered to be licensed to operate; licensed human not required to operate if ADS is engaged; must be registered like all other vehicles.
Insurance / Liability	Not Addressed	Insurance requirements are same as for other vehicles. Sec. a3 making owner the operator implies that owner will be found liable if his/her ADS was at fault.
Data Sharing	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	Not Addressed	No mention of law enforcement. All political subdivisions are expressly preempted from regulating AVs or ADSs.
Testing / Commercial Deployment	Not Addressed	Not Addressed
Testing / Commercial Deployment	No Distinction	Commercial use and operation are expressly allowed; testing is not addressed

Appendix D

Utah

Bill Information	HB 101, 2019, general operation	Sb 56, 2018, (platooning)
Definition of Driver / Operator	"operate" is driving by a human or an engaged ADS; "remote driver" is a human driver who is not manually controlling vehicle functions but operates the vehicle.	Not Addressed
Safety / Verification	Vehicle must comply with all applicable safety standards, FMVSS, and bear certification label, including exemption notice under federal law.	Exempts operator of a vehicle that is part of a connected platooning system from minimum following distance requirements.
Licensing / Registration	Exempts a vehicle with engaged ADS from licensure requirements, but does not exempt them from registration requirements.	Not Addressed
Insurance / Liability	Requires compliance with existing insurance requirements	Not Addressed
Data Sharing	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	Owner required to report ADS crashes according to existing law; state may inquire whether engaged ADS was involved; preempts political subdivisions from regulating autonomous vehicles in addition to regulation provided in state statute.	Not Addressed
Testing / Commercial Deployment	Not Addressed	Not Addressed
Testing / Commercial Deployment	No Distinction	No Distinction

Washington (EO)

Bill Information	EO 17-02, 2017, (Pilot testing)	HB2470, 2020 (NOT PASSED), (general AV operation)
Definition of Driver / Operator	Not explicitly defined; though EO states vehicles must have an operator onboard that can take control if necessary	Defines both as "means every person who drives or is in actual physical control of a vehicle"
Safety / Verification	Entities developing pilots must self-certify compliance with and provide notification to the state Department of Licensing (DOL)	Automated vehicle providers must submit safety self-assessment to NHTSA, even though not mandatory under federal voluntary guidelines
Licensing / Registration	Operators must possess a valid U.S. driver license	Vehicle registration required to the state
Insurance / Liability	Vehicle owners shall attest to proof of financial responsibility as required by state law.	Operator must be lawfully insured
Data Sharing	Not Addressed	Not Addressed
Local / State Coordination including Law Enforcement	Not Addressed	Not Addressed
Testing / Commercial Deployment	Not Addressed	Not Addressed
Testing / Commercial Deployment	Pilot programs for testing are enabled through the state.	No Distinction

APPENDIX E

Key Considerations for Regional ADS Coordination

COORDINATING STATE POLICIES, LAWS, AND REGULATIONS FOR AUTOMATED DRIVING SYSTEMS ACROSS NEW ENGLAND

Appendix E

Safety and Emissions Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Are vehicle safety inspections required?	**Responsibility**: State **Regional View**: Vehicle safety inspections are required in most states either biennially or annually, except for CT where most passenger vehicles are exempt.	**State**: Due to current lack of federal safety standards specific to ADS, there is a liability risk associated with allowing ADS to operate on public roads that varies based on use cases and operational design domains. **Regional**: From a regional perspective, a lack of harmonization may create risks to neighboring states and users of the transportation system or vehicles, particularly for a shared fleet format.	**State**: Monitor and engage in standards development at federal level. **Regional**: Monitor and engage in standards development at federal level. **Federal**: Federal standards developed to ensure state to state consistency, development of best practices, and information sharing.	Medium
Are emissions tests required?	**Responsibility**: State **Regional View**: Emissions inspections are required in all states. Maine only requires emissions inspections in Cumberland County.	**State**: Risk is minimal as ADS-equipped vehicles are largely expected to also be EVs, but until full EV conversion, ADS-equipped vehicles should continue to be subject to emissions testing. **Regional**: Risk is minimal as all states require testing statewide, except Maine which only requires testing in one county.	**State**: Eliminate emissions testing for all EVs, unless already exempted. **Regional**: Eliminate emissions testing for all EVs. **Federal**: None needed	Low

Appendix E

Safety and Emissions Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Does there need to be a steering wheel in the vehicle?	**Responsibility**: Federal **Regional View**: Required as part of the FMVSS.	**State**: Lack of clarity on equipment standards will result in a wide array of equipment packages based on waivers, or manufacturers, and aftermarket companies will experiment with equipment standards without authority. **Regional**: A wide range of equipment standards would create substantial confusion from jurisdiction to jurisdiction regarding registration, inspection, and law enforcement.	**State**: Monitor and engage in standards development at federal level. Consider changes focused on purpose-built vehicles. **Regional**: Establish working groups to identify potential equipment standards for ADS in the absence of FMVSS standards. **Federal**: Engage with NHTSA to support development of federal standards for general application nationwide.	High
Can a vehicle owner retrofit a vehicle to install after market ADS systems and turn off vehicle safety systems?	**Responsibility**: Federal **Regional View**: Absent a waiver, such a modification would violate FMVSS and would not be eligible for registration or pass safety inspection.	**State**: Detection of aftermarket modifications that do not conform to safety standards is difficult based on annual or biannual safety inspections. Current inspections do not likely cover testing of vehicle safety systems. **Regional**: Aftermarket products could create significant issues when modified vehicles are traveling from state to state, including law enforcement confusion.	**State**: Engage with NHTSA to support development of federal standards for general application nationwide. **Regional**: Work within the six New England states to develop a standard vehicle safety inspection checklist for ADS-equipped vehicles. **Federal**: Work with NHTSA to develop a federal framework for monitoring unlawful aftermarket modifications that compromise safety.	High

Appendix E

Safety and Emissions Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is installation of software updates to vehicles required?	**Responsibility**: Unknown **Regional View**: Unknown	**State**: If manufacturers and aftermarket providers require routine downloads of software updates similar to personal computers or smartphones, how will these updates be tested and verified as safe? **Regional**: This is largely an invisible issue that would only manifest itself in a significant crash. Interstate issues would manifest after the crash. Also becomes a larger issue for ADS on personally owned vehicles, but will apply to ADS fleets.	**State**: If not preempted by FMVSS, states should consider regulations to test and validate new software prior to download and installation by consumers. **Regional**: States should work together to develop consistent testing and validation regulations. **Federal**: States should work with NHTSA to develop federal standards for the testing and validation of software updates prior to installation. This will include whether software updates should be automatic or subject to owner approval first.	Medium
Does an automated vehicle need identifying markers or indications outside the vehicle?	**Responsibility**: State **Regional View**: None	**State**: Clear identification of ADS-equipped vehicles by identifying features would assist law enforcement and inform emergency responses in the event of a catastrophic failure. **Regional**: Consistent markings from state to state will promote uniform understanding by law enforcement and other interested parties.	**State**: In the absence of preemptive changes to FMVSS, develop standard markings for use by manufacturers on ADS-equipped vehicles. **Regional**: States should work together to develop consistent standards. **Federal**: Work with NHTSA to add applicable standards to FMVSS.	Medium

Appendix E

Insurance Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is insurance required?	**Responsibility**: State **Regional View**: Existing insurance requirements for human-driven vehicles across the six New England states are generally consistent, with the notable exception of New Hampshire, which has no insurance requirement.	**State**: Insurance is a risk mitigation tool for making sure injuries can be compensated. **Regional**: From a regional perspective, a lack of harmonization may create risks to neighboring states and users of the transportation system or vehicles.	**State**: Amend state statutes and applicable regulations to create a single standard for automobile insurance requirements and limits for ADS-equipped vehicles in consideration of uses cases and operational design domains. **Regional**: Convene national study group to develop consistent insurance requirements and limits from state to state. **Federal**: Consider a compact for the six New England states to harmonize such requirements.	High
Is insurance required when a vehicle is operating on public roads with no person in the vehicle?	**Responsibility**: State **Regional View**: Unknown	**State**: Operating any vehicle without insurance is also unlawful (except in NH), regardless of whether there are occupants or not. **Regional**: Motor vehicles traveling across state lines in violation of multiple statutes pose risks to the motoring public from a health, welfare, and safety perspective, and significantly complicates law enforcement efforts.	**State**: Work to ensure that unlawful conduct does not exempt an owner from liability under state insurance requirements. **Regional**: Work to ensure that all states, including NH, have consistent motor vehicle insurance requirements from state to state. **Federal**: Consider a compact for the six New England states to harmonize such requirements.	High

Appendix E

Insurance Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is self-insurance allowed for individuals?	**Responsibility**: State **Regional View**: Self-insurance is not allowed for individuals (except in NH, where no insurance is required).	**State**: State-based motor vehicle insurance policies have evolved over decades and represent state-of-the practice risk mitigation instruments for motor vehicle insurance. The use of self-insurance should be evaluated carefully. **Regional**: A potpourri of insurance approaches from state-to-state leaves motorists vulnerable to insurance variations that are unfamiliar and difficult to understand and can reduce consumer confidence when traveling between states.	**State**: Strengthen existing insurance laws consistent with best practices nationally and regionally, including in consideration of non-human operators of ADS-equipped vehicles. **Regional**: Work with other states to develop a common policy approach, consistent with national best practices, that can be adopted by each state. **Federal**: Consider a compact to create a regional approach to insurance requirements.	Medium

Appendix E

Insurance Requirements for Registration				
	Human Drivers	Transition to ADS		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is proof of insurance required?	**Responsibility:** State **Regional View**: Proof of insurance is generally required in all New England states, with the exception of NH.	**State**: The requirement to be able to produce proof of insurance is a simple risk mitigation tool to ensure that a motorist involved with law enforcement or in a crash can document their insurance. **Regional**: The ability to produce proof of insurance in states that have an insurance requirement provides a recognizable and familiar method of verifying compliance with applicable laws.	**State**: Continue to require proof of insurance consistent with national best practices. Considerations will be needed around vehicles without any human driver. **Regional**: Consider development of a standard regionwide digital form of proof of insurance, which will improve law enforcement efficiency when traveling across state lines and in the context of ADS-equipped vehicles. **Federal**: Consider a compact to address this matter on a regional basis.	High

Appendix E

Insurance Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is self-insurance allowed for fleet operators?	**Responsibility**: Federal and State **Regional View**: Self-insurance for fleet operators subject to IRP is governed by FMCSA regulations. Intrastate "fleets" are generally subject to state laws, which vary widely in application but generally result in a commercial registration in the home state subject to typical reciprocity requirements.	**State**: The state plays a minimal role in the regulation of fleets subject to FMCSA oversight and IRP participation. Intrastate "fleets" are governed by state statutes, which generally require that commercial vehicles follow the same rules as registrations for passenger vehicles. The state's risk is that commercial vehicles that are effectively underinsured or uninsured can result in financial harm to the motoring public in the event of a crash. **Regional**: Regional interests are generally represented for most fleet operations by the IRP and FMCSA regulations. Risks include improperly capitalized self-insurance policies that expose the motoring public to unnecessary risks when traveling across state lines.	**State**: Review registration requirements for fleet vehicles governed by state statute and ensure that self-insured operators are sufficiently capitalized. **Regional**: Consider a regional approach for fleet vehicles not governed by FMCSA and IRP. Determinations around how fleets of ADS-equipped vehicles will be classified are still unknown. **Federal**: Work with FMCSA to ensure that self-insured vehicles operating in interstate commerce are properly capitalized to manage appropriate risk.	High

Appendix E

Ownership and Residency Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is registration to an in-state entity required?	**Responsibility**: State **Regional View**: All New England states require that registrations for passenger vehicles be issued to residents only. Commercial vehicles are not held to the same requirements, and in some instances, can be issued to out-of-state corporate entities with local agents. Commercial vehicles subject to IRP are registered in their base jurisdiction and have registration reciprocity in other member jurisdictions.	**State**: Not having a clear chain of ownership that is in-state may impact ability to resolve claims. **Regional**: From a regional perspective, a clear chain of ownership helps resolve claims and assists with addressing any consumer concerns.	**State**: Review registration requirements to ensure that all registrants are duly accountable to claims, even if represented in- state by an agent. **Regional**: Determine regional approach to assist with registration requirements for tracking ADS deployments and to coordinate information sharing. **Federal**: None.	Low

Appendix E

Ownership and Residency Requirements for Registration				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Can fleets of vehicles be registered for movement of passengers?	**Responsibility**: State **Regional View**: The states vary on how they regulate intrastate "fleets," but generally the states allow for registration of fleets.	**State**: The regulation of fleets that are designed for shared mobility via ADS-equipped vehicles is in the public interest and to make sure consumers are protected. **Regional**: Consistent regulation across state lines makes public acceptance and convenience most effective, in addition to creating a business case.	**State**: Adopt consistent regulations from state to state with a foundation around the regulation of transportation network companies. **Regional**: Adopt consistent regulations from state to state. **Federal**: None, unless funding is provided for supporting first-last mile transit connections.	High
Can fleets of vehicles be registered for movement of goods in-state?	**Responsibility**: State / Federal **Regional View**: The states vary on how they regulate intrastate "fleets," but generally the states allow for registration of fleets.	**State**: The regulation of fleets that are designed for the movement of goods intrastate and via ADS-equipped vehicles is an evolving topic. There are also questions around whether nationally operating companies fall within the Interstate Commerce Clause. **Regional**: Consistent regulation across state lines for local goods movement is in the interests of the region based on evolving use for low-speed purpose-built ADS vehicles.	**State**: Adopt consistent regulations from state to state. **Regional**: Adopt consistent regulations from state to state. **Federal**: None, unless Interstate Commerce Clause determined to be application.	High

Appendix E

Requirements for Vehicle Operation				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Can the driver of a vehicle be a corporation or non-human?	**Responsibility**: State **Regional View**: The statutes of the six new England states either imply or affirmatively state that licenses to operate a motor vehicle can only be issued to natural persons.	**State**: States have a pivotal and unique role in deciding who gets to operate a motor vehicle. This power has long been vested in state authority. This is because the state is uniquely empowered and positioned to protect the health, welfare, and safety of its citizens. Allowing non-natural persons to operate a motor vehicle is at the heart of ADS technology and business plans. **Regional**: If one state allows non-natural persons to operate a motor vehicle, there will be a potential for inconsistencies for insurance, liability, accountability, and law enforcement across the states for ADS governance. Thus, it is in the interests for the states to coordinate around such a legislative change.	**State**: Amend the licensing statutes of all six New England states to include corporations and other non-natural persons as a “person” eligible for a driver license. This would clarify an otherwise uncertain term and remove uncertainty from the legal landscape. **Regional**: Develop a model law for adoption by all six New England states to allow for uniform definition of a "person" eligible to operate a motor vehicle to include a corporation or non-natural person. **Federal**: None	High

Appendix E

Requirements for Vehicle Operation				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Does a person have to be in the "driver's seat" at all times?	**Responsibility**: State **Regional View**: Not currently addressed.	**State**: Motorists monitoring ADS operations from a location in the vehicle that is not the driver's seat might have their ability to operate the vehicle in the event of an emergency impaired, which could compromise public safety. **Regional**: Impaired operation of vehicles in interstate travel can cause law enforcement confusion and undue risk to the motoring public.	**State**: Develop statutes that address ADS operations to specify whether or not a natural person is required in the vehicle when operating in ADS mode. **Regional**: Develop a regional framework to promote a consistent policy between the states around whether or not drivers or operators are required in the driver's seat. **Federal**: Work with NHTSA to add applicable standards to FMVSS.	Medium
Can a licensed person operate a vehicle remotely?	**Responsibility:** State **Regional View:** Not currently addressed.	**State**: This is not currently expressly addressed in state law. Remote operation, if it were to become lawful, would need oversight to ensure the safety of the motoring public. **Regional**: The development of a governance approach will also need to consider broadband infrastructure to ensure connectivity for remote operations.	**State**: Commission a working group to study how and under what conditions, remote operation might be permitted for ADS. **Regional**: Work with the other states to develop a regional approach to how and under what conditions, remote operation might be permitted for ADS. **Federal**: Work with NHTSA and FMCSA to determine how and under what conditions, remote operation might be permitted.	Low

Appendix E

Requirements for Vehicle Operation				
	Human Drivers	Transition to ADS		
	Regulatory Status Quo	Risk Identification	Future Forward Harmonization	Regional Priority
Are there distracted driving laws that would preclude a driver from doing something other than monitoring the environment?	**Responsibility**: State **Regional View**: Each New England state restricts the use of portable electronic devices while operating a motor vehicle. In general, there is substantial alignment between the states.	**State**: Passengers are free to use portable electronic devices while a motor vehicle is moving. In an ADS context, there will need to be considerations around whether a driver or operator will be able to use portable devices when the ADS is engaged. **Regional**: Consistent definitions and standards from state to state are important to minimize confusion on the part of operators driving in interstate travel.	**State**: Adopt regional standards to ensure consistency across all states. These standards will be influenced by the levels of automation for ADS. **Regional**: Develop regional standards and restrictions for adoption on a state-by-state basis. **Federal**: Provide guidance around best practices for safety of passengers in ADS-equipped vehicles.	High
Are there requirements to share vehicle operational data from vehicles where V2-X capabilities exist?	**Responsibility:** State **Regional View:** Not currently addressed.	**State**: The sharing of operational data with V2X infrastructure could improve safety outcomes and dramatically reduce congestion. There are risks to privacy and financial systems that could become significant if sharing is not properly regulated. **Regional**: The sharing of information can benefit regional transportation planning and infrastructure investment prioritization.	**State**: States should determine whether such data sharing is required in the public interest and, if so, how data privacy is protected. **Regional**: The region should develop a standardized approach for information sharing related to ADS operations that mutually benefits the public and private sector. **Federal**: None, unless national privacy standards are adopted.	Medium

Appendix E

Requirements for Vehicle Operation				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Are there requirements to confirm operations under most updated software for vehicle?	**Responsibility**: State or Federal **Regional View**: Not currently addressed	**State**: Faulty our outdated operating system software could present significant safety hazards. **Regional**: Faulty operating systems will not know state boundaries and could cause regional safety problems if downloaded into large numbers of vehicles. It is also difficult to know whether a vehicle is operating with the most up to date software even if updates are mandatory since there may also be the need to have a decent broadband signal to complete the download.	**State**: Work with law enforcement to determine safety considerations. **Regional**: Commission a working group to evaluate the issue of ensuring safe vehicle operations and anticipated over the air updates for ADS software. **Federal**: Consider national testing standards to defer the cost and bureaucracy of an independent testing regime, as well as to ensure uniformity in the nation.	Medium

Appendix E

Law Enforcement Interaction / Crash Reporting				
	Human Drivers	**Transition to ADS**		
	Regulatory Status Quo	**Risk Identification**	**Future Forward Harmonization**	**Regional Priority**
Is there requirement that vehicle data be shared for crash investigations?	**Responsibility**: State **Regional View**: To the extent certain vehicle data is currently required to be reported on standard state forms, there is the need for uniformity among the states.	**State**: State regulating bodies have a vested interest in understanding the origins and causes of crashes. This is particularly acute in the ADS context due to the public's inherent distrust of new technologies. Data from vehicle sensors and operating systems could significantly improve safety outcomes for ADS and should be shared when possible and not impacting manufacturer's intellectual property rights. **Regional**: Regional coordination related to ADS suggests that sharing data on crashes across state lines will help all jurisdictions improve oversight of ADS and create the conditions for widespread public acceptance.	**State**: Establish a crash reporting regime that will allow regulators to review crash patterns and trends, thereby allowing for incremental improvements to the technology, while simultaneously balancing the commercial interests of the manufacturers. **Regional**: Ensure that state reporting regimes are coordinated and consistent for maximum sharing effect. **Federal**: Work with NHTSA and FMCSA to develop national reporting standards that will provide a national database on ADS crashes to improve safety and public acceptance.	High