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Analysis of Autonomous Vehicle Policies

Kentucky Transportation Center Research Report — KTC-16-25/PL-26-1F

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Research Report
KTC-16-25/PL-26-1F

Analysis of Autonomous Vehicle Policies

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in cooperation with the
Kentucky Transportation Cabinet

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16. Abstract <p>The rapid development and adoption of connected and autonomous vehicles will transform the U.S. transportation system over the next 30 years. Although the widespread use of fully connected and autonomous vehicles is still several years away, it is nonetheless critical that legislators, policymakers, and regulators understand how the presence of these vehicles will restructure the operation of roadway networks. Without a doubt, lawmakers and policymakers will need to develop new laws — and revise existing ones — to account for the presence of connected and autonomous vehicles. This report provides an overview of connected and autonomous vehicles — their positives and negatives, how quickly consumers may adopt them, and strategies state departments of transportation can use to streamline their deployment — before examining the recent efforts at the federal and state level to establish laws and regulations that will smooth the transition for connected and autonomous vehicles. Federal agencies, such as the National Highway Traffic Safety Administration, have issued guidance for manufacturers and state and local governments. Meanwhile, numerous states have enacted or proposed legislation to deal with connected and autonomous vehicles. The content of these statutes varies among states, however, shared areas of concern include defining what constitutes an autonomous vehicle, establishing basic protocols for testing autonomous vehicles on public roadways, specifying under what circumstances a manufacturer is liable for crashes, and setting guidelines for operating autonomous vehicles. Looking toward the Commonwealth, a review of the Kentucky Revised Statutes and Kentucky Administrative Regulations identifies current policies and regulations that may apply to connected and autonomous vehicles. Policymakers and legislators will likely have to grapple with issues pertaining to licensing, registration, cell phone usage, and the definition of vehicle operators in the context of autonomous vehicles. Given that the proliferation of connected and autonomous vehicles will accelerate over the next 10-15 years, Kentucky will benefit if these issues are addressed and resolved in a timely manner.</p>			
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Table Of Contents

ACKNOWLEDGEMENTS	vi
EXECUTIVE SUMMARY	vii
CHAPTER ONE: INTRODUCTION.....	9
1.1 Study Overview	9
1.2 Research Objectives.....	10
1.3 Structure of the Report.....	11
CHAPTER TWO: LITERATURE REVIEW.....	12
2.1 Defining Connected and Autonomous Vehicles.....	12
2.2 Potential Benefits and Barriers	18
2.3 Consumer Acceptance	23
2.4 State Preparedness	25
CHAPTER THREE: FEDERAL/STATE POLICY AND LEGISLATION	29
3.1 Federal Policy	29
3.2 State Policy and Legislation.....	35
CHAPTER FOUR: KENTUCKY STATUTES AND REGULATIONS.....	55
4.1 Kentucky Revised Statutes	55
Chapter 174.....	55
Chapter 176.....	55
Chapter 186.....	56
Chapter 189.....	61
Chapter 190.....	63
4.2 Kentucky Administrative Regulations.....	69
Title 500.....	69
Title 502.....	69
Title 601.....	70
Title 603.....	71
Title 605.....	72
CHAPTER FIVE: CONCLUSION.....	73
REFERENCES	76
APPENDIX.....	80
Draft Language for a State Bill (Smith 2014)0.....	80
NHTSA Policy Update	85
Model State Policy.....	87
Arizona Executive Order 2015-09	92
Best Practice Recommendations for Texas DOT	94

List of Tables

Table 1: Levels of Automation	15
Table 3: Connected Vehicle Applications	16
Table 4: Positive and Negative Impacts of Autonomous Vehicles (Isaac 2016).....	19
Table 5: Potential New Tools and Authorities.....	32
Table 6: Cross-Cutting Areas of Guidance.....	33
Table 7: Automation Guidance.....	34
Table 8: Summary of Enacted State Legislation on Autonomous Vehicles.....	37
Table 9: Proposed State Legislation 2015-2016	40
Table 10: Texas Safety Strategies for Connected and Autonomous Vehicles.....	52
Table 11: Short and Medium/Long Range Recommended Plans for State and Local Governments Related to Autonomous Vehicles.....	54
Table 12: KRS Chapter 174.....	55
Table 13: KRS Chapter 186.....	58
Table 14: KRS Chapter 189.....	62
Table 15: KRS Chapter 190.....	67
Table 16: KAR Title 601, Chapter 9.....	70
Table 17: KAR Title 605, Chapter 1.....	72

List of Figures

Figure 1: Carnegie Mellon Autonomous Car.....	13
Figure 2: PennDOT Recommended CAV Action Timeline.....	27
Figure 3: Vehicle Performance Guidance.....	31
Figure 4: Status of Autonomous Vehicle Legislation.....	36

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Executive Summary

Recent technological advances have brought the implementation of connected vehicles and autonomous vehicles (CVs, AVs, or self-driving vehicles; also often referred to together as CAVs) closer to reality. The most well-known effort, The Google Self-Driving Car Project, is being tested in California and Texas. Ford and Volvo both have plans to develop and manufacture AVs. With these efforts, it appears increasingly likely that driverless technology will phase into public use in the U.S. in the near future.

AVs offer many benefits to transportation systems. They reduce crashes, alleviate congestion, diminish pollution, and increase mobility while improving travel time. AVs can be used for: personal/family transportation in suburban areas, on-demand personal-mobility services in urban areas, short-term rental vehicles, fleet ownership by corporations or for cooperative use, local delivery services, or to transport persons with disabilities. This report provides an overview of connected and autonomous vehicles, what consumers can expect, how state departments of transportation may regulate these vehicles, and what efforts federal and state agencies have put forth to establish laws and regulations.

Federal and state vehicle policy implications make it crucial for legislators, policymakers, and regulators to understand how the presence of AVs will restructure the operation of roadway networks. Policymakers may consider regulating vehicle capabilities, testing and certification, and insurance requirements. Chapter 2 is a literature review that discusses how CVs and AVs have been defined, the potential benefits and barriers associated with these technologies, and consumers' willingness to use and finance driverless technologies. This chapter also provides a high-level review of legal and privacy issues raised by CAV technologies.

Chapter 3 examines guidance from The National Highway Traffic Safety Administration as well as AV-related policies that have been legislated at the state-level. Summarized are those enacted and proposed bills by states who are exploring connected and autonomous vehicle technology. Shared areas of concern include defining what constitutes an autonomous vehicle, establishing basic protocols for testing autonomous vehicles on public roadways, specifying under what circumstances a manufacturer is liable for crashes, and setting guidelines for operating autonomous vehicles.

Chapter 4 reviews the Kentucky Revised Statutes and Kentucky Administrative Regulations to identify potential barriers to AVs that may require attention. This chapter discusses vehicle regulations and driving laws in Kentucky, with particular focus on licensing, registration, cell phone usage, and the definition of vehicle operators in the context of autonomous vehicles. This early work will help Kentucky establish the appropriate legal and regulatory environment for AVs as the technology is put into use.

Connected and autonomous vehicles (CAVs) have the potential to increase the safety and efficiency of vehicle travel. Despite the advantages, policymakers will have to consider the potential drawbacks CAV technology brings, including an increase in VMTs, job loss in the transportation industry, and costs that may initially be too high for many consumers. There are privacy concerns over the collection and use of data as well as costs governments will have to bear

as they build new transportation infrastructure. The U.S. Department of Transportation's (USDOT) *Federal Automated Vehicles Policy* contains information on AV performance, state policy, and current and potential new regulatory tools the federal government has at its disposal to ensure the safe operation of AVs. The USDOT encourages states to develop clear regulations focused on testing, liability, AV identification via registration protocols, and crash procedures. Their guidance instructs states to retain responsibility for licensing drivers, registering vehicles, overseeing traffic laws, and regulating insurance requirements. Currently, eight states have passed legislation related to AVs. Many KRS passages refer to a person operating a vehicle — fully automated vehicles would lack input from human drivers. Policymakers will need to define *operator* in the context of AVs to avoid potential conflicts. There are a seemingly endless number of research topics in the area of CAVs. Future work may include the study of economic models, how traffic patterns are affected by CAVs, concerns over data security and privacy, use of controlled lanes, and further policy analysis, to name a few.

Chapter One: Introduction

1.1 Study Overview

Technological advances have brought autonomous vehicles (AVs, also referred to as automated vehicles or self-driving vehicles) closer to reality.¹ Perhaps the most well-known effort, the Google Self-Driving Car Project², has reached the testing stage in California and Texas, with test vehicles having travelled over one million miles to date. Ford has announced plans to introduce a fully autonomous³ vehicle (no steering wheel or control pedals) in 2021.⁴ Volvo and Uber are partnering to develop AVs— Volvo will manufacture the “base vehicles” with Uber adding its own autonomous driving software to the vehicles.⁵ Uber also began testing retrofitted Ford Fusions in Pittsburgh in September 2016, although drivers remain in the vehicles to monitor their performance.⁶ Uber has also acquired a self-driving technology start-up, Otto, whose mission is to retrofit commercial vehicles with self-driving technology.⁷ *Business Insider* estimates there will be 10 million AVs on the road by 2020.⁸ Isaac (2016, p.4) provides a more exacting discussion of the timeline for introducing AVs:

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

AVs can be used for varying purposes, including (Glancy et al. 2016, p. 28):

- Individually owned personal/family transportation
- On-demand personal-mobility services in urban areas
- Rental vehicles for short-term mobility and transport needs
- Long-haul movement of goods and commodities
- Commercial local delivery services
- Paratransit driverless vehicles (services for persons with disabilities)
- Fleets owned by corporations or other entities
- Fleet ownership by groups of users for cooperative use
- Urban low speed vehicles on limited roadways

AV technologies have a multitude of uses and numerous benefits. They reduce crashes, alleviate congestion, diminish pollution, and increase mobility while improving travel time. According to the National Highway Traffic Safety Administration (NHTSA), there were over 35,000 crash deaths and 2.44 million in injuries in 2015. Thus, any improvement AVs could offer may save a

¹ For a history of AVs see Anderson et al. (2014) Chapter Four, p. 55-74.

² <https://www.google.com/selfdrivingcar/>

³ See Chapter 2 for a discussion of automation levels.

⁴ <http://www.forbes.com/sites/pikerresearch/2016/08/19/ford-autonomous-vehicle/#6853211b2752>

⁵ <https://www.media.volvocars.com/global/en-gb/media/pressreleases/194795/volvo-cars-and-uber-join-forces-to-develop-autonomous-driving-cars>

⁶ <http://www.npr.org/sections/alltechconsidered/2016/09/14/493823483/self-driving-cars-take-to-the-streets-of-pittsburgh-courtesy-of-uber>

⁷ <http://www.govtech.com/fs/Otto-Uber-Drive-into-Autonomous-Future-Together.html>

⁸ <http://www.businessinsider.com/report-10-million-self-driving-cars-will-be-on-the-road-by-2020-2015-5-6>

number of lives and yield significant cost savings, not just from crashes but from other externalities such as emissions, congestion, and noise (Anderson et al., 2014). Along with AVs, connected vehicles (CVs) also have promising technologies that can improve safety. These vehicles are equipped with technology that can communicate with the driver, other vehicles (vehicle-to-vehicle or V2V), and infrastructure (vehicle-to-infrastructure or V2I). Panasonic recently announced a partnership with the Colorado Department of Transportation to build connected vehicle infrastructure along I-70.⁹

Before AVs become widespread, it is critical to analyze the policy implications of their presence on the road. Policymakers may consider regulating vehicle capabilities, human factors (i.e., testing and certification), and insurance requirements (Anderson et al., 2014). This includes examining liability changes for insurance (manufacturer versus personal) and understanding the impacts of inconsistent state regulations related to AVs. Overlap between federal, state, and even local laws could include (Glancy et al. 2016, p. 70):

- Federal legislation and administrative regulation with respect to such matters as highways, vehicle safety, and fuel efficiency standards
- State common law with respect to property, tort, and contract matters
- State legislation and administrative regulations regarding such matters as licensing vehicles and operators, minimum vehicle standards, insurance, roadway usage, and traffic laws, as well as other issues including privacy, security, criminal law, and environmental regulations
- Local ordinances regarding traffic, pedestrian, and bicycle safety and parking

Ensuring that AV testing and operation is safe while not burdening the automotive and software industries with excessive regulations will facilitate the introduction of technological advancements and accelerate deployment and adoption (if that is a desired policy goal). Thierer and Hagemann (2015) advocate for “permissionless innovation,” or letting technological development and the creation of new businesses proceed unimpeded to allow the continued development of AV technology.

1.2 Research Objectives

Rapid technological advancements combined with the transformative potential of CVs and AVs (often referred to as CAVs) raise a number of critical policy-related questions. This report discusses the implications of CAVs for vehicle regulations and driving laws in Kentucky. First, we review and define the current environment for CAVs, focusing on the potential benefits of these technologies, barriers to implementation, and consumer acceptance. Second, we discuss the policies and proposed regulations other states have introduced to establish the appropriate legal and regulatory environment for AVs. The primary emphasis is on a review of legislative efforts and legislative and policy initiatives across the U.S.. Finally, the report examines current policy to identify relevant information for AV policy and potential barriers and challenges for the testing, certification and/or implementation of AVs within existing law, regulation, and policy, including Kentucky Revised Statutes (KRS) and Kentucky Administrative Regulations (KAR). The study

⁹<http://www.techrepublic.com/article/panasonic-takes-major-step-toward-autonomous-driving-with-its-first-connected-vehicle-platform-in/>

examines Kentucky-specific policy, including KRS and KAR, to understand how they might apply to AV policy and regulation within the following areas: Driver Definitions/Requirements, Equipment/Vehicle Regulations, Licensing Definitions/Requirements, Operational Limitations, Safety Equipment, and any other relevant areas. The findings highlight key factors agencies and policymakers should address as they develop regulations for AV technologies.

1.3 Structure of the Report

Chapter 2 is a literature review that discusses how CVs and AVs have been defined, the potential benefits and barriers associated with these technologies, and consumers' willingness to accept and pay for new technologies. This chapter also provides a high-level review of legal and privacy issues raised by CAV technologies. Chapter 3 examines AV-related policies at the federal level as well as legislation that has been enacted or proposed at the state-level. Enacted and proposed bills are summarized in separate tables. These tables also contain hyperlinks to each piece of legislation, which the reader may consult for more information. Chapter 4 looks at KRS and KAR to identify potential barriers to AVs that may require attention. The final chapter presents suggestions and proposes future research topics. The Appendix contains supplemental information, including draft language for a state bill, model state policy, and best practices recommendations.

Chapter Two: Literature Review

2.1 Defining Connected and Autonomous Vehicles

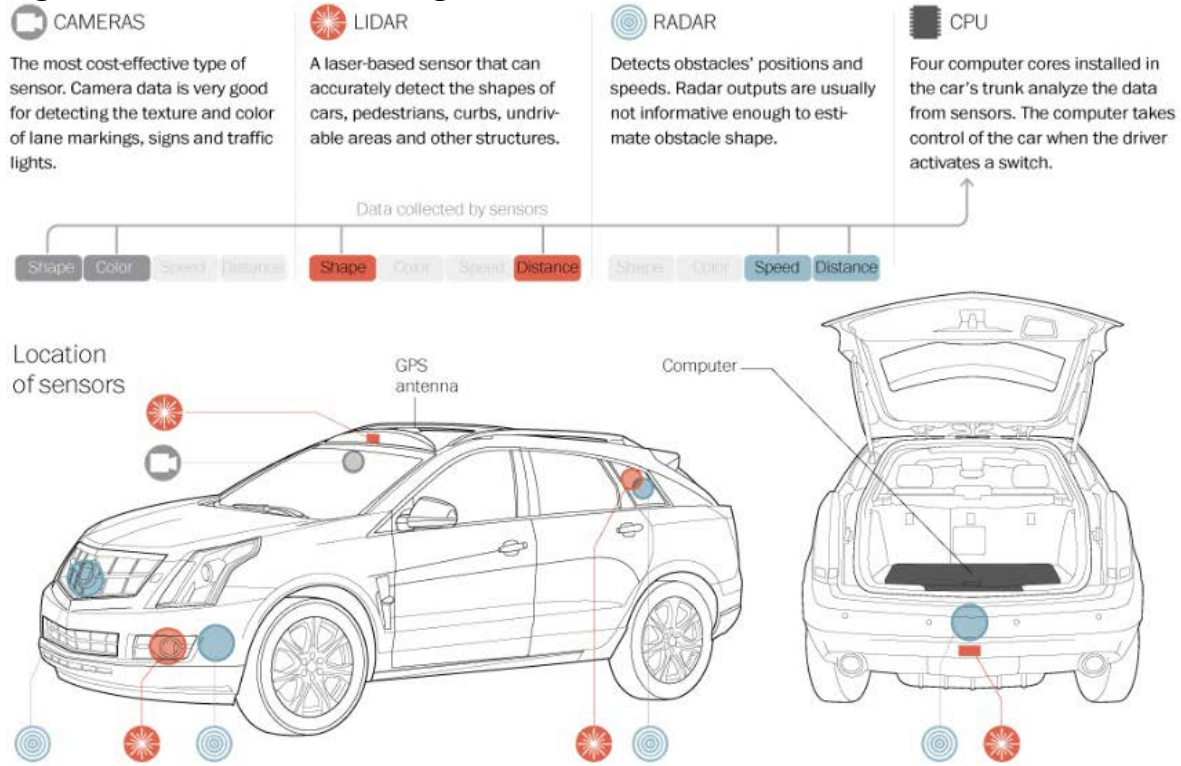
Automated vehicles (AVs) are equipped with technologies such as sensors or cameras, which let vehicles to sense their environment and potentially operate without human assistance. Zmud et al. (2015, p.2) define AVs as those “in which at least some aspects of a safety-critical control function (e.g., steering, throttling, or braking) occur without direct driver input.”

Daziano, Sarrias, and Leard (2016) define *automated navigation technology* as:

Any combination of (1) self-driving navigation systems informed by onboard sensors (autonomous vehicles) vehicle-to-vehicle (V2V) and (2) vehicle-to-infrastructure (V2I) communication systems that inform navigation and collision avoidance applications (connected vehicles). (p. 1)

Figure 1 highlights the operational underpinnings of an AV. While the report is representative of AV technology, there are concerns over the interoperability of different AV technologies, and researchers are working to identify an optimal approach (Thierer and Hagemann, 2015).

Figure 1: Carnegie Mellon Autonomous Car



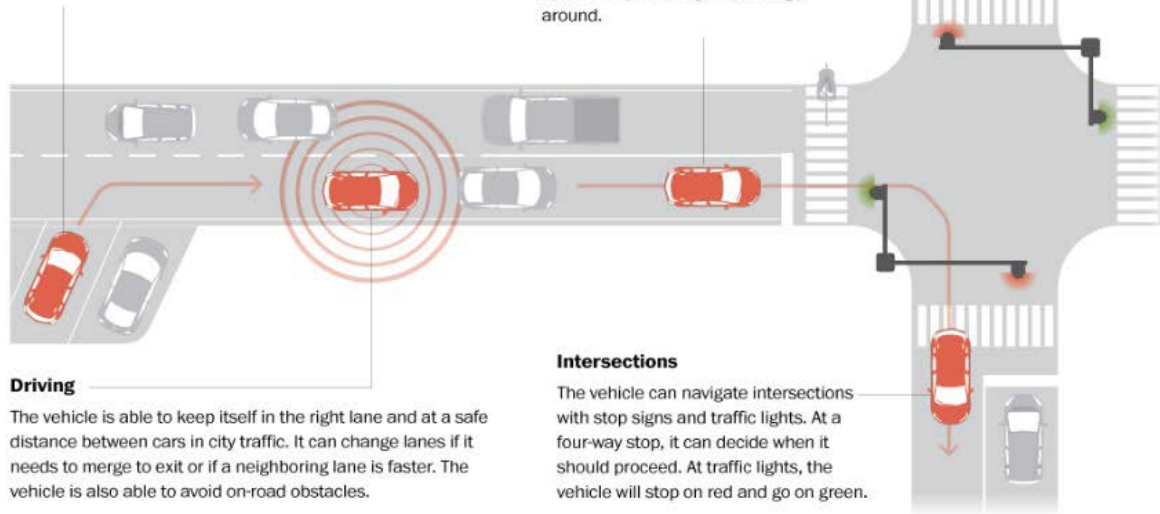
How the car performs on the road

Planning

The vehicle automatically generates a route from the user's current location to the desired destination, factoring in speed limits, traffic lights, stop signs, lane changes, and other information.

Pedestrians and bicyclists

The vehicle can detect pedestrians crossing the road and stop for them. It will detect bicyclists as well and keep a safe distance while looking for an opportunity to change lanes or go around.



¹⁰ <http://apps.washingtonpost.com/g/page/local/autonomous-cars/1260/>

SAE International's On-Road Automated Vehicle Standards Committee issued a report, *Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems*. It defines six levels of automation which are adopted in the USDOT's *Federal Automated Vehicles Policy* discussed in Chapter 3. Table 1 provides a detailed summary of those levels.

Table 1: Levels of Automation¹¹

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
Automated driving system (“system”) monitors the driving environment						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the dynamic driving task with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an automated driving system of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

¹¹ SAE International, Report J3016

Connected vehicles (CVs) are named after the communications and data devices they are equipped with. CVs are equipped with onboard dedicated short-range communications (DSRC)¹² that enable two-way data sharing between other vehicles and infrastructure (Baxter, 2012), on the 5.9 GHz spectrum. NHTSA explains how vehicle-to-vehicle (V2V) technology works:

V2V communications systems are composed of devices, installed in vehicles, that use dedicated short-range radio communication (DSRC) to exchange messages containing vehicle information (e.g., vehicle’s speed, heading, braking status). V2V devices use this information from other vehicles and determine if a warning to the vehicle’s driver is needed, which could prevent a vehicle crash.¹³

In addition to V2V technology, CVs may also communicate vehicle-to-infrastructure (V2I) with roadside equipment. According to Wright et al. (2014, p. 2) a complete CV system includes the following elements:

- Roadside communications equipment (for DSRC or other wireless services) along with enclosures, mountings, power, and network backhaul
- Traffic signal controller interfaces for applications that require signal phase and timing (SPaT) data
- Systems and processes required to support management of security credentials and ensure a trusted network
- Mapping services that provide highly detailed roadway geometries, signage, and asset locations for the various connected vehicle applications
- Positioning services for resolving vehicle locations with high accuracy and precision
- Data servers that collect and process data provided by vehicles and distribute information, advisories, and alerts to users

The technologies underwriting CVs has been closely managed by the USDOT, while AV development has been spearheaded by private industry (Zmud et al., 2015). AVs can be equipped with technologies that let them communicate like CVs, however, these are not necessary for AVs to operate. Still, the benefits of V2V and V2I communications could make AVs even safer.

USDOT recognizes many CV applications in areas such as safety, environment, weather, data, and mobility. These are listed in Table 2.¹⁴

Table 2: Connected Vehicle Applications

V2I Safety
Red Light Violation Warning
Curve Speed Warning
Stop Sign Gap Assist
Spot Weather Impact Warning

¹² For discussion of Spectrum Issues see Anderson et al. (2014) p. 84-92.

¹³ http://www.safercar.gov/staticfiles/safercar/v2v/V2V_Fact_Sheet_101414_v2a.pdf

¹⁴ http://www.its.dot.gov/pilots/cv_pilot_apps.htm

Reduced Speed/Work Zone Warning
Pedestrian in Signalized Crosswalk Warning (Transit)
V2V Safety
Emergency Electronic Brake Lights (EEBL)
Forward Collision Warning (FCW)
Intersection Movement Assist (IMA)
Left Turn Assist (LTA)
Blind Spot/Lane Change Warning (BSW/LCW)
Do Not Pass Warning (DNPW)
Vehicle Turning Right in Front of Bus Warning (Transit)
Agency Data
Probe-Based Pavement Maintenance
Probe-Enabled Traffic Monitoring
Vehicle Classification-Based Traffic Studies
CV-Enabled Turning Movement and Intersection Analysis
CV-Enabled Origin-Destination Studies
Work Zone Traveler Information
Environment
Eco-Approach and Departure at Signalized Intersections
Eco-Traffic Signal Timing
Eco-Traffic Signal Priority
Connected Eco-Driving
Wireless Inductive/Resonance Charging
Eco-Lanes Management
Eco-Speed Harmonization
Eco-Cooperative Adaptive Cruise Control
Eco-Traveler Information
Eco-Ramp Metering
Low Emissions Zone Management
AFV Charging/Fueling Information
Eco-Smart Parking
Dynamic Eco-Routing (light vehicle, transit, freight)
Eco-ICM Decision Support System
Road Weather
Motorist Advisories and Warnings (MAW)
Enhanced MDSS
Vehicle Data Translator (VDT)
Weather Response Traffic Information (WxTINFO)
Mobility

Advanced Traveler Information System
Intelligent Traffic Signal System (I-SIG)
Signal Priority (Transit, Freight)
Mobile Accessible Pedestrian Signal System (PED-SIG)
Emergency Vehicle Preemption (PREEMPT)
Dynamic Speed Harmonization (SPD-HARM)
Queue Warning (Q-WARN)
Cooperative Adaptive Cruise Control (CACC)
Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG)
Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
Emergency Communications and Evacuation (EVAC)
Connection Protection (T-CONNECT)
Dynamic Transit Operations (T-DISP)
Dynamic Ridesharing (D-RIDE)
Freight-Specific Dynamic Travel Planning and Performance
Drayage Optimization
Smart Roadside
Wireless Inspection
Smart Truck Parking

2.2 Potential Benefits and Barriers

The benefits that accrue to the public from the use of CVs include crash reductions, improved mobility, and reduced emissions (Wright et al., 2014).¹⁵ Drivers can also receive real-time information on congestion, parking, weather, incidents, and special events (Hendrickson et al., 2014). The USDOT’s significant involvement in developing CVs has stemmed from the agency’s recognition that the technologies can bring about significant safety improvements (Brugeman et al., 2012). V2V technology lets vehicles in close proximity communicate with each other about potential problems that could lead to crashes (e.g., vehicles braking ahead). V2V’s range is approximately 300 meters, enabling the quicker detection of potential threats than other technologies (e.g., cameras and radar) are capable of. However, V2V can be integrated with such technology to leverage even greater benefits. NHTSA estimates applying this technology to intersections and left turns could reduce crashes by 50 percent. To ameliorate privacy concerns, V2V does not collect or share personal or identifying information between vehicles. The USDOT explains the promise of CVs in the following way:

Connected vehicle safety applications are designed to increase situational awareness and reduce or eliminate crashes through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) data communications. Connected vehicle mobility applications provide a connected, data-rich travel environment. These communications should support driver advisories, driver warnings, and vehicle and/or infrastructure controls, by capturing real-time data

¹⁵ For an overview of various applications and requirements related to CV technology see Wright et al. (2014) Appendix A.

from equipment located on-board vehicles (automobiles, trucks, and buses) and within the transportation infrastructure.¹⁶

Beyond Traffic 2045 lists many potential benefits of adopting AVs:

- Crash reductions
- Enabling real-time route planning
- Increasing capacity of current infrastructure through synchronized traffic flows
- Improved transportation access for the young, elderly, and disabled
- Reducing freight transportation costs
- Improving productivity by freeing up driving/commuting time

Beyond Traffic 2045 also identifies barriers to widespread AV implementation, including costs, safety and privacy, legal and regulatory issues, and security.

Isaac (2016) lists a number of potential impacts AVs may have, but notes that many of these will be affected by government policies (p. 3-4). Table 3 summarizes these impacts.

Table 3: Positive and Negative Impacts of Autonomous Vehicles (Isaac 2016)

<i>Positive</i>
Public safety improvements/reduction in crashes
Mobility gains for certain populations (elderly, disabled)
Reduced congestion
Lower demand for parking
More personal mobility options and reduction in costs
Increased road capacity
<i>Negative</i>
Increase in vehicle miles travelled
Spread of urban sprawl
Loss of jobs (taxi drivers, commercial vehicle operators, etc.)

While the benefits from AVs are apparent, lurking beneath the surface are a host of negative consequences that could have far-reaching economic implications. Widespread adoption of AVs could significantly influence other economic sectors such as transportation providers (taxis, trucks, etc.), auto insurance, auto sales, hospitals, and health insurance, among others (Thierer and Hagemann, 2015).

Fagnant and Kockelman (2015) note that AV safety benefits and the potential for reducing congestion may transform driver behavior. Potential changes include increased mobility, parking changes geared toward less expensive areas, and car and ride sharing programs expanding. While this may increase vehicle miles travelled (VMTs), ameliorating congestion and reducing the impacts of acceleration/deceleration could lower fuel usage and emissions. Fagnant and Kockelman estimate the economic impacts of market shares for autonomous vehicles of 10, 50, and 90 percent and find that comprehensive cost savings (crash, congestion, and parking savings)

¹⁶ <http://www.iteris.com/cvria/html/about/connectedvehicle.html>

could yield from \$37 billion up to \$447 billion and save 1,100 to 21,700 lives. Based on 2011 crash statistics, Wagner et al. (2014) estimate a 90 percent decline in fatalities — due to AVs — would have an economic impact of \$265 billion. Fagnant and Kockelman (2015) estimate the social benefits of adopting AVs at between \$2,000 to \$4,000 per vehicle. Wagner et al. (2014) estimate the annual cost savings from decreased congestion could range from \$1.2 billion for a one percent reduction to up to \$120 billion for a 99 percent reduction, but note there are scenarios in which congestion could increase. These figures do not account for the potential health effects of decreased walking (due to the convenience of potential autonomous car services), job losses endured by taxi and truck drivers, and potential increases in suburbanization and sprawl due to ease of travel.

Sivak and Schoettle (2016) calculate the potential gains in productivity that individuals would enjoy if they no longer have to drive. The average American could gain an hour of productivity per day, although the average trip itself is much shorter. Using data from a prior survey (Schoettle and Sivak, 2014a) and report (Sivak and Schoettle, 2015) they find that 62 percent of drivers are unlikely to see an increase in productivity due to refusal to ride in AVs, apprehension leading to distraction, and potential motion sickness. To increase potential productivity gains the authors believe individuals must have greater confidence in the vehicles, motion sickness would have to be reduced, and that it's critical to the potential for non-traditional seating and/or untethered objects to cause injuries in crashes.

Despite their immense promise, many remain concerned about AV safety. Sivak and Schoettle (2015a, p.2) raise four critical questions that must be addressed:

1. Can self-driving vehicles compensate for contributions to crash causation by other traffic participants, as well as vehicular, roadway, and environmental factors?
2. Can all relevant inputs for computational decisions be supplied to a self-driving vehicle?
3. Can computational speed, constant vigilance, and lack of distractibility of self-driving vehicles make predictive knowledge of an experienced driver irrelevant?
4. How would road safety be influenced during the expected long transition period during which conventional and self-driving vehicles would need to interact on the road?

Sivak and Schoettle (2015a) claim it is exceedingly unlikely that AVs would reduce fatality rates to zero, that experienced drivers could perform safely in an AV, and that when AVs and conventional vehicles begin to share the road it is probable that safety may temporarily diminish with respect to conventional vehicles.

Blanco et al. (2016) use national crash data, including naturalistic driving data from the Google Self-Driving Car project and the Second Strategic Highway Research Program (SHRP 2) Naturalistic Driving Study, to examine the safety implications of AVs. They note that varying levels of reporting requirements across states complicate efforts to define crashes and that many crashes go unreported. Comparing national crash rate estimates with controls for unreported crashes against the crash rates for the Self-Driving Car, they found that the Self-Driving Car had lower crash rates across all levels of crash severity: “Additionally, when the Self-Driving Car events were analyzed using methods developed for SHRP 2, none of the vehicles operating in autonomous mode were deemed at fault” (p. iv). Conversely, Schoettle and Sivak (2015c) find that

AVs have a higher crash rate per million miles travelled than other vehicles. However, there is limited data available on AVs given the relatively low number of miles they have been driven compared to conventional motor vehicles, and none of the autonomous vehicles were at-fault in the crashes included in their analysis. Another point in AVs' favor is that the severity of any injuries is lower than for conventional vehicles.

An activity-based modelling of AV deployment in the Seattle area found that under several scenarios, capacity improvements could increase vehicle-miles travelled (VMTs), but if they were coupled with a potential reduction in parking costs, the benefits of capacity improvements could be negated (Childress et al., 2015). Similarly, a model of AV impacts on the morning commute in Austin, Texas, showed increased capacity, however, there were additional trips, as many chose not to park their vehicles due to cost (Levin and Boyles, 2015). Additionally, transit demand waned because most people who currently use transit do so to avoid parking costs — this would be eliminated by AVs with a drop-off and return home feature. Anderson et al. (2014, p. 39) echo this concern:

Rather than improve transportation that can aid all citizens, focusing on AVs could merely perpetuate our individualistic car-centered society by starving public transit of riders. One of the current key attractions of public transit is that one can read or use a smartphone. When those activities can be done in a private car, fewer citizens may use mass transit. This, in turn, may reduce fare income and lead public transit authorities to either cut services or increase fare costs, which may create a vicious circle of declining transit ridership.

Using industry responses, Wagner et al. (2014) produce an estimated timeline for the development of AV technology levels, noting that high levels of automation are still several years away. Planning agencies envision AVs having many impacts on mobility and travel. Possibilities include a reduction in vehicle numbers, using public transportation to forge better connections between starting points and destinations, and lowered parking demand, which could free up valuable land in urban areas (Williams, 2013). AVs could promote more dispersion and low-density development around urban areas, but could also have the opposite effect by softening the demand for parking spaces (AVs could be parked remotely or placed into continual use through vehicle sharing programs) and freeing up land for development (Anderson et al., 2014). Households could save up to \$6,000 per vehicle by joining an AV-sharing type program (Anderson et al., 2014), and if parking costs are significant, additional savings could be realized, stimulating movement toward an AV-sharing type program.

Several factors may inhibit AV implementation: costs, licensing, security of autonomous fleet, privacy related to data collection and usage, and liability issues in the event of a crash (Wright et al., 2014). Glancy et al. (2016, p. 19) write about the legal issues confronting AVs:

Interaction among many types of technologies will enable driverless vehicles to operate on public roads without being operated by human drivers. The complexities of these technical systems will present unusual challenges to courts and legislatures tasked with creating and applying legal rules regarding driverless vehicles.

In civil law,¹⁷ individual liability, such as human error leading to a crash, is categorized as negligence, while manufacturers can be subject to strict products liability (Glancy et al., 2016). Related to individual liability, Anderson et al. (2014) believe the potential for AVs to lower crash rates will in turn reduce insurance costs and spur AV adoption. However, issues related to manufacturer liability may grow, potentially delaying the development of AV technology unless states agree to mitigate this liability.¹⁸ Glancy et al. (2016) forecast how personal injury cases related to AVs may evolve over time. Broadly, the evolution of litigation related to AVs could proceed in the following manner (p. 36):

Claims that allege user negligence will predominate at first, but eventually will fall off substantially as driverless vehicles and their users both grow more common and competent. These claims against users will be replaced, to a degree, by claims that allege defects in driverless vehicles (the “upward” shift spoken of by other commentators), although these claims will not be as common as negligence lawsuits brought against drivers are today, due to the enhanced safety profile of these devices.

In short, 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.

According to Teigen, Wheet, and Rall (2013, p.1), “Laws in every state on operating motor vehicles, driving while impaired, and insuring cars all make one big assumption — that a human is behind the wheel of a moving vehicle.” Assigning fault to an individual in an AV or the vehicle’s manufacturer and/or software developer is a key issue to address. However, liability issues have previously been tackled in other areas, such as for steamboats and railroads (Glancy et al., 2016). Insurance can also be problematic. There are questions to resolve such as who is responsible for carrying insurance and what does it need to cover (Shanker et al., 2013). 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 out 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.

Smith (2014) explores the legality of AVs from three perspectives: the Geneva Convention on Road Traffic from 1949, NHTSA regulations, and state vehicle codes. The Convention established uniform rules for safety on roads. One of these rules states that a vehicle must have a driver who is able to control it. Smith believes this rule can be met by AVs that have the option for human driver intervention. In terms of NHTSA regulations, the only potential issue is related to emergency flashers, which differs from Kim et al.’s (2016) interpretation in the prior paragraph. Generally, state vehicle codes are not prohibitive in terms of AVs, but new technologies may introduce complex questions. State codes and regulations often assume that human drivers are in

¹⁷ AVs may also necessitate changes to criminal law. See Douma and Palodichuk (2012), Gurney (2015), and Glancy et al. (2016)

¹⁸ See Section 3.2 State Policy and Legislation

control while driving, which may be a complicating, but not prohibiting, factor as *driver* is a fairly broad term across states. States may need to modify existing statutes and regulations pertaining to licensing, registration, and the extent of acceptable vehicle modifications. Vehicle platooning may also be an issue due to following-distance requirements. Legal requirements of prudence and care while operating an AV may apply to the instructions a driver gives, the performance of the vehicle (if the driver has a vehicle that is reckless, for example), and vigilance to the vehicle's performance. Smith (2014, p. 413) recommends five measures to alleviate any legal uncertainty surrounding AVs:

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.

Smith concludes that “existing law does not categorically prohibit the sale or automated operation of such vehicles” (p. 419). Smith also includes draft language that states may use to clarify the legality of AVs. This language is included in the Appendix.

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). Commercial use could target users through in-car advertising and route selection designed to travel past certain businesses. Federal and state governments may seek to address individual privacy through disclosure or establishing rights to data and its usage; however, given other technologies such as smartphones that have been widely adopted, this issue could be resolved. AV users have the reasonable expectation of privacy in their vehicles including for trips, location, and communications (Glancy et al., 2016). At the federal level, the *Drivers Privacy Protection Act* provides security while many states have privacy statutes that require fair information practices. The *Electronic Communications Privacy Act* and the *Telecommunications Act of 1996* and Federal Trade Commission address privacy at the federal level. Security of AVs remains a concern given that electronic control systems in vehicles have been hacked¹⁹. The NHTSA, through its work to ensure vehicle cybersecurity, should address the potential for individuals to take control of autonomous vehicles to perpetrate a terrorist attack (Kohler and Colbert-Taylor, 2015).

2.3 Consumer Acceptance

Many studies have examined consumers' willingness to accept, pay for, and adopt AVs, as well their attitudes towards AVs. This is important in the context of developing new technologies like AVs, as willingness to pay and acceptance of a new transportation paradigm will likely be an important indicator of how quickly it will be adopted. Kyriakidis et al. (2015) report on an international survey of over 5,000 individuals. Twenty-two percent of respondents did not want to

¹⁹ <http://arstechnica.com/security/2010/08/cars-hacked-through-wireless-tyre-sensors/>

pay more for fully automated AVs, while 20 percent were willing pay an additional \$7,000. Five percent said they would go over \$30,000. However, nearly 70 percent indicated they expect AVs to have 50 percent market penetration by 2050. Casley et al.'s (2013) survey of 467 drivers found that 30 percent would spend more than \$5,000 on their next vehicle for full automation, and 82 percent of respondents indicated their top consideration in deciding whether to purchase an AV was safety. Sivak and Schoettle (2015c) estimate that the availability of AVs will increase demand for private transportation by up to 11 percent, which may in turn affect pricing. J.D. Power (2012) surveyed 17,400 vehicle owners about the price of various CAV technologies. Before they learned about the pricing, 37 percent of respondents expressed interested in having that technology available in their next vehicle, but once pricing was revealed (\$3,000) only 20 percent were interested.

Schoettle and Sivak's (2016) survey of 618 U.S. drivers found that most prefer no self-driving capability or partial autonomy to vehicles that are fully automated. Respondents were more concerned about the safety of fully automated vehicles than for partially automated vehicles, and most said they preferred the vehicle give them the option to manually control the vehicle. These findings align with the results of earlier surveys of U.S., United Kingdom, and Australian drivers (Schoettle and Sivak, 2014b) and another survey of just U.S. drivers (Schoettle and Sivak 2015b). Schoettle and Sivak (2014) found that a majority of survey respondents were unwilling to pay more for automation. In the U.S., 25 percent of respondents said they would pay up to \$2,000 for automation. Payre et al. (2014) surveyed over 400 French drivers, finding that over 60 percent accepted the premise of fully autonomous driving, with higher acceptance rates depending on the type of driving involved (e.g., on highways or in congested areas). Howard and Dair (2013) found residents of Berkeley, California, were interested in AVs' safety and parking benefits. Wagner et al. (2014) surveyed public and private industry stakeholders and present several key findings: AVs' capabilities and future development trajectory are uncertain, benefits of AV deployment could be large but are not well established, public and private sector stakeholders will need to coordinate with one another to develop regulations, regulating AV testing and deployment is necessary but should not be overly burdensome, limited funding prevents further public investment in infrastructure, slow infrastructure development could hinder CAVs, cybersecurity is important, and manufacturers have concerns about potential liability.

Experts surveyed about CVs indicated that deploying only V2V would be feasible and provide benefits, but including V2I would help maximize CV benefits (Brugeman et al., 2012). Two key challenges to adopting CV technology are costs and security. The estimated cost to consumers for these technologies is \$350 in 2017 and drops to \$300 by 2022. Michigan has tested V2I technology in a pilot project in Ann Arbor and is adding to interstates in the Detroit area devices that will communicate with vehicles (Vock, 2016). The Ann Arbor pilot let vehicles receive information from sensors and devices such as traffic signals and curve warnings.²⁰ The American Association of Highway Transportation Officials (AASHTO) is sponsoring a resolution to develop a nationwide challenge to deploy Dedicated Short Range Communications (DSRC) infrastructure with Signal Phase and Timing (SPaT) broadcast in at least one corridor (approximately 20 signalized intersections) in each of the 50 states by January 2020.²¹ Additionally, DSRC can potentially be used to update software for AV applications (Anderson et al. 2014). Underwood

²⁰ For more on a number of deployment scenarios see Wright et al. (2014) p. 46-72

²¹ <http://stsmo.transportation.org/Documents/SPaT%20Resolution%20Background%20ver%206%2008232016.pdf>

(2014) surveyed over 200 experts in the field of CVs and AVs. They identified legal liability as the most difficult barrier to full automation, however, it did not appear that consumer acceptance would be an issue. However, they deemed Level 3 automation (Table 1) less practical than other levels of automation because drivers may become too accustomed to the automated features, preventing them from taking action when needed.

Daziano, Sarrias, and Leard (2016), based on a survey of 1,260 people in the U.S., estimate consumer's willingness to pay for automation. They found that an average household is willing to pay \$3,500 for partial automation and up to \$4,900 for full automation. Additionally, there was a significant dichotomy between those who were willing to pay over \$10,000 for full automation versus those who were not willing to pay any amount. Bansal et al. (2016) surveyed 347 residents of Austin, Texas to gauge their willingness to pay for varying levels of automation. Respondents, on average, were ready to pay \$7,253 for full automation and \$3,300 for partial automation. Over 80 percent of respondents were interested in fully automated vehicles. People who drove the most were most interested. They conclude that "this result may be because those who travel longer distances by car can expect to benefit more from safer, more automated, and connected travel with Level 4 technology; and they can perform other activities en route" (p. 17). Respondents voiced concerns about technology and equipment failures, while perceiving crash reductions as the greatest benefit of AVs. Willingness to pay may be less of an issue if AVs can service the needs of families that currently require two or more vehicles. Schoettle and Sivak (2015a) estimate that average vehicle ownership could fall as much as 43 percent. It is possible that vehicles would need to be replaced more frequently because they would presumably accumulate mileage at a more rapid pace. Schoettle and Sivak (2015a) note that the rapid adoption of technologies throughout the U.S. could make increased vehicle turnover a net benefit.

2.4 State Preparedness

General state guidance related to CVs and AVs, as well as potential timeframes, set the stage for an examination of legislation in Chapter 3. Zmud et al. (2015, p. xi) look at two potential adoption scenarios for CVs and AVs:

In the *Revolutionary* path, automotive manufacturers (original equipment manufacturers [OEMs]), suppliers, and technology firms make disruptive and aggressive RandD investments that accelerate progress in AV and vehicle-to-vehicle (V2V) technologies... In the *Evolutionary* path, OEMs and suppliers achieve step-wise improvements in advanced driver assistance systems (ADAS).

State department of transportation (DOT) officials interviewed in the study held, by a slim majority, that the evolutionary case is most likely. A slightly higher number of officials also said this would be their preferred trajectory because it would cause fewer disruptions for DOTs.

However, local and regional transportation agencies preferred the revolutionary trajectory, as the private sector would likely assist in financing the infrastructure changes needed to accommodate CAVs. State DOTs have greater control over the implementation of V2I due to the costs associated with the infrastructure needed to support it. Zmud et al. (2015) also examine four areas that could add uncertainty to implementation — society, technology, economy, and policy. Social factors include demand, consumer acceptance, auto ownership rates, and data privacy. Technological

factors relate to security, the interaction between a driver and a vehicle, and vehicles' ability to make decision under uncertain conditions, while economic factors include cost and necessary infrastructure. Finally, policy factors encompass the approaches to regulating CV/AV policy, any federal mandates such as V2V requirements, and liability concerns from industry.

V2I will require infrastructure investments outside of vehicles in the form of roadside units (RSUs). Wright et al. (2014) estimate the cost of deployment at \$17,600 per site, with annual operations and maintenance costs of \$3,050. Additional costs for back-end technology and servers may run between \$3,000 and \$40,000 (averaging \$30,800), depending on existing infrastructure. The cost of fitting signals with equipment for communicating with a DSRC RSU may cost upwards of \$3,200.

Zmud et al. (2015) list implementation strategies for state DOTs to consider when studying the impacts of CV and AV technologies (p. 34-35):

- Review current legislation and policies for potential impacts
- Designate a responsible individual(s) to monitor and oversee CV and AV issues
- Participate in national discussion through various federal and interest groups
- Work with in-state research organizations, such as universities and other labs
- Develop an internal working group with members representing the different areas in which the impacts of CVs and AVs will be felt
- Establish external stakeholder groups to identify and address potential issues
- Conduct education outreach to state and local government officials
- Participate in federal deployment pilot projects
- Generate plan for workforce development
- Develop a strategy to manage financial issues that may arise from implementation

USDOT lists seven steps for states to consider regarding V2I deployment.²²

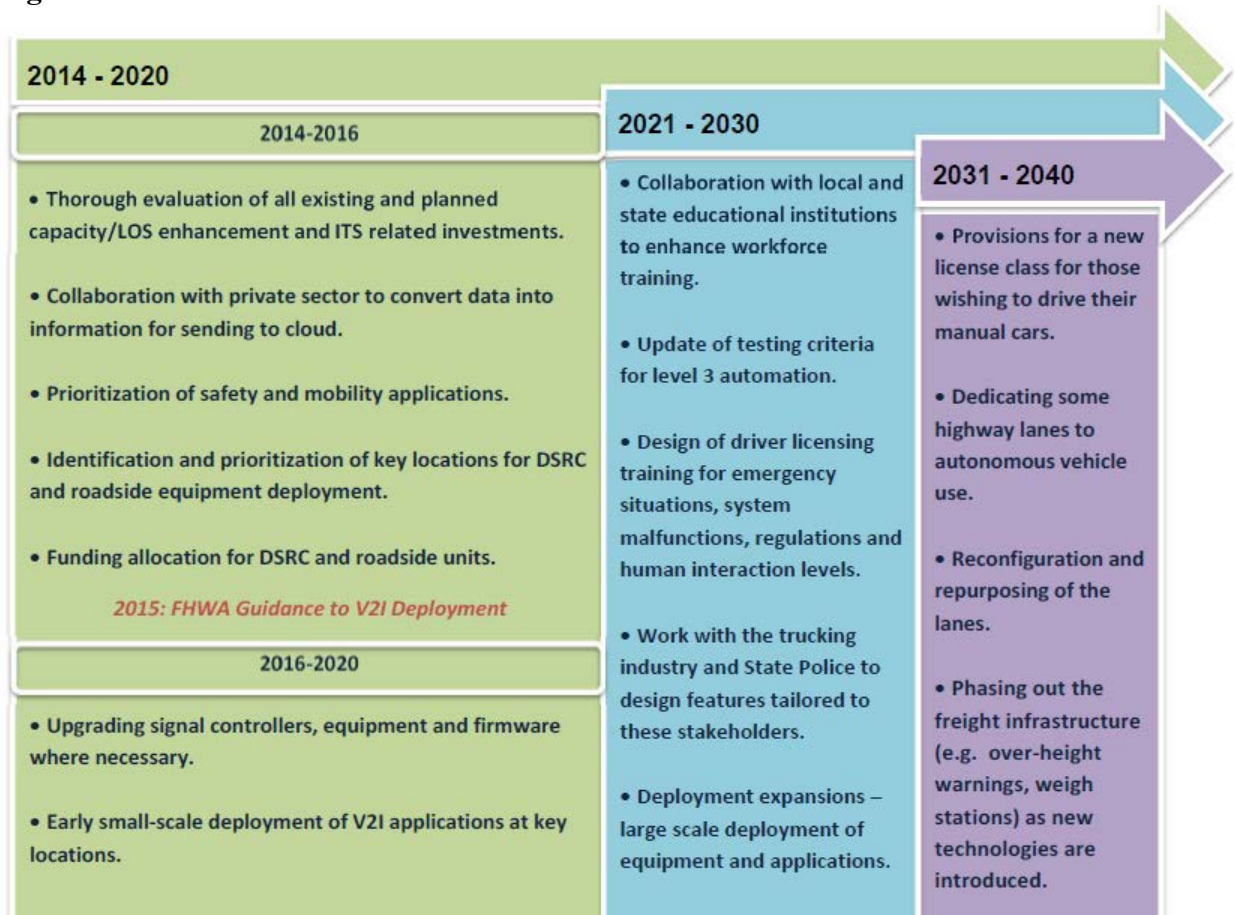
1. Begin the planning process
2. Begin updating regional ITS architecture
3. Consider participating in the connected vehicle pooled fund
4. Become involved in the V2I Deployment Coalition
5. Monitor affiliated testbed activities and consider joining
6. Purchase certified equipment to ensure interoperability
7. Participate in training

For deploying CV technologies, Wright et al. (2014) recommend that state and local agencies develop their own strategies, which may include stakeholder meetings, identifying concepts and applications of interest, reviewing and updating plans to reflect the potential deployments, identifying locations and the potential need for pilots, and addressing potential funding needs. Hendrickson et al.'s (2014) study for the Pennsylvania Department of Transportation (PennDOT) produced several recommendations to prepare for the CAV transition. These recommendations included evaluating planned investments in Intelligent Transportation System (ITS) to ensure they

²² http://www.its.dot.gov/factsheets/pdf/V2I_WhatShouldStatesDo.pdf

are applicable to CAVs, identifying installation locations with the greatest benefits, figuring out how to handle data, and funding DSRCs and RSUs. Figure 2 shows a recommended timeline for various CAV implementation steps (Hendrickson et al., 2014, p. 54).

Figure 2: PennDOT Recommended CAV Action Timeline



The study also recommends strategies to maximize the benefits of CAVs. These actions can help lay the groundwork for CAV implementation:

- Identify mobility applications that will produce the greatest benefit for transportation operation and management
- Identify the data and communication devices that will be needed
- Assess current data collection and identify gaps
- Establish partnerships with private companies to encourage data sharing and collaboration

While analysts' opinions on how quickly CAV technologies will be adopted vary, there is consensus that they have the potential to transform personal mobility and freight transport. While these technologies carry numerous benefits, a number of issues likely must be addressed to ensure they are fully realized. Consumer surveys indicate buyers are accepting of CAVs, but the cost of purchasing a vehicle may remain a hurdle for many. Preparing for CAV technologies by analyzing

costs and potential implementation scenarios illuminates how states can develop a plan of action to facilitate the testing, adoption, and widespread operation of CAVs.

Chapter Three: Federal/State Policy and Legislation

3.1 Federal Policy

The federal government has addressed the issue of autonomous vehicles (AVs) in various pieces of legislation and guidance. The Fixing America's Surface Transportation (FAST) Act²³ mentions AVs in several places. It requires that the Comptroller General submit an analytical report within two years that examines the autonomous technology policies developed by other public agencies, assesses the U.S. Department of Transportation's (USDOT) "organizational readiness...to address autonomous vehicle technology challenges, including consumer privacy protections,"²⁴ and puts forward recommendations for implementing autonomous technology and policy. One of the FAST Act's initiatives, "Advanced Transportation and Congestion Management Technologies Deployment," will provide grants for pilot projects. A key goal of this initiative is to "accelerate the deployment of vehicle-to-vehicle, vehicle-to-infrastructure, autonomous vehicles, and other technologies." The FAST Act includes provisions to fund this effort. Another source of funding for research on AVs are University Transportation Centers (UTC). At least one of the ten regional centers awarded under the FAST Act will have a designated focus on "the field of comprehensive transportation safety, congestion, connected vehicles, connected infrastructure, and autonomous vehicles." President Obama's FY17 budget proposes \$4 billion over 10 years for autonomous vehicle pilot programs and collaboration with industry to develop "a common multistate framework."²⁵ The National Highway Traffic Safety Administration (NHTSA) also responded to a letter of clarification from Google that would not require a human driver, indicating that artificial intelligence steering an autonomous vehicle could be considered as the driver, under federal law.²⁶

NHTSA, whose authority was granted in the 1966 National Traffic and Motor Vehicle Safety Act, is the agency primarily responsible for regulating motor vehicles (Anderson et al., 2014). The legislation enables NHTSA to create Federal Motor Vehicle Safety Standards (FMVSS). FMVSS pertain to design, construction, performance, and durability requirements. NHTSA can also mandate recalls and distribute public information through its New Car Assessment Program. In 2013 NHTSA issued a *Preliminary Statement of Policy Concerning Automated Vehicles*²⁷ that covered NHTSA's research plan, definitions of automation levels, and recommendations for states focused on AVs. NHTSA recommends that states:

- Ensure drivers are capable of operating AVs,
- Regulate testing of AVs to ensure safety through standard reporting requirements,
- Set limits on testing if conditions merit,
- Provide technology failure alerts for drivers

²³ <https://www.congress.gov/114/plaws/publ94/PLAW-114publ94.pdf>

²⁴ This was proposed in 2015 prior to the passage of the FAST Act as HR 3876, which was introduced in the House of Representatives but received no further action.

²⁵ <http://www.nhtsa.gov/About+NHTSA/Press+Releases/dot-initiatives-accelerating-vehicle-safety-innovations-01142016>

²⁶ <http://www.reuters.com/article/us-alphabet-autos-selfdriving-exclusive-idUSKCN0VJ00H;http://isearch.nhtsa.gov/files/Google%20-%20compiled%20response%20to%2012%20Nov%20%2015%20interp%20request%20--%204%20Feb%2016%20final.htm>

²⁷ <http://www.nhtsa.gov/About-NHTSA/Press-Releases/U.S.-Department-of-Transportation-Releases-Policy-on-Automated-Vehicle-Development>

- Install technology that does not interfere with or disable required safety features, and
- Recorded data in the event of a crash, and not allow AVs for purposes other than testing.

NHTSA recently updated its AV policy²⁸ to emphasize that:

DOT and NHTSA policy is to facilitate and encourage wherever possible the development and deployment of technologies with the potential to save lives. To that end, NHTSA will use all available tools to determine the safety potential of new technologies; to eliminate obstacles that would prevent or delay technology innovations from realizing that safety potential; and to work with industry, governmental partners at all levels, and other stakeholders to develop or encourage new technologies and accelerate their adoption where appropriate.

The updated policy includes several AV-related goals USDOT and NHTSA established in 2016, including:

- Working with industry and stakeholders to develop guidance for operation of AVs
- Develop model state policy with the goal of producing a consistent national policy
- Encouraging industry to engage regarding interpretations of current rules
- Encourage industry to submit requests for exemptions in interpretation is not sufficient
- USDOT and NHTSA will develop tools for AV technologies and seek new authority as needed to ensure safety

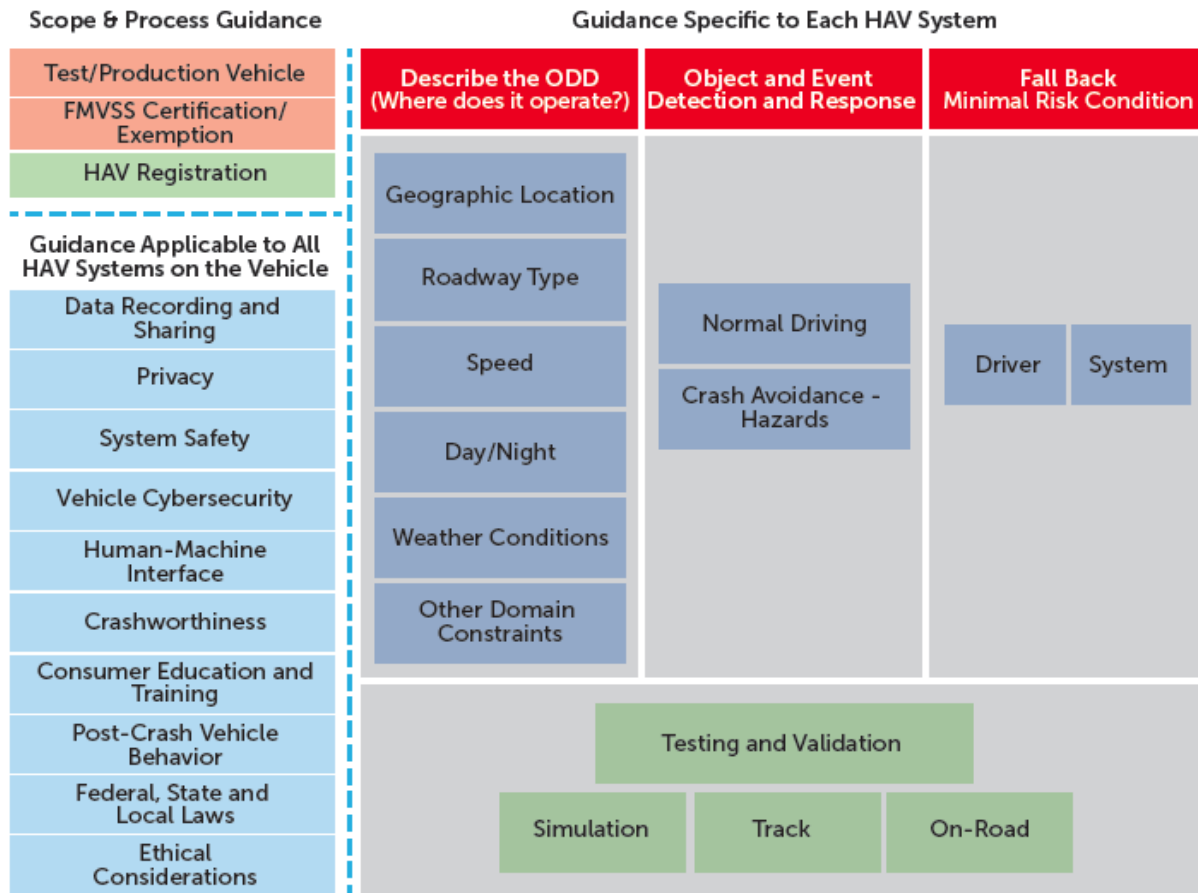
On September 20, 2016, USDOT issued *Federal Automated Vehicles Policy*,²⁹ which focuses on performance guidance, model state policy, current regulatory tools, and new tools/authority. This policy defines highly automated vehicles (HAVs) as those with SAE levels 3-5³⁰ and includes guidance manufacturers should use to determine the level of vehicle automation (Figure 3; see Figure I, p. 14). Manufacturers also have responsibility for determining conformance with FMVSS and to request clarification from NHTSA as needed.

²⁸ <http://www.nhtsa.gov/Research/Crash+Avoidance/Automated+Vehicles>;
the full text of the updated policy statement can be found in the Appendix

²⁹ <https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016>

³⁰ These levels of automation are designated by SAE International, a professional organization that establishes standards across many transportation industries.

Figure 3: Vehicle Performance Guidance



NHTSA has also requested that manufacturers detail what steps they have taken to follow the guidance. Future rules may require safety assessment letters that document a number of pertinent areas including data collection and usage, privacy, cybersecurity, and registration/certification, among others. NHTSA has four approaches to address new technologies and changes to current technologies: letters of interpretation, exemptions from current standards, amending rules or developing new rules, and enforcement abilities to address product defects that materially affect safety. In addition to current tools for regulating HAVs, NHTSA is exploring other regulatory strategies (p. 70-82). Table 4 divides these strategies into categories and summarizes each.

Table 4: Potential New Tools and Authorities

<i>Authorities</i>
<p>Safety Assurance:</p> <ul style="list-style-type: none"> • Pre-market measures such as testing and analyses, manufacturer reporting of safety measures and data.
<p>Pre-Market Approval:</p> <ul style="list-style-type: none"> • Currently, manufacturers pre-certify and NHTSA randomly selects vehicles to test, however, NHTSA could test all vehicles or use a hybrid process of manufacturer certification and NHTSA testing of HAV technologies not currently regulated by FMVSS.
<p>Cease-and-Desist Authority:</p> <ul style="list-style-type: none"> • NHTSA could require manufacturers to address safety risks that are deemed imminent hazards (e.g., death and personal injury).
<p>Expanded Exemption Authority:</p> <ul style="list-style-type: none"> • Under current rules, NHTSA can only exempt 2,500 vehicles per year over a two-year period. Expanding this limit would increase available data to analyze safety performance while still limiting overall impacts.
<p>Post-Sale Authority to Regulate Software Changes:</p> <ul style="list-style-type: none"> • New technologies will require updates after manufacture. NHTSA can regulate these updates, but it may require processes to ensure compliance of software updates.
<i>Tools</i>
<p>Variable Test Procedures to Ensure Behavioral Competence and Avoid Gaming of Tests:</p> <ul style="list-style-type: none"> • NHTSA requires the authority to vary tests to ensure that HAVs can respond to the many different obstacles in a driving environment.
<p>Functional and System Safety:</p> <ul style="list-style-type: none"> • NHTSA officials may want to require manufacturers to submit reports on its Vehicle Performance Guide and report risks identified during their analyses.
<p>Regular Reviews for Making Agency Testing Protocols Iterative and Forward-Looking:</p> <ul style="list-style-type: none"> • NHTSA could attempt to analyze the impacts of testing procedures on innovation and allow public comment as well as periodically revisit the effects of FMVSS on HAVs to ensure a technology-neutral impact.
<p>Additional Recordkeeping and Reporting:</p> <ul style="list-style-type: none"> • Manufacturers could be required to maintain records of testing and report their results (including crashes or other incidents).
<p>Enhanced Data Collection Tools:</p> <ul style="list-style-type: none"> • HAVs will collect data on their surroundings to make decisions, and using data recorders (along with required reporting) could help identify what causes crashes and/or incidents.
<i>Agency Resources</i>
<p>Network of Experts:</p> <ul style="list-style-type: none"> • NHTSA could use ideas, expertise, and other resources from experts.
<p>Special Hiring Tools:</p> <ul style="list-style-type: none"> • NHTSA may need to hire individuals with particular skills and expertise to assist with areas such as pre-market testing. It could use several hiring tools to accomplish this.

USDOT also discusses a guidance that cuts across multiple areas for HAVs (p. 17-26). These are summarized in Table 5.

Table 5: Cross-Cutting Areas of Guidance

Area	Summary
Data Collection and Usage	Manufacturers should have a process for collecting and storing incident and crash data, as well as outcomes, when incidents are avoided. These data can be shared (w/out identifying information) and used to improve knowledge and outcomes.
Privacy	Manufacturers should have privacy policies that are transparent, clarify choices regarding data collection and use, respect the context and purpose for which data are collected, minimize data collection/retention (preserving only what is necessary to achieve stated purposes), secure data, ensure data integrity, and accountability of data protection.
System Safety	Safety processes should include robust system design and validation. They should follow all standards, guidance, and best practices from established organizations, risk assessments, and software and design validation.
Cybersecurity	Development should assess cybersecurity risks and include guidance and best practices.
Human Machine Interface (HMI)	Documented processes are needed to assess and validate interactions among human drivers, occupants, and external actors (e.g., pedestrians) and the HMI as well as communications with external actors; the HMI should provide information about the function and performance of the HAV, including possible issues and control requirements.
Crashworthiness	HAVs need to comply with NHTSA standards, and manufacturers should use new technologies to improve occupant safety as well as non-occupied autonomous vehicles that may impact other vehicles on the road.
Consumer Education and Training	Manufacturers and others should develop employee, dealer, and consumer education programs regarding the differences between HAVs and conventional motor vehicles. These programs could include on-road experiences that demonstrate HAVs' features and functions.
Registration and Certification	Manufacturers should submit identifying information and descriptions of items that are produced for use in or with HAVs.
Post-Crash Behavior	Manufacturers should have processes to assess and validate how an HAV is returned to service after a crash; if safety systems are damaged the vehicle should not operate in HAV mode.
Federal, State, and Local Laws	Manufacturers should have plans to comply with federal, state and local laws. HAVs should comply with all traffic laws in their operating domain.
Ethical Considerations	For situations in which HAVs may be required to make decisions over a conflict, such as the safety of one occupant versus another, manufacturers should develop algorithms with input from stakeholders.

The guidance also covers dimensions of the automation itself, from design to validation (p. 27-34). Table 6 identifies various factors, briefly describing each.

Table 6: Automation Guidance

Area	Summary
Operational Design Domain (ODD)	Manufacturers should determine operational domains for HAVs, including the road types, geographic areas, speeds, and environmental conditions the vehicles will operate under. Testing should assess HAVs to ensure they can safely operate across their domain. The domain should also be defined in manuals.
Object and Event Detection and Response (OEDR)	An HAV is responsible for OEDR when operating in its domain and has the <i>behavioral competency</i> to operate in traffic, obey traffic laws, and respond to other users and hazards. HAVs should also be able to handle pre-crash situations such as loss of control, lane changes, rear-end, and low speed situations. If possible, road construction and changes in traffic patterns, manual traffic direction by police, and disabled vehicles in travel lanes should be addressed in the ODD.
Fall Back	Also referred to as minimal risk condition, manufacturers should have a process to fall back on to minimize risk if a problem arises. Fall back could include stopping the vehicle outside active traffic lanes.
Validation Methods	Manufacturers should develop tests to verify that HAVs function at a high level of safety. Simulations, tracks, and on-road tests are valid methods to evaluate HAV performance.

The guidance reviewed above, including cross-cutting areas and automation, applies to HAVs. For automation at an SAE Level 2, cross-cutting areas generally apply with limited automation applicability (Table 1, p. 34).

One other area to consider is federal vehicle safety standards and their applicability to AVs. Kim et al. (2016) reviewed current Federal Motor Vehicle Safety Standards (FMVSS)³¹, which do not directly address autonomous technology, in order to determine if there are instances within the FMVSS that could be problematic for the adoption of autonomous vehicles. When searching for references to drivers, there were several findings of “driver” as needed for manual control in addition to the definition of a driver as “the occupant of the motor vehicle seated immediately behind the steering control system” (§571.3). Assuming autonomous vehicles maintain the ability of a driver to take control, then this would not be problematic. When examining 13 autonomous vehicle design concepts for highway automation, truck platooning, and highly automated vehicles, only two standards were found that could be problematic for conventional designs: theft protection and rollaway prevention (§571.114; transmission or gear shift cannot be moved from the park position without a key in the ignition and automatic transmission with a park position must require the brake to be pressed before shifting out of park) and light vehicle brake systems (§571.135; activated by foot control). If an autonomous vehicle is designed without conventional controls such as a steering wheel by which a person could take control of the vehicle, then there were some conflicts in FMVSS from standards for controls and display (§571.101), rear visibility (§571.111), and occupant crash protection (§571.208). Generally, the findings indicated that while there were

³¹ Safety performance requirements that auto manufacturers must certify their vehicles meet. See: http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title49/49cfr571_main_02.tpl.

some barriers in the FMVSS that may need to be revised, there were not any significant impediments to autonomous vehicles so long as the design remained similar to conventional motor vehicles.

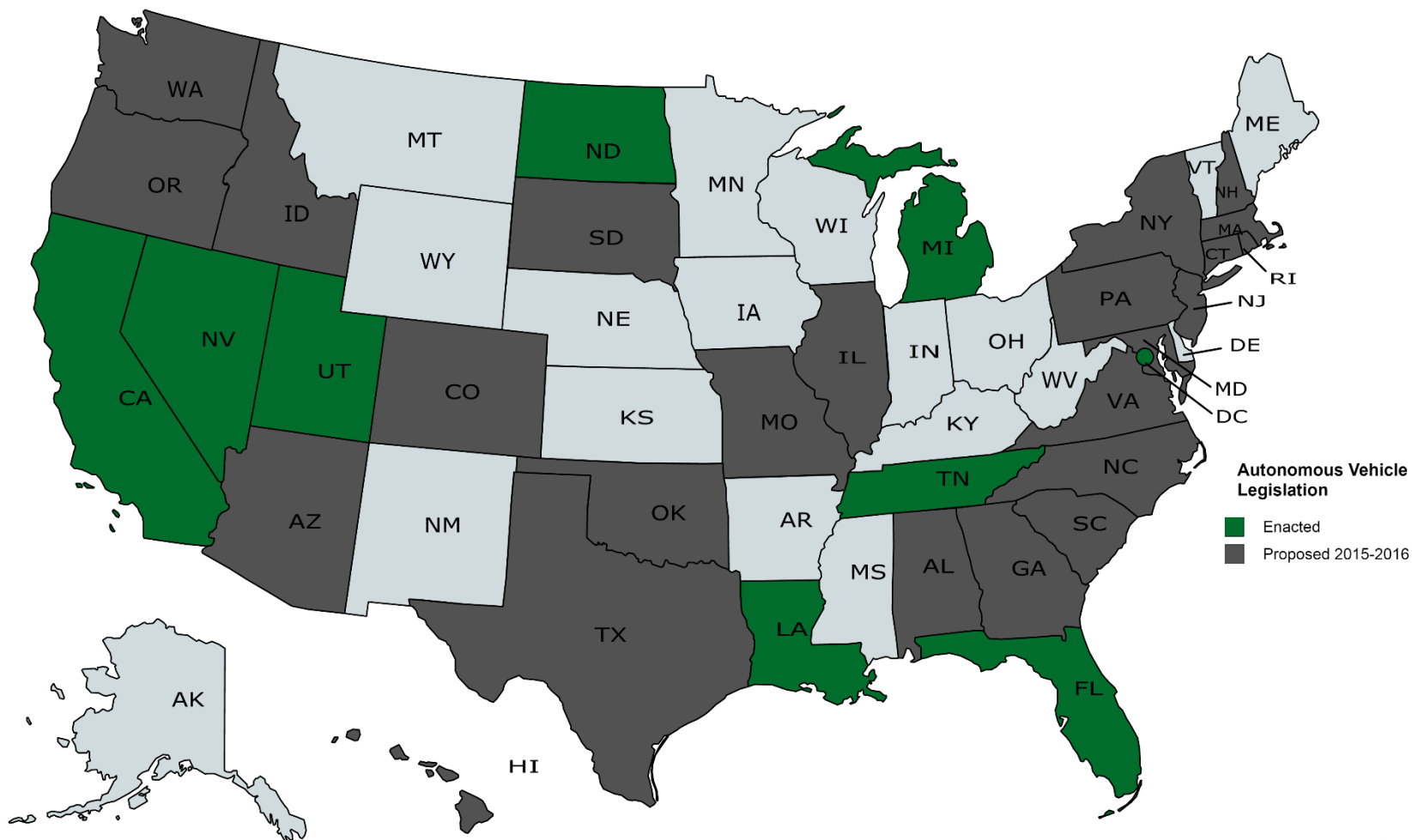
The *Federal Automated Vehicles Policy* defines the role states can play in HAV regulation and prescribes a model policy. It recommends keeping federal and state responsibilities unchanged and intact once HAVs have been introduced. Responsibilities accorded to the federal government (administered through NHTSA) include setting and enforcing FMVSS, managing recalls related to safety defects, communicating safety issues to the public, and issuing guidance to manufacturers. State governments will continue to license and register vehicles, enact and enforce traffic laws, conduct applicable safety inspections, and regulate insurance and liability requirements. The model policy touches on a number of critical issues states should pay special attention to. States are advised to designate a lead agency to oversee and monitor HAV testing. They should also develop clear processes and regulations for testing HAVs, resolve ambiguities or problems related to liability and insurance issues, address crash investigation procedures and safety inspections, establish a system to identify HAVs through registration and titling requirements, and direct law enforcement to limit driver distractions in vehicles that are not fully automated. The Appendix includes a full copy of the model policy.

3.2 State Policy and Legislation

Because of the rapid evolution AV technology, the number of states looking to address the potential impacts of these vehicles on the transportation system has increased. Common issues arising in AV-related legislation are safety, public acceptance, progression of automated technology, infrastructure needs and costs, licensing requirements, regulatory regimes for AVs, liability changes, and platooning (Wilmot and Greensword, 2016). The National Conference of State Legislators reports that 16 states introduced legislation focused on AVs in 2015. This is an increase over previous years — in 2014, 12 states advanced legislation; nine states and the District of Columbia introduced legislation in 2013; and six states did so in 2012.³² Currently, eight states have passed legislation related to AVs — Nevada, California, Louisiana, Florida, Michigan, Utah, Tennessee, and North Dakota. Washington, D.C. has also enacted legislation. Figure 4 shows the status of legislation across the U.S. Many of the proposed bills have been stranded in various committees, and legislative action in the near-term is unlikely, Table 7 summarizes enacted legislation and Table 8 gives an overview of proposed legislation from 2015-2016 (for bills left in committee from 2015, the bill status is listed as *failed*). Both tables list the bill number, year of introduction, and briefly summarize the bill's contents. Where available, the table provides hyperlinks so that readers can access the full text.

³² <http://www.ncsl.org/research/transportation/autonomous-vehicles-legislation.aspx>

Figure 4: Status of Autonomous Vehicle Legislation³³



³³ Compiled from the National Conference of State Legislators' Autonomous/Self-Driving Vehicle Legislation Database and the Center for Internet and Society at Stanford University's page on "Automated Driving: Legislative and Regulatory Action"

Table 7: Summary of Enacted State Legislation on Autonomous Vehicles³⁴

State	Bill	Brief Summary
California	SB 1298 (2012)	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “any vehicle equipped with autonomous technology that has been integrated into that vehicle” • Defines <i>autonomous technology</i> as “technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator” • Defines <i>operator</i> as “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” • Finds that the state does not currently prohibit or regulate autonomous vehicles • Requires state to adopt safety and performance requirements and subsequently allows operation and testing on public roads • Requires manufacturers to disclose information vehicles collect
California	AB 1592 (2016)	<ul style="list-style-type: none"> • Authorizes the Contra Costa Transportation Authority to conduct a pilot project for the testing of fully autonomous vehicles in specified locations with certain speed limits
Florida	HB 1207 (2012)	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “any vehicle equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Finds that the state does not currently prohibit or regulate autonomous vehicles • States intent to encourage testing and operation of autonomous vehicles on public roads • Authorizes people with driver’s licenses to operate autonomous vehicles; • Requires people testing autonomous vehicles to have insurance or bonding prior to testing • Mandates preparation of a report to advise on additional policy action that may be needed
Florida	HB 7027 (2016)	<ul style="list-style-type: none"> • Permits individuals with driver’s license to operate autonomous vehicles on public roads • Strikes a requirement that operation is only allowable for testing purposes and that a driver must be in the vehicle • Mandates that autonomous vehicles meet any relevant federal regulations
Florida	HB 7061 (2016)	<ul style="list-style-type: none"> • Defines <i>driver-assistive truck platooning technology</i> as “vehicle automation and safety technology that integrates sensor array, wireless vehicle-to-vehicle communications, active

³⁴ Summary developed from the National Conference of State Legislators’ Autonomous/Self-Driving Vehicle Legislation Database and the Center for Internet and Society at Stanford University’s page on “Automated Driving: Legislative and Regulatory Action”

		<p>safety systems, and specialized software to link safety systems and synchronize acceleration and braking between two vehicles while leaving each vehicle’s steering control and system command in the control of the vehicle’s driver”</p> <ul style="list-style-type: none"> • Calls for study on driver-assistive truck platooning technology and allows for a pilot upon completion of the study
Louisiana	HB 1143 (2016)	<ul style="list-style-type: none"> • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed in high-or-full automation mode, without any supervision by a human operator...”
Michigan	SB 169 (2013)	<ul style="list-style-type: none"> • Defines <i>automated vehicle</i> as “a motor vehicle on which automated technology has been installed, either by a manufacturer of automated technology or an upfitter that enables the motor vehicle to be operated without any control or monitoring by a human operator” • Defines <i>automated technology</i> as “technology installed on a motor vehicle that has the capability to assist, make decisions for, or replace an operator” • Defines <i>upfitter</i> as “a person that modifies a motor vehicle after it was manufactured by installing automated technology in that motor vehicle to convert it to an automated vehicle” • Defines <i>automatic mode</i> as “the mode of operating an automated motor vehicle when automated technology is engaged to enable the motor vehicle to operate without any control or monitoring by an operator” • Permits testing of autonomous vehicles under certain conditions
Michigan	SB 663 (2013)	<ul style="list-style-type: none"> • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed • The same liability applies to manufacturers of original components
Nevada	AB 511 (2011)	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “a motor vehicle that uses artificial intelligence, sensors and global positioning system coordinates to drive itself without the active intervention of a human operator” • Directs the state DMV to develop rules for license endorsement and operation which cover insurance, safety standards, and testing
Nevada	SB 140 (2011)	<ul style="list-style-type: none"> • Allows the use of cellular phones in legally operating autonomous vehicles
Nevada	SB 313 (2013)	<ul style="list-style-type: none"> • Mandates that autonomous vehicles undergoing testing have insurance

		<ul style="list-style-type: none"> • States that autonomous vehicles being registered in the state must meet certain conditions • Holds that a manufacturer is not liable for certain injuries if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed
North Dakota	HB 1065 (2015)	<ul style="list-style-type: none"> • Allows research into autonomous vehicles focused on how they could reduce crashes, congestion, and improve fuel efficiency
Tennessee	SB 598/ HB 616 (2015)	<ul style="list-style-type: none"> • Prohibits local governments from banning autonomous vehicles or vehicles automation technologies
Tennessee	SB 2333/ HB 2173 (2016)	<ul style="list-style-type: none"> • Permits a motor vehicle to be operated, or to be equipped with, an integrated electronic display visible to the operator while the vehicle's autonomous technology is engaged.
Tennessee	SB 1561/ HB 1564 (2016)	<ul style="list-style-type: none"> • Establishes a certification program manufactures have to complete before autonomous vehicles can be tested or operated • Creates a per mile tax for autonomous vehicles
Utah	HB 280 (2016)	<ul style="list-style-type: none"> • Calls for a study of autonomous vehicles that evaluates federal standards and identifies best practices, examines safety and regulatory approaches, and develops recommendations
Utah	HB 373 (2015)	<ul style="list-style-type: none"> • Authorizes the state DOT to conduct a connected vehicle testing program
Washington, D.C.	2012 DC B 19-0931	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “a vehicle capable of navigating District roadways and interpreting traffic-control devices without a driver actively operating any of the vehicle’s control systems.” • Requires that a person be able to assume control of an autonomous vehicle at any time • Stipulates that only recently manufactured vehicles may be converted to an autonomous vehicle (2009 or built within 4 years of conversion) • Holds that manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed

Table 8: Proposed State Legislation 2015-2016³⁵

State	Bill	Status	Brief Summary
Alabama	SB 178 (2016)	Referred to Senate Committee on Transportation and Energy	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “motor vehicle that uses artificial intelligence, sensors, and global positioning system coordinates, to drive itself without active intervention of a human operator” • Permit autonomous vehicles on public roads • Includes a requirement for state law enforcement to test and approve autonomous vehicles • Mandates that autonomous vehicles carry insurance (at least \$5 million); state can create license endorsements and require testing
California	AB 2682 (2016)	Passed Assembly. In Senate	<ul style="list-style-type: none"> • Mandates that state DMV hold public hearings if model state policy is developed; ensure regulations conform with that policy (later amended to a bill dealing with sex offenders)
California	AB 2866 (2016)	Passed Assembly Transportation Committee	<ul style="list-style-type: none"> • Authorizes the operation of a fully autonomous vehicle if the operator has the ability to take control in the event of technology failure or emergency • Testing and operating results must be submitted to the state
California	SB 431 (2016)	Passed Senate. To Assembly Committee on Transportation.	<ul style="list-style-type: none"> • Requires state to make a determination of a reasonable and prudent distance between vehicles to take into account the presence of autonomous technology • Specifies that a caravan or motorcade consists of three or more vehicles
Connecticut	HB 6344 (2015)	Failed	<ul style="list-style-type: none"> • Allows the use of autonomous vehicles in Connecticut for testing purposes
Georgia	SB 113 (2016)	Senate Recommitted	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “any motor vehicle installed with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that provides the motor vehicle with the capability to drive without the direct active control or monitoring by a human operator”

³⁵ Summary developed from the National Conference of State Legislators’ Autonomous/Self-Driving Vehicle Legislation Database and the Center for Internet and Society at Stanford University’s page on “Automated Driving: Legislative and Regulatory Action”; Bill status current as of 9/1/16.

			<ul style="list-style-type: none"> • Designates a new class (named <i>autonomous vehicles</i>) of vehicles that will include autonomous vehicles and allows for regulation of such vehicles • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed • Lists requirements for autonomous vehicle operation and authorizes the use of autonomous vehicles for testing purposes
Georgia	SB 113 (2015)	Failed	<ul style="list-style-type: none"> • See GA SB 113 (2016)
Hawaii	HB 2687 (2016)	Referred to committees	<ul style="list-style-type: none"> • Authorizes the use of autonomous vehicles for research and testing • Mandates that the DOT establish application and approval process • Instructs the DOT to report annually to the Legislature
Hawaii	SB 630 (2016)	Committee recommendation to defer	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “motor vehicle that is equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Authorizes individuals with HI driver’s license to operate autonomous vehicles • Includes safety requirements related to the operation of autonomous vehicles
Hawaii	HB 632 (2015)	Failed	<ul style="list-style-type: none"> • See HI HB 2687 (2016)
Hawaii	HB 1458 (2015)	Failed	<ul style="list-style-type: none"> • Permits the operation of autonomous vehicles if conditions (insurance, license, safety) are met • Authorizes industry to test autonomous vehicles on public roads

Idaho	SB 1108 (2015)	Failed (Passed Senate, no action in House)	<ul style="list-style-type: none"> • Sets forth requirements for autonomous vehicle testing and insurance • States that autonomous vehicles must meet federal standards • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed
Illinois	HB 3136 (2016)	Passed House; In Senate	<ul style="list-style-type: none"> • Defines <i>automated motor vehicle</i> as “a vehicle capable of operating in full automation mode, or the unconditional, full-time performance by an automated driving system of all aspects of the dynamic driving task” • Directs the Secretary of State to study the feasibility of autonomous vehicles
Massachusetts	HB 2977 (2016)	Replaced by new draft, MA HB 4321	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “any vehicle equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Lists requirements to operate an autonomous vehicles • Authorizes autonomous vehicle testing • Contains insurance requirements for autonomous vehicles • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed
Massachusetts	HB 4321 (2016)	In House Committee on Ways and Means	<ul style="list-style-type: none"> • See MA HB 2977
Massachusetts	SB 1841 (2016)	Pending, Senate Study Order	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “a motor vehicle that uses computers, sensors, and other technology and devices that enable the vehicle to safely operate without the active control and continuous monitoring of a human operator” • Allows autonomous vehicles on public roads if manufacturers certify the vehicle meets safety standards specified by the DOT

			<ul style="list-style-type: none"> • Authorizes testing if testing safety standards developed by the DOT are met
Maryland	HB 8/ SB 126 (2016)	Passed House; Failed in Senate	<ul style="list-style-type: none"> • Establishes the Task Force to Study Issues Related to the Use of Self-Driving Vehicles to determine best practices for governing autonomous vehicles and put forward recommendations
Maryland	HB 172/ SB 778 (2015)	Failed (Passed House; Failed in Senate)	<ul style="list-style-type: none"> • Establishes the Task Force to Study Issues Related to the Use of Self-Driving Vehicles to determine best practices for governing autonomous vehicles and make recommendations
Michigan	SB 927 (2016)	In Senate Judiciary Committee	<ul style="list-style-type: none"> • Makes tampering with the electronic system of a motor vehicle to “willfully destroy, damage, impair, alter, or gain unauthorized control of the motor vehicle” illegal
Michigan	SB 928 (2016)	In Senate Judiciary Committee	<ul style="list-style-type: none"> • Specifies category and class of crime, as well as penalties, for accessing “electronic systems of motor vehicle to obtain data or control of vehicle”
Michigan	SB 995 (2016)	In Senate Economic Development and International Investment Committee	<ul style="list-style-type: none"> • Defines <i>automated motor vehicle</i> as “a motor vehicle on which an automated driving system has been installed” • Defines <i>automated driving system</i> as “hardware and software that are collectively capable of performing all aspects of the dynamic driving task for a vehicle on a part-time or full-time basis without any supervision by a human operator” • Defines <i>automated technology</i> as “technology installed on a motor vehicle that has the capability to assist, make decisions for, or replace a human operator” • Grants autonomous vehicles the ability to operate • Proscribes local governments from imposing regulations on on-demand autonomous vehicle network • Authorizes the operation of autonomous vehicles without an individual in it • Holds that the vehicle manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology without consent

Michigan	SB 996 (2016)	In Senate Economic Development and International Investment Committee	<ul style="list-style-type: none"> • Lets manufacturers participate in SAVE Project, an initiative to make on-demand autonomous vehicle networks available to the public (as defined in SB 997) • Requires insurance for each vehicle in a fleet • States that manufacturers must assume liability for vehicles in SAVE Project if automated system is at-fault • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology without consent
Michigan	SB 997 (2016)	Referred to Senate Economic Development and International Investment Committee	<ul style="list-style-type: none"> • Defines automated driving system, automated technology, and automated motor vehicle (see SB 995) • Excludes roads under control of mobility research centers (facility operated under agreement between state, local government, and a university) from provisions that would apply to private roads open to the public • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology without consent
Michigan	SB 998 (2016)	Referred to Senate Economic Development and International Investment Committee	<ul style="list-style-type: none"> • Holds that a manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed • Affirms that mechanics are not liable for repairs if done according to manufacturer’s specifications
Minnesota	SF 2569/ HF 3325 (2016)	Re-referred to Senate Finance Committee; Re-referred to House Government Operations and Elections Policy	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “vehicle equipped with technology that has the capability to drive a vehicle without the active control or monitoring of a human operator” • Establishes Autonomous Vehicles Task Force and demonstration project; the latter could serve mobility needs of the disabled and will be overseen by the task force
Mississippi	SB 2676 (2015)	Failed	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “motor vehicle that is equipped with autonomous technology”

			<ul style="list-style-type: none"> • Defines <i>autonomous technology</i> as “technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator” • Permits the use of autonomous vehicles if they are registered and meet federal standards, have a human operator that can take control, and autonomous technology that can be disengaged and alert operator of technology failure • States that driver’s license endorsements will be developed for autonomous vehicles
Missouri	HB 924 (2015)	Failed	<ul style="list-style-type: none"> • Enables testing of autonomous vehicles if proof of insurance is submitted, the vehicle is operated by a designee of the manufacturer, and individual is in the vehicle and can monitor and take control of the vehicle • Holds that a manufacturer of autonomous technology is immune from liability if another person modifies an automated vehicle or autonomous technology
New Jersey	AB 554 (2016)	In Assembly Committee on Law and Public Safety	<ul style="list-style-type: none"> • Mandates that autonomous motor vehicles sold in the state be equipped with ignition interlock device
New Jersey	AB 851 (2016)	In Assembly Committee on Transportation and Independent Authorities	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “motor vehicle that uses artificial intelligence, sensors, global positioning system coordinates, or any other technology to carry out the mechanical operations of driving without the active control and continuous monitoring of a human operator” • Defines <i>autonomous mode</i> as “the operation of the autonomous vehicle without the active control of a human being” • Directs the Motor Vehicle Commission to establish driver's license endorsement for autonomous vehicles
New Jersey	AB 3745 (2016)	In Assembly Transportation and Independent	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “a motor vehicle that uses autonomous technology, including sensors, global positioning system coordinates,

		Authorities Committee	<p>or any other technology to perform the mechanical operations of driving”</p> <ul style="list-style-type: none"> • Defines <i>autonomous technology</i> as “technology that has the capability to drive a motor vehicle without active physical control or monitoring by an operator” • Authorizes testing of autonomous vehicles on public roads if an operator is in driver’s seat and can take over control; a \$5 million insurance policy has been taken out; and an application is made to the state indicating the vehicle can be taken over by the operator, has safety alerts for technology failures, and stores collision data
New Jersey	SB 343 (2016)	In Senate Transportation Committee	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “motor vehicle equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Directs the Motor Vehicle Commission to establish a driver’s license endorsement for autonomous vehicles
New York	AB 31 (2016)	In Assembly Committee on Transportation	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as a “motor vehicle equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Requires that autonomous vehicles operating in the state comply with federal regulations, have a means to disengage the autonomous technology, alert the driver to technology failure, and have in-vehicle indicators that show when autonomous technology is engaged • Authorizes autonomous vehicle testing with proof-of-insurance (must be no less than \$5 million)

New York	AB 10586 (2016)	In Assembly Committee on Transportation	<ul style="list-style-type: none"> Establishes an Autonomous Vehicle committee to study methods of testing and operating autonomous vehicles, including legislative changes, liability issues, potential for autonomous vehicles to promote research and development
New York	SB 7879 (2016)	Passed Senate. Pending in Assembly Committee on Transportation	<ul style="list-style-type: none"> Maintains that “No person shall operate a motor vehicle without [having] at least one hand... on the steering mechanism at all times when the motor vehicle is in motion, unless driving technology is engaged to perform the steering function”
North Carolina	HB 782/ SB 600 (2015)	Failed	<ul style="list-style-type: none"> Defines <i>autonomous vehicle technology</i> as “technology that is installed on a motor vehicle and that has the capability to drive the motor vehicle without the active control or monitoring of a human operator”; Directs the Division of Motor Vehicles to study strategies for implementing autonomous vehicle technology (including legislative changes), identify any liabilities from autonomous vehicles, and any other relevant issues
Oregon	SB 620/ HB 2428 (2015)	Failed	<ul style="list-style-type: none"> Defines <i>autonomous vehicle</i> as “a motor vehicle equipped with an autonomous system” Defines “autonomous system” as “system that enables the operation of a motor vehicle without the active physical control of, or monitoring by, a human operator” Manufacturers can test and sell autonomous vehicles if they receive certification from the state Authorizes the testing and operation of autonomous vehicles if they meet certain criteria such as having mechanisms to disengage autonomous system, an installed failure alert system, and the ability to store data before potential collisions Stipulates that operators must have a proper license and be in the driver’s seat monitoring the vehicle’s operation
Pennsylvania	SB 1268/ HB 2203 (2016)	Referred to Senate Transportation Committee;	<ul style="list-style-type: none"> Defines <i>autonomous vehicle</i> as “a motor vehicle that is equipped with autonomous technology that can operate without the active physical control or monitoring of a human operator”

		Recommitted to House Rules Committee	<ul style="list-style-type: none"> • Defines <i>autonomous technology</i> as “equipment, devices, or other technology installed on a motor vehicle, either by the original equipment manufacturer or an aftermarket installer, which renders the motor vehicle capable of driving or operating without the active control of a human operator” • Sanctions testing of autonomous vehicles under certain conditions, including manual control options, insurance, and registration
Rhode Island	SB 2514 (2016)	In Senate Judiciary Committee	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “any vehicle equipped with autonomous technology” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle that has the capability to drive the vehicle on which the technology is installed without the active control or monitoring by a human operator” • Authorizes the use of autonomous vehicles
Texas	HB 933 (2015)	Failed	<ul style="list-style-type: none"> • Holds that manufacturer is not liable if another person attempts to retrofit a vehicle with autonomous technology unless a defect already existed • States that licenses for individuals operating autonomous vehicles will be designated • Proposes the development of an autonomous vehicle border security pilot program
Texas	SB 1167 (2015)	Failed	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “motor vehicle that is capable of using autonomous technology to operate itself without the active control or continuous monitoring of a person” • Defines <i>autonomous technology</i> as “technology installed on a motor vehicle enabling the vehicle to operate without the active control or continuous monitoring of a person” • Authorizes the DOT to examine autonomous freight testing with private companies • Requires the DOT to plan for wireless communication needs of autonomous vehicles

Texas	HB 3690 (2015)	Failed	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “self-propelled vehicle or piece of equipment that uses autonomous technology to operate itself without the active control or continuous monitoring of a person” • Defines <i>autonomous technology</i> as “technology that enables a vehicle or piece of equipment to operate without the active control or continuous monitoring of a person” • States the DOT can operate autonomous vehicles to perform construction or maintenance work provided several qualifications are met
Virginia	HB 1372 (2016)	Failed	<ul style="list-style-type: none"> • Defines <i>autonomous vehicle</i> as “a vehicle, as defined by Levels 4 and 5 of SAE J3016, that utilizes an automated driving system that handles all aspects of the dynamic driving task, and does not require the involvement of a driver at any time for it’s safe operation” • Defines <i>piloted vehicles</i> as “a vehicle as defined by Levels 1 through 3 of SAE J3016, that has the ability to perform one or more driving mode specific tasks, but requires the driver to respond appropriately to vehicle requests to intervene and resume control”
Washington	HB 2106 (2016)	Reintroduced in House	<ul style="list-style-type: none"> • Chapter 46.61 RCW (Rules of the Road) “does not apply to vehicles used in autonomous vehicle testing... if the testing occurs: within the boundaries of Joint Base Lewis-McChord and with prior written approval”

Many of the enacted or proposed bills offer definitions of AVs and autonomous technology. Isaac (2016) observes that state legislation has mainly centered on drivers, manufacturers insurance, compliance with safety laws via testing, data storage for a period of time, and incident reporting. Examining several states, Wagner (2015, p. 5) groups AV legislation into the following categories: vehicle components, operational requirements, operator requirements, vehicle conversion and liability requirements, and mobile communications and data privacy requirements. Other states have tackled questions relating to licensing, safety, and insurance. Some legislation has assigned responsibilities for developing registration and/or certification processes for AVs. Several states have addressed how manufacturer product liability will impact AV development, although it is important to use warnings and education for consumers as well (Anderson et al., 2014). Another point of contention among policymakers has been whether AVs should be required to have a steering wheel as a safety measure. Evidence has shown that increasing automation also increases driver distraction (Vock, 2016). There is some deference given to potential federal policy and regulations due to the interstate commerce implications of vehicle travel. Finally, legislation has sought to protect auto manufacturers against liability if vehicles are retrofitted with autonomous technology. Such protections are presumably designed to encourage testing of autonomous vehicles. Wilmot and Greensword (2016, p. 58) offer a summary of state level legislation as follows:

The general format of the legislation is to define an autonomous vehicle, address who is responsible for issuing licenses to operate an autonomous vehicle, who is authorized to provide training to operate an autonomous vehicle, what facilities may be used to operate autonomous vehicles on and what weather conditions (if any) should prevail while autonomous vehicles are operated, and whether certified operators are restricted to testing vehicles or whether permission is granted to operate autonomous vehicles for general purposes. They also generally include the necessity to report any crashes or malfunctions, require that an event recording device be installed in the vehicle, require that an operator be present in the vehicle and be able to regain control of the vehicle at all times, and that liability insurance of \$5M be provided for each vehicle tested on public roads.

Examining states in which proposals have either failed or are still under consideration reveals their different approaches to AV legislation. Arizona’s governor issued an executive order in 2015³⁶ directing state agencies to “support the testing and operation of self-driving vehicles on public roads in Arizona.” This executive order authorizes pilot programs with universities (under certain rules) and the formation of a Self-Driving Vehicle Oversight Committee to advise the DOT and other agencies on the use of AVs. In another example, Virginia’s governor has touted a new partnership that will facilitate research into and the development of AVs:

The Virginia Department of Transportation and the Department of Motor Vehicles have entered into a new partnership with the Virginia Tech Transportation Institute, Transurban and HERE—Nokia’s mapping business—to create the Virginia Automated Corridors. The new initiative will streamline the use of Virginia roads and state-of-the-art test facilities for automated-vehicle testing, certification, and migration towards deployment.³⁷

³⁶ See the Appendix for the full text of Executive Order 2015-09.

³⁷ <https://governor.virginia.gov/newsroom/newsarticle?articleId=8526>

The partnership will open Virginia’s roads for automated technologies testing (with licensing and insurance considerations provided by the state). Pennsylvania has formed an Autonomous Vehicles Testing Policy Task Force, which will provide guidance to the Pennsylvania Department of Transportation (PennDOT).³⁸ The task force includes stakeholders from various groups, such as industry, universities, and federal and state officials.

Anderson et al. (2014, p. 6) list several critical questions policymakers will want to consider when deliberating on potential AV legislation:

- How, if at all, should the use of AVs be regulated, and at what level?
- What kinds of vehicles should be allowed on the road, and who is allowed to operate them?
- How should the safety of AVs be tested, and by whom? To what safety standards should AVs be held?
- How might different liability regimes shape the timely and safe adoption of AVs, and what are the tradeoffs? Under what conditions would limitations on tort liability be appropriate?
- What are the implications of a patchwork of state-by-state laws and regulations, and what are the tradeoffs in harmonizing these policies?
- To what extent should policymakers encourage the adoption of AVs; e.g., through smart road infrastructure, dedicated highway lanes, manufacturer or consumer incentives?

The National Association of City Transportation Officials (NACTO) issued a policy statement on AVs³⁹ that included a checklist for consideration when developing policies and regulations.

- Promote safety for pedestrians, bicyclists, transit riders, automated vehicle passengers, and all street users within the multi-modal urban context;
- Incentivize shared, automated, electric vehicles to reduce the environmental impacts of vehicular travel and refocus planning on the principle of mobility as a service;
- Support the future vision of communities as great places to live, work, and play by using technology as a tool to change land use as well as how streets are built;
- Re-balance the use of the right-of-way with less space for cars and more space for people walking, cycling, using transit and recreating;
- Support public transit by providing first and last mile connections to major transit lines via shared, automated vehicles, and by providing cost-effective, on-demand transit in lieu of low-performing fixed routes; and
- Improve mobility for all, contributing to a more equitable transportation system, where benefits reach all demographics and any negative effects are not unjustly concentrated.

Several states have also issued reports covering approaches to AVs. Utah has issued a report on the “Best Practices for Regulation of Autonomous Vehicles on Utah Highways”⁴⁰, which examines federal and other state actions and arrives at a set of recommendations and questions for further consideration. First, Utah could follow NHTSA guidance to establish a committee to deal with some of issues associated with AVs that focus on safety, data security, infrastructure preparation,

³⁸ <http://www.penndot.gov/Pages/all-news-details.aspx?newsid=233#.V1COyNkrKUI>

³⁹ <http://nacto.org/wp-content/uploads/2016/06/NACTO-Policy-Automated-Vehicles-201606.pdf>

⁴⁰ <https://le.utah.gov/interim/2016/pdf/00004126.pdf>

training and licensing, enforcement, and consistency across states. Questions for Utah policymakers to consider related to AVs are as follows:

- Is Utah’s goal to be an early adopter of HAVs? If so, what are the legislative priorities associated with enabling that goal? Does any existing legislation hinder this goal?
- Does Utah wish to make a greater effort to leverage autonomous vehicle technology growth for potential economic development? If so, which sectors of the industry and/or which manufacturers are the best fit for Utah? How can Utah incentivize private industry to locate and invest here?
- Should Utah take a more conservative approach of learning from national efforts and other states before moving forward on new legislation, policies or efforts to entice private industry partnerships?

Kockelman et al. (2016) analyze safety strategies to prepare for CAVs as well as recommendations for deployment of those vehicles (Appendix). Table 9 lists safety strategies by short, medium, and long-term and includes a short summary of each strategy.

Table 9: Texas Safety Strategies for Connected and Autonomous Vehicles

Short Term Strategies	
<i>Road markings</i>	Technologies need clear marking to function properly
<i>Signage development</i>	Updating signage and signage standards to ensure vehicles can read and respond appropriately
<i>Shaping legislative policy</i>	Texas DOT working with legislature to address issues such as standards for operation, defining “operator”, rules for platooning, and liability questions among others
Medium Term Strategies	
<i>Construction/detours methodology</i>	Plans for addressing the use of mapping technology that may change due to temporary road changes
<i>Lane management</i>	Potential for dedicated lanes for AVs
<i>Nighttime rules of road</i>	Examine potential rules for headlights for AVs
<i>SAV integration</i>	Potential for shared AVs and need for standards for such operations
<i>Developing and enforcing regulations of empty driving</i>	Shared AV use could increase VMT, so Texas should consider regulations related to empty driving and sustainability
<i>Roadway design amendments</i>	Continually updating design manuals to reflect changes in technology
<i>Tolling and demand management</i>	Exploring various methodologies to ensure travelers for the marginal cost of their trip
Long Term Strategies	
<i>Construction and maintenance design</i>	Changing construction and maintenance approaches if needed to facilitate AV use
<i>Rural signage and rural road design</i>	As urban areas are likely to be more affected first, eventually rural changes would also be necessary
<i>Smart intersections</i>	Traversing intersections using a first-come first-serve reservation system

Wagner (2015) also addresses policy considerations for AV testing in Texas, listing five factors that have arisen in other state legislation and are pertinent for Texas. The primary justifications offered for an AV testing program in Texas was economic development, as private industries will invest in testing and safety improvements.

1. Safety
2. Maintaining interstate and federal regulatory agreement
3. Determining an optimal level of regulation
4. Allow AV industry ability to continue to innovate
5. Ensure social benefits balance with administrative burden and potential costs

Finally, Wilmot and Greensword (2016) list several recommendations for Louisiana related to legislation and regulations for AVs. These recommendations are based on a review of practices in other states.

1. Operators of autonomous vehicles must obtain an autonomous vehicle operator's license from the Office of Motor Vehicles, Department of Public Safety in Louisiana.
2. Training in the operation of an autonomous vehicle must precede issuing of an operator's license.
3. Training in the operation of an autonomous vehicle must be provided by an authorized Original Equipment Manufacturer (OEM).
4. Completion of a successful training program must be certified by an authorized OEM before an applicant can apply for an autonomous vehicle operator's license.
5. An autonomous vehicle must be clearly identified as distinct from other vehicles by means of a distinctly colored number plate or other markings.
6. Operation of an automated vehicle on public roads is limited to testing only; use of autonomous vehicles by the public for general use is not recommended until the safe operation of mixed autonomous and driven vehicles is established.
7. Liability insurance of \$5M dollars should be required as a condition of registration of an autonomous vehicle in the state.
8. Testing of autonomous vehicles on public roads should only be permitted when conditions on the road permit safe operation. Suitable conditions include good weather, good visibility, and stable traffic conditions.
9. Autonomous vehicles must have an Event Data Recorder (EDR) that is capable of storing and retaining data from at least 30 seconds prior to a crash.
10. Any crash must be reported together with detail regarding the crash and the EDR data prior and during the event.
11. The autonomous vehicle must allow an operator to quickly gain control of an autonomous vehicle in the event of any malfunction in the autonomous features of the vehicle.
12. 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.
13. Monitor development of autonomous vehicles on a continuing basis so that opportunities to update legislation, regulation, policy formulation, or action by public agencies in the state can be identified and acted upon.

Isaac (2016) analyzes potential responses different levels of government can offer to address some of the challenges related to AVs, and offers several recommendations. Isaac proposes that the federal government should direct its energies toward updating or developing safety standards for AVs. In doing so, it could establish standards for AV manufacturing, design, and infrastructure. Additionally, privacy concerns over data collection and sharing will need to be addressed along with security concerns about hacking. He envisions state and local governments assuming responsibility for issues related to transit, finances (potential loss of revenue from taxes, traffic enforcement, etc.), local infrastructure, and congestion management. Isaac’s recommendations (p. 23-29) for state and local governments are divided into short, medium, and long range plans (Table 10). Additional issues state and local governments need to consider include enforcement activities and incident management, among others. Anderson et al. (2014) identify one potential short-term action to improve safety — requiring that AVs be sensitive and responsive to road signage, particularly changes to normal traffic patterns such as construction.

Table 10: Short and Medium/Long Range Recommended Plans for State and Local Governments Related to Autonomous Vehicles

<i>Short Term</i>
Stay informed on developments related to AVs
Add AVs to local/state transportation goals and plans
Communicate with stakeholders, such as manufacturers and researchers
Support AV testing
Consider evolving dynamics of AVs when setting policy
Encourage data sharing
<i>Medium/Long Term</i>
Update travel demand models (planning)
Evaluate capacity needs (planning)
Analyze transit plans and requirements in the future (planning)
Forecast financial impacts (planning)
Update traffic signs/markings; adjust signal locations and timing (infrastructure)
Reduce lane width (infrastructure)
Modify speed limits (infrastructure)
Modify parking options; add drop-off/pick-up areas (infrastructure)
Add electric vehicle charging stations (infrastructure)
New models for pavement maintenance (infrastructure)
Designate roads for autonomous vehicles as they are ready (infrastructure)

Generally, states have facilitated AV testing while maintaining regulatory oversight of AV operations in order to ensure roadway safety. Anderson et al. (2014, p. xxiv) write that, “Overall, the guiding principle for policymakers should be that AV technology ought to be permitted if and when it is superior to average human drivers.” While addressing problematic regulations and ensuring safe testing and operation of AVs are important policy goals, it would still be critical for states to defer to federal guidance and rulemaking as it is offered, as different regulations across states may make interstate travel problematic.

Chapter Four: Kentucky Statutes and Regulations

The research team reviewed the Kentucky Revised Statutes (KRS) and Kentucky Administrative Regulations (KAR) to determine whether any of the state’s current statutes or regulations pertaining to AVs require review and/or modification. The search emphasized the following areas:

- Driver Definitions/Requirements
- Equipment/Vehicle Regulations
- Licensing Definitions/Requirements
- Operational Limitations
- Safety Equipment
- Other Relevant Topics

Keyword searches aided in the discovery of relevant KRS and KAR sections. This chapter describes relevant passages from the KRS and KAR.

4.1 Kentucky Revised Statutes

We first performed several keyword searches of the KRS. A search for *motor vehicle* returned 546 hits; *automobile* yielded 78 hits; and *driver* produced 174 hits. Through parsing the results and KRS Title Page⁴¹, the following chapters identified as being most relevant to this study — in Title XV, *Roads, Waterways, and Aviation*, and in Title XVI, *Motor Vehicles*.

Chapter 174

Chapter 174 of Title SV is entitled *Transportation Cabinet*. Relevant sections from this chapter include the oversight of licenses, promoting traffic safety, and delegating authority to issue administrative regulations (Table 11). The full text of these sections can be found at <http://www.lrc.ky.gov/Statutes/index.aspx>.

Table 11: KRS Chapter 174

Statute	Summary
174.055 Other agency functions transferred to cabinet.	KYTC assumes functions related to operator licensing, traffic safety, and motor vehicle inspection
174.060 Licenses and fees.	KYTC assumes functions related to motor vehicle licensing
174.065 Traffic safety.	KYTC shall work with other organizations and agencies to promote traffic safety
174.080 Administrative regulations.	KYTC’s Secretary can develop regulations related to the Department of Highways, state highways, bridges, and other areas.

Chapter 176

Chapter 176 focuses on Department of Highways’ duties and operations. The only relevant section is 176.505, *Motorcycle Advisory Commission for Highway Safety Established*, which holds that the commission “shall examine Transportation Cabinet policies and procedures in areas including

⁴¹ <http://www.lrc.ky.gov/Statutes/index.aspx>

but not limited to crash barrier design, road maintenance practices, road construction, traffic control devices, and intelligent transportation systems, and recommend changes where necessary.”

Chapter 186

Title XVI contains several germane chapters. Chapter 186 concerns vehicle licensing. The following section presents selected definitions from this chapter, with the most salient definitions being *operator* and *vehicle*. Table 12 summarizes potentially relevant sections such as those concerning registration and reciprocity, which may be important depending on other states’ AV policy frameworks. Licensing, fees for licenses, and laws concerning suspension and/or revocation of licenses due to traffic violations may also eventually be affected if states require AV operators to obtain special licenses or licenses are deemed to be unnecessary. No sections, however, appear to include content that would be a barrier to AVs. Qualifications and definitions related to eyesight may no longer be an issue. Owners of AVs will continue to register the vehicles, although there may be slight changes to the process for designating AVs. Other areas which assume the necessity of an operator could be revised by changing the definition. The full text of these sections is available at <http://www.lrc.ky.gov/Statutes/index.aspx>.

186.010 Definitions.

- (2) “Highway” means every way or place of whatever nature when any part of it is open to the use of the public, as a matter of right, license, or privilege, for the purpose of vehicular traffic.
- (3) “Manufacturer” means any person engaged in manufacturing motor vehicles who will, under normal conditions during the year, manufacture or assemble at least ten (10) new motor vehicles.
- (4) “Motor vehicle” means in KRS 186.020 to 186.260, all vehicles, as defined in paragraph (a) of subsection (8) of this section, which are propelled otherwise than by muscular power. As used in KRS 186.400 to 186.640, it means all vehicles, as defined in paragraph (b) of subsection (8) of this section, which are self-propelled. “Motor vehicle” shall not include a moped as defined in this section, but shall include low-speed vehicles as defined in this section.
- (5) “Moped” means either a motorized bicycle whose frame design may include one (1) or more horizontal crossbars supporting a fuel tank so long as it also has pedals, or a motorized bicycle with a step-through type frame which may or may not have pedals rated no more than two (2) brake horsepower, a cylinder capacity not exceeding fifty (50) cubic centimeters, an automatic transmission not requiring clutching or shifting by the operator after the drive system is engaged, and capable of a maximum speed of not more than thirty (30) miles per hour.
- (6) “Operator” means any person in actual control of a motor vehicle upon a highway.
- (7)
 - (a) “Owner” means a person who holds the legal title of a vehicle or a person who pursuant to a bona fide sale has received physical possession of the vehicle subject to any applicable security interest.
 - (b) A vehicle is the subject of an agreement for the conditional sale or lease, with the vendee or lessee entitled to possession of the vehicle, upon performance of the contract terms, for a period of three hundred sixty-five (365) days or more and with the right of purchase upon performance of the conditions stated in the agreement and with an immediate right of possession vested in the conditional vendee or lessee, or if a mortgagor of a vehicle is entitled to possession, the conditional vendee or lessee or mortgagor shall be deemed the owner.
 - (c) A licensed motor vehicle dealer who transfers physical possession of a motor vehicle to a purchaser pursuant to a bona fide sale, and complies with the requirements of KRS

186A.220, shall not be deemed the owner of that motor vehicle solely due to an assignment to his dealership or a certificate of title in the dealership's name. Rather, under these circumstances, ownership shall transfer upon delivery of the vehicle to the purchaser, subject to any applicable security interest.

- (8) (a) "Vehicle," as used in KRS 186.020 to 186.260, includes all agencies for the transportation of persons or property over or upon the public highways of this Commonwealth and all vehicles passing over or upon said highways, excepting road rollers, road graders, farm tractors, vehicles on which power shovels are mounted, such other construction equipment customarily used only on the site of construction and which is not practical for the transportation of persons or property upon the highways, such vehicles as travel exclusively upon rails, and such vehicles as are propelled by electric power obtained from overhead wires while being operated within any municipality or where said vehicles do not travel more than five (5) miles beyond the city limit of any municipality.
- (b) As used in KRS 186.400 to 186.640, "vehicle" means every device in, upon or by which any person or property is or may be transported or drawn upon a public highway, excepting devices moved by human and animal power or used exclusively upon stationary rails or tracks, or which derives its power from overhead wires.
- (9) KRS 186.020 to 186.270 apply to motor vehicle licenses. KRS 186.400 to 186.640 apply to operator's licenses.
- (10) "Dealer" means any person engaging in the business of buying or selling motor vehicles. (11) "Commercial vehicles" means all motor vehicles that are required to be registered under the terms of KRS 186.050, but not including vehicles primarily designed for carrying passengers and having provisions for not more than nine (9) passengers (including driver), motorcycles, sidecar attachments, pickup trucks and passenger vans which are not being used for commercial or business purposes, and motor vehicles registered under KRS 186.060.

186.576 Definitions for KRS 186.576 to 186.579.

As used in KRS 186.576 to 186.579:

- (1) "Applicant" means any person applying for an instruction permit or an operator's license who must use a bioptic telescopic device in order to operate a motor vehicle;
- (2) "Binocular vision" means visual acuity that is 20/200 or better in both eyes, with or without corrective lenses;
- (3) "Bioptic telescopic device" means a two (2) focus optical system used to magnify distant objects by including a small telescope that is mounted in a spectacle lens in a manner to allow an unobstructed view of the horizontal visual field through a person's normal distance corrective lens;
- (4) "Certified driver training program" means a program that provides and coordinates comprehensive assessment and training of driving skills and responses that emphasizes the vision, hearing, psychological, perceptual, orientation, and mobility skills of an applicant and that is certified by the department;
- (5) "Combined visual acuity" means visual acuity attained by using both eyes together where a person has binocular vision;
- (6) "Corrective lenses" means eyeglasses, contact lenses, and intraocular lenses, but does not mean a bioptic telescopic device;
- (7) "Daytime driving restriction" means operation of a motor vehicle is restricted to the period of time from between thirty (30) minutes after sunrise and thirty (30) minutes before sunset. Under

- this restriction, driving during adverse weather conditions that significantly reduce the visibility of the roadway, other traffic, and traffic control devices shall be prohibited;
- (8) “Office” means the Office for the Blind;
- (9) “Monocular vision” means visual acuity that is 20/200 or better in only one (1) eye, with or without corrective lenses;
- (10) “Restricted out-of-state driver” means a person who has been issued, by another state, a valid operator's license with a restriction requiring the use of a bioptic telescopic device;
- (11) “Vision specialist” means a licensed ophthalmologist or optometrist;
- (12) “Visual acuity” means the measure of a person's visual acuity based on the Snellen visual acuity scale; and
- (13) “Visual field” means the area of physical space visible to the eye in a given fixed position.

Table 12: KRS Chapter 186

Statute	Summary
186.140 Reciprocity for nonresidents.	<ul style="list-style-type: none"> Vehicles registered in another state are exempt in KY for the same period of time as provided in the reciprocating state
186.145 Registration of nonresident by use of copy of registration or title document.	<ul style="list-style-type: none"> Motor vehicles registered in states lacking reciprocity must register in KY
186.150 Residents not to use license of other states.	<ul style="list-style-type: none"> KY residents must license motor vehicles in KY unless reciprocity applies
186.400 Duties of Transportation Cabinet — Administration of laws.	<ul style="list-style-type: none"> KYTC can set regulations related to operator’s licenses not specifically covered
186.402 Statement of legislative intent relating to young drivers.	<ul style="list-style-type: none"> A goal of the General Assembly is to improve safety for young drivers
186.410 Operators' licenses — Requirements and issuance — Personal identification cards, validity — Driver training programs.	<ul style="list-style-type: none"> Requirements to obtain operator’s license to operate a vehicle and driver education programs
186.4101 Reconciliation of two-year and four-year renewal periods.	<ul style="list-style-type: none"> Operator’s license renewed every four years
186.430 Exemption of nonresidents.	<ul style="list-style-type: none"> If certain criteria are met, nonresidents with valid licenses can drive in KY for a year
186.435 Application for operator's license by driver who becomes Kentucky resident — Verification of status in other jurisdiction — Procedures for permanent residents.	<ul style="list-style-type: none"> Licensed drivers must apply for a KY operator’s license after they become a resident of the state
186.440 Persons ineligible for operator's license — Reinstatement fee and exemption.	<ul style="list-style-type: none"> States the ineligibility criteria for acquiring an operator’s license
186.442 Suspension or revocation of license or driving privileges in another jurisdiction — Persons eligible for restricted license — Issuance of license valid only in Kentucky — Removal of restrictions — Inapplicability to commercial driver's license.	<ul style="list-style-type: none"> States the criteria for operator’s licenses based on status in other jurisdictions

186.444 Medical review board — Purpose — Members — Informal hearing — Authority of cabinet to promulgate administrative regulations — Prohibition against age-based licensing limitations — Appeal.	<ul style="list-style-type: none"> • Medical review board to oversee disabilities that can affect safe operation of motor vehicles • Prohibits age-based restriction on license acquisition
186.450 Instruction permits for motor vehicle and motorcycle — Application — Age requirements — Restrictions on driving with permit.	<ul style="list-style-type: none"> • Requirements for operator permits
186.452 Intermediate license to operate a motor vehicle.	<ul style="list-style-type: none"> • Criteria for intermediate licenses
186.454 Intermediate license holder application process.	<ul style="list-style-type: none"> • Process for applying for an intermediate license
186.470 Application of minor — Renewal of minor's license or permit — Parental consent to release of academic information to cabinet — Cancellation.	<ul style="list-style-type: none"> • Parental consent for operator's license under age 18
186.480 Examination of applicants by Department of Kentucky State Police — Exemptions.	<ul style="list-style-type: none"> • KY State Police will examine all applicants for operator's licenses
186.490 Duties of the circuit clerk.	<ul style="list-style-type: none"> • Specify procedures for KYTC to issue temporary licenses, collect and remit fees, and maintain records
186.495 Alphabetical index of operators' licenses.	<ul style="list-style-type: none"> • County circuit clerks maintain an index of operator's licenses issued
186.510 License to be in possession and to be shown on demand.	<ul style="list-style-type: none"> • Individuals should have their license available at all times when driving
186.531 Fees for licenses, permits, and identification cards.	<ul style="list-style-type: none"> • Fee structure for operator's licenses
186.550 Courts to report convictions and send licenses to cabinet.	<ul style="list-style-type: none"> • Convictions for violations of motor vehicle laws should be reported and courts should possess the license of a person convicted of a law required mandatory license revocation
186.560 Mandatory revocation or denial of license — Causes — Period of revocation or denial — Prohibition against reductions of certain revocations or denials — Limited exception relating to enrollment in alcohol or substance abuse education or treatment programs.	<ul style="list-style-type: none"> • Operator license revocation criteria
186.570 Denial or suspension of license — Informal hearing — Appeal — Surrender of certificate — Medical review board — Prohibition against raising insurance on	<ul style="list-style-type: none"> • Process for suspending or denying an operator's license based on a number of factors

basis of denial or suspension for child support arrearage.	
186.572 Assessment of penalty points for speeding on limited access highway.	<ul style="list-style-type: none"> • Penalty points assessed for speeding
186.574 State traffic school for new drivers and for traffic offenders — Fees — Fee in lieu of court costs — Procedures — County attorney-operated traffic safety program.	<ul style="list-style-type: none"> • Overview of state traffic school for new drivers and offenders
186.577 Testing applicants for initial operator's license or initial instruction permit — Restrictions or driving privileges based on visual acuity test — Certain drivers restricted to use of bioptic telescopic devices.	<ul style="list-style-type: none"> • Eyesight testing for operator's license applicants
186.578 Visual acuity requirements for certified driver training program — Testing of knowledge of motor vehicle laws — Out-of-state drivers establishing residence in Kentucky — Restriction on taking of operator's license examination after three failings — Consequence of failure to pass examination.	<ul style="list-style-type: none"> • Eyesight requirements for driver training programs, testing, and out-of-state drivers' requirements after establishing KY residency
186.579 Restricted operator's license requiring daytime driving, use of bioptic telescopic device, and vehicle with left and right outside mirrors — Removal of restrictions — Renewal.	<ul style="list-style-type: none"> • Eyesight restrictions for acquiring an operator's license
186.580 Appeals.	<ul style="list-style-type: none"> • Ability to appeal denial of a license
186.590 Minor's negligence imputed to person signing application or allowing him to drive.	<ul style="list-style-type: none"> • Liability for minor's negligence while driving
186.610 Prohibited uses of licenses — Fraud in application.	<ul style="list-style-type: none"> • Prohibitions against using an operator's license including fraud
186.620 Unlawful to drive or permit another to drive without license — Display of license on request of peace officer — Defense.	<ul style="list-style-type: none"> • Unlawful to allow anyone without a license to drive a motor vehicle
186.630 Renting a motor vehicle to another.	<ul style="list-style-type: none"> • Unlawful to rent a motor vehicle to an unlicensed person
186.640 Driving without operator's license is evidence of negligence in accident.	<ul style="list-style-type: none"> • A driver in an accident lacking a license is evidence of negligence
186.6401 Persons required to complete examinations under KRS 186.480.	<ul style="list-style-type: none"> • Criteria for an examination requirement before receiving an operator's license
186.641 When abstract of driving record to be certified to county attorney.	<ul style="list-style-type: none"> • KYTC notifying county attorneys regarding habitual offenders

186.860 Authorization to develop and join the Nonresident Violator Compact.	<ul style="list-style-type: none"> • KYTC can join an interstate compact for processing traffic violations across state borders
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Chapter 189

Chapter 189 of KRS deals with traffic regulations. The following section provides an overview of key definitions, while Table 13 summarizes potentially relevant sections. With respect to vehicle regulations, there is an assumption that manufacturers will continue to comply with statutes concerning vehicle components such as horns, seatbelts, lights, and brakes, and that AVs will abide by established motor vehicle regulations when travelling on public roads. Several statutes pertain to vehicle equipment, and although it's assumed manufacturers will continue to comply with state law, AVs may not be equipped with steering devices or mirrors for a driver to utilize. Current bans on cell phone usage may be unnecessary for AVs that operate without driver input. Truck following distance may be problematic for truck platooning.

189.101 Definitions for chapter.

As used in this chapter:

(3) “Highway” means any public road, street, avenue, alley or boulevard, bridge, viaduct, or trestle and the approaches to them and includes private residential roads and parking lots covered by an agreement under KRS 61.362, off-street parking facilities offered for public use — whether publicly or privately owned — except for-hire parking facilities listed in KRS 189.700.

(6) “Motor truck” means any motor-propelled vehicle designed for carrying freight or merchandise. It shall not include self-propelled vehicles designed primarily for passenger transportation but equipped with frames, racks, or bodies having a load capacity of not exceeding one thousand (1,000) pounds.

(7) “Operator” means the person in actual physical control of a vehicle.

(8) “Pedestrian” means any person afoot or in a wheelchair.

(9) “Right-of-way” means the right of one (1) vehicle or pedestrian to proceed in a lawful manner in preference to another vehicle or pedestrian approaching under such circumstances of direction, speed, and proximity as to give rise to danger of collision unless one grants precedence to the other.

(10) “Roadway” means that portion of a highway improved, designed, or ordinarily used for vehicular travel, exclusive of the berm or shoulder. If a highway includes two (2) or more separate roadways, the term “roadway” as used herein shall refer to any roadway separately but not to all such roadways collectively.

(11) “Safety zone” means the area or space officially set apart within a roadway for the exclusive use of pedestrians and which is protected or is so marked or indicated by adequate signs as to be plainly visible at all times while set apart as a safety zone.

(12) “Semitrailer” means a vehicle designed to be attached to, and having its front end supported by, a motor truck or truck tractor, intended for the carrying of freight or merchandise and having a load capacity of over one thousand (1,000) pounds.

(13) “Truck tractor” means any motor-propelled vehicle designed to draw and to support the front end of a semitrailer. The semitrailer and the truck tractor shall be considered to be one (1) unit.

(17) “Trailer” means any vehicle designed to be drawn by a motor truck or truck-tractor, but supported wholly upon its own wheels, intended for the carriage of freight or merchandise and having a load capacity of over one thousand (1,000) pounds.

(18) “Unobstructed highway” means a straight, level, first-class road upon which no other vehicle is passing or attempting to pass and upon which no other vehicle or pedestrian is approaching in the opposite direction, closer than three hundred (300) yards.

(19) (a) “Vehicle” includes:

1. All agencies for the transportation of persons or property over or upon the public highways of the Commonwealth; and
2. All vehicles passing over or upon the highways.

(b) “Motor vehicle” includes all vehicles, as defined in paragraph (a) of this subsection except:

1. Road rollers;
2. Road graders;
3. Farm tractors;
4. Vehicles on which power shovels are mounted;
5. Construction equipment customarily used only on the site of construction and which is not practical for the transportation of persons or property upon the highways;
6. Vehicles that travel exclusively upon rails;
7. Vehicles propelled by electric power obtained from overhead wires while being operated within any municipality or where the vehicles do not travel more than five (5) miles beyond the city limits of any municipality; and
8. Vehicles propelled by muscular power.

Table 13: KRS Chapter 189

Statute	Summary
189.020 Equipment of vehicle not to be nuisance or menace.	<ul style="list-style-type: none"> • Vehicles are to be equipped to minimize nuisances <i>and</i> promote safety
189.100 Steering device not to be defective.	<ul style="list-style-type: none"> • Owners are not to operate motor vehicles with defective steering devices
189.130 Mirrors.	<ul style="list-style-type: none"> • Individuals are not to operate motor vehicles that are not equipped with mirrors, as noted in this statute
189.231 State maintained highways — Restriction and regulation of traffic.	<ul style="list-style-type: none"> • KYTC Secretary can use traffic control devices on state highways, and drivers must obey instructions from devices
189.233 Regulation of traffic on state highways.	<ul style="list-style-type: none"> • Through an official order KYTC’s secretary can regulate traffic and parking on portions of the state highway system
189.290 Operator of vehicle to drive carefully.	<ul style="list-style-type: none"> • Vehicle operators should operate vehicles carefully considering safety of pedestrians and other vehicles
189.292 Use of personal communication device prohibited while operating motor vehicle in motion on traveled portion of roadway – Exclusions – Administrative regulations.	<ul style="list-style-type: none"> • Prohibits the use of cell phones while driving

189.294 Use of personal communication device by minor prohibited while operating motor vehicle, motorcycle, or moped in motion on traveled portion of roadway — Exclusions — Administrative regulations.	<ul style="list-style-type: none"> • Prohibits minors from using cell phones while driving
189.340 Overtaking vehicles — Traffic lanes — Following vehicles.	<ul style="list-style-type: none"> • Passing regulations, minimum required distance between trucks

Chapter 189 uses the term *person* in 99 places. This may introduce problems for regulating AVs, because fully automated vehicles will not have a person who continuously controls them. As such, requirements in the statute that specify drivers are to perform various actions may become irrelevant in the context of AVs. Another area of interest are penalties, which are levied on individuals in response to unlawful driving actions. Policymakers will have to decide what type of penalties are appropriate to impose for AVs which commit traffic violations. Chapter 189, in a number of places, invokes a more specific phrase — *person shall not operate* — in reference to motor vehicle operation. However, these may be unproblematic if a *person* is understood to be *operating* the AV they own and use on public roads. The following sections in Chapter 189 use the phrase *person shall not operate* and may have relevance for AVs: 189.050, 189.055, 189.070, 189.090, 189.110, 189.125, 189.205, 189.210, 189.212, 189.221, 189.230, 189.265, 189.270, 189.271, 189.282, 189.284, 189.285, 189.286, 189.294, 189.515, 189.517, 189.520, 189.530, 189.860, 189.930, 189.993.

Chapter 189.A, which covers *Driving Under the Influence*, may take on diminishing importance in the context of AVs. But there are still regulatory questions that policymakers will have to grapple with. For example, how should the law treat an intoxicated occupant who owns but is not in control of a vehicle? Or, if an individual is not in control of a vehicle and is never required to assume control due to automation, is this statute relevant for AVs? This raises some of the same questions as other penalties related to motor vehicle traffic violations.

Chapter 190

Chapter 190 discusses motor vehicle sales, and these sections would continue to apply to owners and sellers of AVs, unless there are specific changes mandated. We have omitted sections related to vehicle financing and tampering with odometers because we assume that AVs could be bought and sold in a manner comparable to conventional motor vehicles, and that AVs would have to comply with laws governing equipment such as odometers. There do not appear to be any issues that would impede the manufacture or sale of AVs. The next section includes all potentially relevant statutes, while Table 14 summarizes key features of Chapter 190.

190.010 Definitions for chapter.

As used in this chapter:

(1) “Manufacturer” means any person, partnership, firm, association, corporation, or trust, resident or nonresident, who manufactures or assembles new motor vehicles, or imports for distribution through distributors of new motor vehicles, or any partnership, firm, association, joint venture, corporation, or trust, resident or nonresident, which is controlled by the manufacturer. Additionally, the term “manufacturer” shall include the following terms:

- (a) “Distributor” which means any person, firm, association, corporation, or trust, resident or nonresident, who in whole or in part offers for sale, sells, or distributes any new motor vehicle to new motor vehicle dealers, or who maintains factory representatives, or who controls any person, firm, association, corporation, or trust, resident or nonresident, who in whole or in part offers for sale, sells, or distributes any new motor vehicle to new motor vehicle dealers;
 - (b) “Factory branch” which means a branch office maintained by a manufacturer for the purpose of selling, or offering for sale, new motor vehicles to a distributor, wholesaler, or new motor vehicle dealer, or for directing or supervising, in whole or in part, factory or distributor representatives, and shall further include any sales promotion organization, whether the same be a person, firm, or corporation, which is engaged in promoting the sale of new motor vehicles in this state of a particular brand or make to new motor vehicle dealers;
 - (c) “Factory representative” which means a representative employed by a manufacturer, distributor, or factory branch for the purpose of making or promoting for the sale of his, its, or their new motor vehicles, or for supervising or contracting with his, its, or their dealers, or prospective dealers;
 - (d) “Distributor branch” which means a branch office similarly maintained by a distributor or wholesaler for the same purposes; and
 - (e) “Distributor representative” which means a representative similarly employed by a distributor, distributor branch, or wholesaler;
- (2) “Motor vehicle dealer” means any person not excluded by subsection (3) of this section, engaged in the business of selling, offering to sell, soliciting, or advertising the same, of new or used motor vehicles, or possessing motor vehicles for the purpose of resale, either on his own account, or on behalf of another, either as his primary business or incidental thereto;
- (3) The term “motor vehicle dealer” shall not include:
- (a) Receivers, trustees, administrators, executors, guardians, or other persons appointed by or acting under the judgment or order of any court, and any bank, trust company, or lending institution that is subject to state or federal regulation, with regard to its disposition of repossessed motor vehicles;
 - (b) Public officers while performing their official duties; or
 - (c) Employees of persons enumerated in paragraphs (a) and (b) of this subsection, when engaged in the specific performance of their duties as employees;
- (4) “New motor vehicle dealer” means a vehicle dealer who holds a valid sales and service agreement, franchise, or contract, granted by the manufacturer, distributor, or wholesaler for the sale of the manufacturer's new motor vehicles;
- (5) “New motor vehicle dealership facility” means an established place of business which is being used or will be used primarily for the purpose of selling, buying, displaying, repairing, and servicing motor vehicles;
- (6) “Used motor vehicle dealer” means any person engaged in the business of selling at retail, displaying, offering for sale, or dealing in used motor vehicles, but shall not mean any person engaged in the business of dismantling, salvaging, or rebuilding motor vehicles by means of using used parts, or any public officer performing his official duties;
- (7) “Motor vehicle leasing dealer” means any person engaged in the business of regularly making available, offering to make available, or arranging for another person to use a motor vehicle pursuant to a bailment, lease, or other contractual arrangement under which a charge is made for

its use at a periodic rate for at least a monthly term, and title to the motor vehicle is in a person other than the user, but shall not mean a manufacturer or its affiliate leasing to its employees or to dealers;

(8) “Restricted motor vehicle dealer” means a motor vehicle dealer who exclusively sells, offers to sell, solicits, or advertises specialized motor vehicles including, but not limited to, funeral coaches, emergency vehicles, and an automotive recycling dealer engaged in the business of dismantling, salvaging, or recycling salvage motor vehicles for the purpose of harvesting used parts, components, assemblies, and recyclable materials for resale, reuse, or reclamation;

(9) “Motorcycle dealer” means a motor vehicle dealer who exclusively sells, offers to sell, solicits, or advertises motorcycles, including alternative-speed motorcycles as defined in KRS 186.010. Motorcycles shall not include mopeds as defined in this section;

(10) “Motor vehicle salesperson” means any person who is employed as a salesperson by a motor vehicle dealer to sell motor vehicles, or who is employed as an auctioneer by a motor vehicle auction dealer to sell motor vehicles at auction;

(11) “Motor vehicle auction dealer” means any person primarily engaged in the business of offering, negotiating, or attempting to negotiate a sale, purchase, or exchange of a motor vehicle through auction;

(12) “Motor vehicle” means every vehicle intended primarily for use and operation on the public highways that is self-propelled including low-speed motor vehicles as defined in KRS 186.010, but shall not include any recreational vehicle or farm tractors and other machines and tools used in the production, harvesting, and care of farm products;

(13) “New motor vehicle” means a vehicle that is in the possession of the manufacturer, distributor, or wholesaler, or has been sold to the holders of a valid sales and service agreement, franchise, or contract, granted by the manufacturer, distributor, or wholesaler for the sale of the make of new vehicle, which is new, and on which the original title has not been issued from the franchised dealer;

(14) “Moped” means a motorized bicycle with pedals whose frame design may include one (1) or more horizontal crossbars supporting a fuel tank, or a motorized bicycle with pedals and with a step through type frame rated no more than two (2) brake horsepower, a cylinder capacity not exceeding fifty (50) cubic centimeters, an automatic transmission not requiring clutching or shifting by the operator after the drive system is engaged, and capable of a maximum speed of not more than thirty (30) miles per hour;

(15) “Commission” means the Motor Vehicle Commission;

(16) “Commissioner” means the commissioner of the department;

(17) “Department” means the Department of Vehicle Regulation;

(18) “Licensor” means the commission;

(19) “Established place of business” means a permanent, enclosed commercial building located within this state, easily accessible and open to the public at all reasonable times, and at which the business of a vehicle dealer, including the display and repair of vehicles, may be lawfully carried on in accordance with the terms of all applicable building codes, zoning, and other land use regulatory ordinances;

(20) “Person” means a person, partnership, firm, corporation, association, trust, estate, or other legal entity;

(21) “Franchise” means the agreement or contract between any new motor vehicle manufacturer, written or otherwise, and any new motor vehicle dealer that purports to fix the legal rights and

liabilities of the parties to an agreement or contract, and pursuant to which the dealer purchases and resells the franchise product;

(22) “Good faith” means honesty in fact, and the observance of reasonable commercial standards of fair dealing in the trade, as is defined and interpreted in KRS 355.2- 103(1)(b);

(23) “Designated family member” means the spouse, child, grandchild, parent, brother, or sister of a dealer who, in the case of a deceased dealer, is entitled to inherit the dealer's ownership interest in the dealership under the terms of the dealer's will; or who has otherwise been designated in writing by a deceased dealer to succeed him in the motor vehicle dealership; or who, under the laws of interstate succession of this state is entitled to inherit the interest; or who, in the case of an incapacitated dealer, has been appointed by a court as the legal representative of the dealer's property. The term includes the appointed and qualified personal representative and testamentary trustee of a deceased dealer;

(24) “Fraud” means a misrepresentation in any manner, whether intentionally false or due to gross negligence, of a material fact; a promise or representation not made in good faith; or an intentional failure to disclose material fact;

(25) “Sale” means the issuance, transfer, agreement for transfer, exchange, lease, pledge, hypothecation, mortgage in any form, whether by transfer in trust or otherwise, of any motor vehicle or interest in it, or of any franchise related to it, as well as any option, subscription, other contract, or solicitation looking to a sale, offer to attempt to sell in any form, whether spoken or written. A gift or delivery of any motor vehicle or franchise with respect thereto, with or as a bonus on account of the sale of anything, shall be deemed a sale of the motor vehicle or franchise;

(26) “Automotive mobility dealer” means any motor vehicle dealer who:

(a) Exclusively engages in the business of selling, offering to sell, or soliciting or advertising the sale of adapted vehicles;

(b) Possesses adapted vehicles exclusively for the purpose of resale, either on his or her own account or on behalf of another, as his or her primary business or incidental thereto; or

(c) Engages in the business of selling, installing, or servicing; offering to sell, install, or service; or soliciting or advertising the sale, installation, or servicing of equipment or modifications specifically designed to facilitate use or operation of a motor vehicle by an aging or disabled person;

(27) “Adapted vehicle” means a new or used motor vehicle especially designed or modified for use by an aging or disabled person;

(28) “Mobility equipment” means equipment specifically designed to facilitate the use of a motor vehicle by an aging or disabled person;

(29) “Nonprofit motor vehicle dealer” means a nonprofit organization exempt from taxation under Section 501(c)(3) of the Internal Revenue Code that purchases motor vehicles that it may offer for purchase to clients and other individuals who meet the definition of client as defined in this section and who are referred to the organization by public or private social service agencies;

(30) “Client” means a person who has an open case file with a nonprofit organization or governmental agency and who meets the standards for disability or disadvantaging condition as established in administrative regulations promulgated by the commission pursuant to KRS 190.032(4);

(31) “Recreational vehicle” means a vehicle that:

(a) Is primarily designed as temporary living quarters for noncommercial recreation or camping use;

- (b) Has its own motive power or is towed by another vehicle;
 - (c) Is regulated by the National Highway Traffic Safety Administration as a vehicle; and
 - (d) Does not require a special highway use permit; and
- (32) “New recreational vehicle dealer” means a new recreational vehicle dealer as defined in KRS 190A.010.

Table 14: KRS Chapter 190

Statute	Summary
190.015 Public policy declared.	<ul style="list-style-type: none"> • Because the sale of vehicles affects the economy and welfare of KY, the state has regulatory authority in this area
190.030 License requirement — Application for license — Time within which license to be granted or refused — Fees — Licenses to be displayed — Temporary sale or display — Bond — Reports by motor vehicle dealer and new recreational dealer.	<ul style="list-style-type: none"> • Motor vehicle dealers required to have a license
190.031 Automotive mobility dealers — License and regulation requirements.	<ul style="list-style-type: none"> • Automotive mobility dealers required to be licensed and regulated
190.032 Nonprofit motor vehicle dealers — License and regulation requirements.	<ul style="list-style-type: none"> • Nonprofits that sell motor vehicles must have a license
190.033 Insurance or bond required of licensees — Exemption.	<ul style="list-style-type: none"> • Motor vehicle dealers must have insurance or bond in the amount(s) specified in statute
190.035 Established place of business and sufficient space required for licensure by commission as motor vehicle dealer or new recreational vehicle dealer — Exemption.	<ul style="list-style-type: none"> • Motor vehicle dealers must establish a place of business in order to obtain a license
190.037 Temporary permits.	<ul style="list-style-type: none"> • If a license application is made, a temporary permit may be granted for no longer than 90 days
190.038 Manufacturer to provide information on service or repairs of its motor vehicles.	<ul style="list-style-type: none"> • Motor vehicle manufacturers must provide manuals or documentation needed to repair a vehicle
190.040 Grounds for denial, suspension, or revocation of license — Notice of denial of application for license — Hearings — Inspection of licensee's records — Appeals from order of commission.	<ul style="list-style-type: none"> • Describes reasons for license denial, suspension, or revocation
190.045 Cancellation, termination, refusal to renew franchise — Notice — Duty of manufacturer.	<ul style="list-style-type: none"> • Requirements for a manufacturer to cancel a franchise
190.0451 New motor vehicle dealer license — Prohibition against licensing new dealer after prior dealer's franchise has been revoked	<ul style="list-style-type: none"> • Prohibition rules against a new franchise if prior franchise has been revoked

— Exceptions — Ten year duration of prohibition.	
190.046 Compensation to dealer for work performed under warranty — “Reasonable compensation” — Submission, determination, and payment of dealer's claims — Compensation to dealer for sponsored sales or service promotion events — Audits — Fraud.	<ul style="list-style-type: none"> • Motor vehicle manufacturers responsible for warranty work
190.0461 Recall of vehicle — Duty of manufacturer or distributor.	<ul style="list-style-type: none"> • Manufacturers must notify motor vehicle owners and dealers of an expected recall date
190.0462 Manufacturer's schedule of compensation to be paid to dealers for warranty service and repairs.	<ul style="list-style-type: none"> • Compensation schedule for dealer warranty work required of manufacturers with license application
190.047 Transfer of motor vehicle sales franchise — Proposal to establish additional dealership or to relocate existing dealership.	<ul style="list-style-type: none"> • Manufacturer must approve the sale of a franchise • Sets criteria for moving or establishing additional dealerships
190.0491 “Delivery” defined — Dealer's duties concerning vehicle damaged in transit — Reversion of ownership — Certification to consumer — Failure of manufacturer to indemnify dealer.	<ul style="list-style-type: none"> • Defines delivery of a motor vehicle • Stipulates dealer requirements if vehicle damaged in transit and disclosure to consumer • Manufacturer must indemnify dealer against judgement due to damages
190.053 Citation of suspected violators	<ul style="list-style-type: none"> • Process for potential violations of licensed dealers
190.058 Motor Vehicle Commission — Membership — Powers — Duties.	<ul style="list-style-type: none"> • Motor Vehicle Commission overview; related to dealers and manufacturers
190.059 Appeal from final order of commission.	<ul style="list-style-type: none"> • Denial, suspension, or revocation of dealer license can be appealed
190.062 Action for damages — Power of commission — Applicability of chapter and KRS Chapter 190A — Written demand for mediation required before civil action involving recreational vehicle franchise issues may be brought.	<ul style="list-style-type: none"> • Recourse for injury in business • Grants commission power to deny, suspend, or revoke licenses for not complying with statute • Demand for mediation required before civil action
190.063 Records, public — Continuation of licenses.	<ul style="list-style-type: none"> • Commission records are in the public domain
190.067 Department of Vehicle Regulation's authority to perform commission's duties upon failure or inability to perform.	<ul style="list-style-type: none"> • If the Commission fails to perform its duties the Department of Vehicle Regulation may assume those duties
190.070 Prohibited practices on the part of a manufacturer, distributor, factory branch, or factory representative.	<ul style="list-style-type: none"> • List of prohibited practices for manufacturers

190.071 Prohibited practices on part of new motor vehicle dealer.	<ul style="list-style-type: none"> List of prohibited practices for new motor vehicle dealers
190.073 Regulations.	<ul style="list-style-type: none"> Holds that Commission can develop regulations for carrying out the provisions in this chapter
190.075 Restraint of violations.	<ul style="list-style-type: none"> Courts can order individuals not to violate provision of this chapter or regulations of the commission
190.080 Previous consumer-owner information provided upon request.	<ul style="list-style-type: none"> Information regarding the last owner of vehicle can be provided

The study did not identify significant hurdles that would prevent the operation of AVs in Kentucky — aside from potential questions related to defining the *operator* of an AV and language such as *person shall not operate* (in reference to a motor vehicle). Policymakers have the option to change the licensing and registration requirements for AVs, but it does not appear this would be necessary. Because AV technology has the potential to affect motor carriers, it may be necessary to examine motor carriers and the licensing of commercial drivers as well. These are covered in Chapters 281 *Motor Carriers* and 281A *Commercial Drivers Licenses*, which can be found in Title XXIV-*Public Utility*.

4.2 Kentucky Administrative Regulations

The Kentucky Administrative Regulations (KAR)⁴² was searched for information potentially relevant to AVs. A keyword search for *motor vehicle* returned 189 hits; *automobile* yielded 58 hits; and *driver* produced 193 hits. Researchers examined these results along with the KAR title page⁴³, and concluded that the most relevant areas are Titles 500 and 502, which focus on the Justice and Public Safety Cabinet and State Police, and Titles 601, 603, and 605, which deal with the Transportation Cabinet and departments such as Vehicle Regulation. For the full text of each of the titles and chapters, see <http://www.lrc.ky.gov/kar/TITLE502.HTM>.

Title 500

Some portions of the KAR which are related to motor carriers may be relevant if AV technology affects the industry. Title 500- *Justice and Public Safety Cabinet*, Chapter 14 *Kentucky Vehicle Enforcement* attends to safety requirements and penalties for violations.

Title 502

Title 502 *Justice and Public Safety Cabinet's* Chapter 10 on *Driver Training* addresses driver training schools and their instructors. Key areas of the chapter regulate driver instructor's licensing, facilities, and other operational aspects of driver training. Definitions from the chapter are listed in the following sections.

502 KAR 10:010. Definitions.

RELATES TO: KRS 332.010

STATUTORY AUTHORITY: KRS 15A.160, 332.100

⁴² <http://www.lrc.ky.gov/kar/frntpage.htm>

⁴³ <http://www.lrc.ky.gov/kar/titles.htm>

NECESSITY, FUNCTION, AND CONFORMITY: KRS 15A.160 and 332.100 provide that the Secretary of the Justice Cabinet in cooperation with the Commissioner, Department of State Police, may adopt such administrative regulations necessary to carry out the provisions of KRS Chapter 332. This administrative regulation establishes the definitions to be utilized in the driver training schools and instructors administrative regulations.

Section 1. As employed in the driver training and instructors administrative regulations, unless the context requires otherwise the following words and phrases have the following meanings:

- (1) “Commissioner” means the Commissioner, Department of State Police.
- (2) “Driver training instructor” means any person who gives driver training or offers a course of driver training for which a fee or tuition is charged.
- (3) “Place of business” means a designated location at which the business of the driver training school is being conducted.
- (4) “Branch office” means an approved location where the business of the driver's school is conducted, other than the principal place of business.
- (5) “High school education or the equivalent in experience” means any high school diploma or the ability to pass a General Educational Development Test. (PSfty-DTS-1; 1 Ky.R. 1031; eff. 6-11-75; Am. 12 Ky.R. 1619; eff. 5-6-86.)

Also in Title 502, Chapter 15 *General Traffic*, includes accident reports and processes for dealing with abandoned vehicles. In terms of AVs, there appear to be no issues here, rather it may be desirable to establish training schools for AVs or potentially amend accident reports to indicate an AV was involved.

Title 601

Title 601- *Transportation Cabinet- Department of Vehicle Regulation* contains several potentially relevant chapters. Section 020 of Chapter 2 (*Administration*) governs driver privacy protection and defines what constitutes personal information, specifying how it can be used.

This section may be applicable to commercial vehicles and AVs — if they collect and transmit data that can be used by government. Given the restrictions currently enumerated, there have not been any issues identified that are related to the use of AVs. However, as data collection increases, it is possible that policymakers will want to revisit and redefine these regulations. Ignition interlock devices are also a topic of Chapter 2, which raises similar enforcement questions as some sections of KRS which do not consider the prospect of automation. For example, would ignition interlock devices even be necessary on AVs?

Chapter 9, *Motor Vehicle Tax*, addresses tax and registration issues. Table 15 summarizes portions that are potentially relevant to AVs.

Table 15: KAR Title 601, Chapter 9

Section	Summary
015. Registration of motor vehicle dealers and manufacturers	<ul style="list-style-type: none"> • Outlines county clerk steps for registration • Establishes license revocation procedures
040. Reciprocity and motor vehicle identification cards	<ul style="list-style-type: none"> • Governs documents and fees required for reciprocity and identification documents

080. Assigned or replacement vehicle identification number	<ul style="list-style-type: none"> • Procedure for acquiring a vehicle identification number if it is missing or not assigned
085. Procedures for becoming a certified vehicle inspector	<ul style="list-style-type: none"> • Requirements and steps to become certified
090. Procedures for inspecting vehicles	<ul style="list-style-type: none"> • Specifies inspection procedures for vehicles brought into KY
130. Motor vehicle registration	<ul style="list-style-type: none"> • Audits and issuance of specialty plates
140. Temporary registration plates	<ul style="list-style-type: none"> • Process for acquiring a temporary registration plate
160. Surrender or reactivation of vehicle title	<ul style="list-style-type: none"> • Procedure for transferring motor vehicle if transferee does not submit documentation • Procedure to reactivate mistakenly surrendered title
200. Registration and titling of rebuilt motor vehicles	<ul style="list-style-type: none"> • Procedures for issuing title and brand if a vehicle has been rebuilt
210. Continuation of title liens	<ul style="list-style-type: none"> • Procedure for continuing a security interest notation on a title
220. Motor vehicle dealer plates	<ul style="list-style-type: none"> • Criteria for issuing and using a motor vehicle dealer plate

Unless policymakers are inclined to tax AVs differently than conventional motor vehicles, or change the approach to reciprocity and inspections, this chapter would appear unproblematic for AVs.

Chapter 12, *Driver’s License*, addresses retesting requirements for expired, transferred or suspended licenses; includes a fee schedule for driver’s licenses; and describes procedures for applying for a hardship driver’s license. Chapter 13, *Driver Improvement*, raises enforcement questions on topics such as assessing penalty points for various traffic offenses. Section 070 outlines the requirements for a minor applying for a driver’s license. The chapter also defines what constitutes a motor vehicle accident prevention course in section 040 and driver education programs, including instructor requirements and types of programs such as state traffic school and high school driver’s education, in Section 110. Both of these may be unnecessary for drivers operating AVs. Sections 090 and 100 cover the Medical Review Board and criteria for reviews and provide definitions and information on the physical and mental conditions that may make it unsafe for the individual to operate a motor vehicle. As in KRS, chapters related to motor carriers are noted, but not examined in detail. In Title 601, Chapter 1 *Motor Carriers* and Chapter 11 *Commercial Driver’s License* are chapters

Title 603

Title 603 *Transportation Cabinet - Department of Highways* mostly deals with construction and maintenance of roads. Section 050 of Chapter 5, *Traffic*, states that the Manual on Uniform Traffic Control Devices for Streets and highways (MUTCD) is the standard for traffic control devices in Kentucky. Section 070, which pertains to motor vehicle dimension limits, allows KYTC’s Secretary to establish size limits for motor vehicles which use the state roadway system. As with

our discussion of the KRS, we assume that AV manufacturers would comply with relevant statutes and regulations related to equipment. Section 090, *Truck Spacing on Bridges*, sets the minimum space for trucks on bridges at 30 feet. This is salient given that truck platooning is an area in which automation technologies will play an increasingly prominent role.

Title 605

Title 605, *Transportation Cabinet- Department of Vehicle Regulation - Motor Vehicle Commission*, specifies the functions and powers of the Motor Vehicle Commission. This is the only chapter under Title 605. Table 16 summarizes potentially relevant sections.

Table 16: KAR Title 605, Chapter 1

Section	Summary
020. Motor vehicle auction dealer title transfer requirements	<ul style="list-style-type: none"> • Motor vehicle auction dealer requirements concerning titles
030. Applications	<ul style="list-style-type: none"> • Allows the Motor Vehicle Commission to provide procedure for application and issuance of motor vehicle dealer licenses
031. Automotive mobility dealer requirements and licensing	<ul style="list-style-type: none"> • Requirements for application and renewal of automotive mobility dealer
050. Dealer and salesman	<ul style="list-style-type: none"> • Relationship between dealer and salesman established • Recordkeeping
070. Change of ownership	<ul style="list-style-type: none"> • Requirements for changing ownership of dealer licenses
130. Procedures	<ul style="list-style-type: none"> • List of Motor Vehicle Commission procedures and practice
160. Motor vehicle component manufacturers	<ul style="list-style-type: none"> • Motor vehicle component manufacturers license qualification
190. Motor vehicle advertising	<ul style="list-style-type: none"> • Defines what constitutes misleading motor vehicle advertising
210. Nonprofit motor vehicle dealer requirements and licensing	<ul style="list-style-type: none"> • Requirements and standards for nonprofit motor vehicle dealers including licensing

Nothing in Title 605 poses barrier to AVs. All of the sections cited relate to how the Motor Vehicle Commission operates, which may assist with regulating AVs. Sections in Title 605 that will likely apply to AVs include those on motor vehicle dealers, advertising, and licensing. These should not require significant modifications, however, policymakers can revise them if more targeted language focused on AVs proves necessary.

Chapter Five: Conclusion

CAVs have the potential to increase the safety of vehicle travel, reduce congestion and emissions, and make transportation more efficient. Despite their promise, policymakers will have to look at a number of drawbacks CAV technology brings, including an increase in VMTs, job loss in the transportation industry, and costs that may initially be too high for many consumers. CVs have a wide range of applications but there are privacy concerns over the collection and use of data as well as costs governments will have to bear as they build V2I-ready infrastructure. States have several options to prepare for the adoption of these technologies, including planning, monitoring, testing, preparing legislation/regulations, developing data standards, establishing partnerships with manufacturers, and educating the public.

Recent policies and guidance issued at the federal level, along with proposed or enacted legislations at the state level, raise key points of consideration. The USDOT's *Federal Automated Vehicles Policy*⁴⁴ contains information on AV performance, state policy, and current and potential new regulatory tools the federal government has at its disposal to ensure the safe operation of AVs. As noted in the guidance, states will retain responsibility for licensing drivers, registering vehicles, overseeing traffic laws, and regulating insurance requirements. The USDOT encourages states to develop clear regulations focused on testing, liability, AV identification via registration protocols, and crash procedures. Currently, eight states have passed legislation related to AVs — Nevada, California, Louisiana, Florida, Michigan, Utah, Tennessee, and North Dakota, although many others have proposed legislation in recent years. Many of the enacted or proposed bills define what constitutes AVs and autonomous technology, licensing requirements, manufacturer liability, and insurance requirements. Some states have tackled questions related to licensing, safety, and insurance. Other legislation has assigned responsibilities to develop registration and/or certification processes for AVs.

Reviewing Kentucky's KRS and KAR statutes and regulations, it is apparent there are areas in which future changes may be needed related to licensing, registration, cell phone usage (for AVs) and traffic enforcement. One KRS-related issue policymakers will need to address are the many passages that refer a person operating a vehicle — fully automated vehicles would lack input from human drivers. Defining *operator* in the context of AVs may help avoid potential conflicts.

The number of research possibilities in the area of CAVs is seemingly inexhaustible. Wagner et al. (2014, p. 41) identify the following research topics:

- The effects of automated vehicles on traveling patterns and congestion are unclear. Additional research and better information are needed to help plan future infrastructure investments.
- Better information is needed to develop economic models focused on adoption rates, technology development timelines, and cost.
- Better models are needed to understand the potential unintended consequences of adopting CAVs, such as their effects on urban development (e.g., promoting suburban development), effects on commuting patterns, and implications for urban planning models and forecasts.

⁴⁴ <https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016>

- AV liability is a concern for manufacturers, and could slow development and implementation.
- As vehicles become more connected, data security and privacy will become a growing concern for public transportation agencies, especially if they have some level of responsibility for ensuring data security or handling data transmissions that occur as part of connected vehicle applications.
- Future research could develop strategies to help DOTs understand the issues related to managing and operating a mixed vehicle environment of connected, automated, and non-connected or automated vehicles.
- Questions remain about the value of using managed or controlled lanes during the early deployment of CAVs. Research could explore the efficacy and operational challenges of such a system.
- Several states are currently grappling with the certification of automated test vehicles. Developing robust certification techniques may demand future research.

Anderson et al. (2014, p. 146-148) also list some policy research needs for AVs.

- Develop more precise estimates of the costs and benefits of AV technologies and determine whether they are shouldered by vehicle operators or the public more broadly.
- Develop better estimates of the distributional consequences of AV technology.
- Identify lessons learned from the introduction of other vehicle technologies that can prepare NHTSA and EPA for this transition.
- Determine what capabilities, enabled by both human capital and statutory authority, NHTSA and EPA require to effectively serve the public interest and facilitate technology development in a rapidly evolving field.
- Understand how future fuel economy standards account for AV technology and identify methods to estimate private and social costs.
- Further develop model legislation concerning AVs to avoid the “50-state patchwork” of laws, which has been described by OEMs and other stakeholders as a serious concern for developing and deploying AVs.
- Analyze the advantages and disadvantages of explicit or implicit regulatory preemption (requiring manufacturers to incorporate the most-promising forms of AV technology by regulatory mandate but simultaneously exempting the manufacturers from state court liability).
- Analyze existing state distracted driving laws to determine whether they should be amended to accommodate AVs.
- Investigate the potential impact of AVs on travel modes and the potential effects these changes will have on planners at all levels, especially state and federal DOTs.
- Identify, define, and examine existing models for transportation data management and potential data needs for AVs. For each model, explore whether the model provides insight into how automated road vehicle data might be handled. Potential issues to explore include what parties may access personal location information, personally identifiable information, and vehicle operations, and how they can and cannot use these data. The latter issue should focus on data access, sharing, and security. The research should then address how these issues would be resolved in the context of different stakeholders (e.g., vehicle manufacturers, data aggregators, government regulators, law enforcement, insurance,

vehicle owners and users). The research should highlight best practices and recommend how those might apply to regulations for AVs.

As CAV technologies continue to develop and proliferate on roads across the U.S., additional research and implementation needs will continue to emerge. By continuing to engage with manufacturers, researchers, federal agencies, local governments, and state legislatures, DOTs will acquire the tools and information necessary to facilitate the safe operation of CAVs.

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Appendix

Draft Language for a State Bill (Smith 2014)0

1. Background.

1.1. Legislative intent. It is the intent of the Legislature to facilitate the development and deployment of automated vehicles in a way that improves highway safety.

1.2. Conventional operation. Nothing in this Act is intended or shall be construed to change existing statutory law as applied to vehicles neither under nor transitioning from automated operation.

1.3. Vehicle owners. Nothing in this Act is intended or shall be construed to abridge the existing statutory civil liability of any vehicle owner.

1.4. Geneva Convention. The Legislature hereby finds that automated operation of vehicles under the conditions prescribed herein is consistent with article 8 of the Convention on Road Traffic because (1) such operation has the potential to significantly improve highway safety, one of the objects of the Convention; (2) this State shall make such operation reasonably knowable to the foreign visitors contemplated by the Convention; (3) the Convention implicitly permits indirect control over vehicles and animals; (4) there shall remain a licensed driver of each vehicle who shall be able to specify or accept the parameters of operation; and (5) these parameters shall be consistent with the traffic laws of this State.

2. Agency implementation.

2.1. The Department shall by rule (1) define certain automation profiles and (2) establish general safety requirements for vehicles in each such profile.

2.2. The Department shall by rule (1) define certain test vehicle profiles and (2) establish general safety requirements for vehicles in each such profile.

2.3. The Department shall by rule establish requirements for automation-only licenses and virtual licenses.

2.4. The Department may by rule establish standards for the collection, transmission, retention, disclosure, use, or ownership of data generated by or for motor vehicles.

2.5. The Department shall make and maintain all other rules necessary to fully implement this Act, except that the Department may in its sole discretion decide to act through informal adjudication rather than through informal rulemaking.

2.6. The Department shall implement this Act in accordance with (1) all standards enacted by the National Highway Traffic Safety Administration and, to the extent that the

Department in its sole discretion deems practicable, (2) relevant guidelines enacted by the National Highway Traffic Safety Administration, (3) relevant standards adopted by SAE International or the International Organization for Standardization, and (4) relevant regulations adopted by the Department of Motor Vehicles of the State of California.

2.7. The Department shall implement this Act in consultation with [the State Highway Patrol] and [the Department of Transportation], but the failure to consult shall not provide a basis for judicial invalidation of an otherwise lawful rule.

2.8. The Department may recommend additional statutory changes to the Legislature.

3. Definitions.

3.1. Automated operation means computer direction of a vehicle's steering, braking, and accelerating without real-time human input.

3.2. Automated vehicle means a motor vehicle capable of automated operation.

3.3. Automation package means the combination of hardware and software necessary for automated operation.

3.4. Automation period means the moment that automated operation begins until the moment that a natural person (1) provides real-time input other than to mitigate an imminent risk, (2) turns off the vehicle, or (3) otherwise acts as specified by rule of the Department.

3.5. Automation profile means a set of technical conditions for and characteristics of automated operation.

3.6. Department means the [Department of Motor Vehicles].

3.7. Drive and operate each mean [as provided in the vehicle code and case law], except that the effective driver exclusively drives and operates an automated vehicle during an automation period.

3.8. Driver and operator each mean [as provided in the vehicle code and case law], except that the effective driver is the exclusive driver and operator of an automated vehicle during an automation period.

3.9. Effective driver means:

3.9.1. If automated operation is initiated to mitigate an imminent risk, the natural person operating the vehicle immediately prior to such initiation;

3.9.2. Else the vehicle's virtual driver;

3.9.3. Else the natural person who actually or, by rule of the Department, presumptively initiates automated operation;

3.9.4. Else the vehicle's owner;

3.9.5. Additionally any person who in willful or wanton disregard for the safety of persons or property activates, permits, or tampers with automated operation.

3.10. Manufacturer means any person engaged in the business of constructing or assembling vehicles of a type required to be registered under [this title].

3.11. Test vehicle means a vehicle registered as a platform for research, development, or demonstration of automated operation or, by rule of the Department, other safety-critical vehicle systems.

3.12. Test vehicle profile means a set of technical conditions for and characteristics of test vehicle operation.

3.13. Virtual driver means, with respect to an automated vehicle, any person holding a virtual license covering that vehicle for the pertinent part of its automation profile.

4. Vehicle registration.

4.1. When registering or renewing the registration of any motor vehicle, the Department shall ascertain and record that vehicle's (1) automation profile and (2) virtual driver, if any.

4.2. Any modification to a motor vehicle or its equipment that alters its automation package shall invalidate its registration, unless such alteration is (1) required by law, (2) by or on behalf of the vehicle's manufacturer, (3) to a test vehicle in accordance with its registration, or (4) otherwise permitted by rule of the Department.

4.3. The Department may decline to register or, with reasonable notice to the owner and the virtual license holder, suspend, revoke, or decline to renew the registration of any motor vehicle that it determines to be unsafe, improperly equipped, or otherwise unfit to be operated on a highway.

4.4. In making a determination regarding the registration of any motor vehicle, the Department may by rule or practice treat as conclusive a decision by the responsible agency of another state to permit or restrict the registration, sale, operation, or testing of the relevant make, model, kind, or category of motor vehicle or equipment.

4.5. The registration of a motor vehicle shall create no presumption as to the safety of that vehicle or its equipment.

5. Driver licensing.

5.1. Automation-only license.

5.1.1. Any natural person of legal driving age who solely by reason of physical disability is ineligible for a [regular noncommercial] driving license shall be eligible for an automation-only license.

5.1.2. Each automation-only license shall specify conditions of operation, including particular automation profiles to which it is restricted.

5.1.3. Any person who holds a valid automation-only license may operate an automated vehicle in accordance with those conditions of operation.

5.2. Virtual license.

5.2.1. Any person, natural or otherwise, who meets requirements established by the Department shall be eligible for a virtual license.

5.2.2. Each virtual license shall cover a specific kind of automated vehicle for all or part of its automation profile.

5.2.3. The Department may require that the holder of a virtual license be the manufacturer or insurer of the vehicles covered by that license.

5.2.4. Any statutory requirements for a driving license that in the Department's determination reasonably pertain only to a natural person shall not apply to an applicant for a virtual license who is not a natural person.

5.2.5. The Department may, with reasonable notice to the license holder and owner of any covered vehicle, suspend, revoke, or restrict a virtual license.

6. Equipment.

6.1. General. [This title's] vehicle and equipment provisions shall be interpreted to facilitate the development and deployment of automated vehicles in a way that improves highway safety.

6.2. Standards. Any vehicle sold, registered, modified for sale, or operated on any highway in this State shall comply with (1) all applicable standards enacted by the National Highway Traffic Safety Administration and (2) all applicable standards enacted by the Department.

6.3. [Automated vehicles.]

7. Rules of the road.

7.1. General. [This title's] rules of the road shall be interpreted to facilitate the development and deployment of automated vehicles in a way that improves highway safety.

7.2. Qualitative standards. No rule shall be interpreted to impose a greater obligation on drivers of automated vehicles than on drivers of vehicles that are not automated, unless the Department by rule specifies otherwise.

7.3. Virtual drivers. Any language in [this title] that [the Department] by rule determines cannot reasonably refer to a virtual driver shall instead refer to a different person or to no person at all, in each case as specified in such rule.

7.4. Unattended vehicles. A vehicle that is under automated operation by a virtual driver shall not be deemed unattended unless it is not lawfully registered, poses a risk to public safety, or unreasonably obstructs other road users.

7.5. Abandoned vehicles. A vehicle that is under automated operation by a virtual driver shall not be deemed abandoned unless it is not lawfully registered, poses a risk to public safety, or unreasonably obstructs other road users.

7.6. Following distance. A platoon that consists of at least one vehicle under automated operation by a virtual driver and that is otherwise lawful and operating lawfully shall not be deemed in violation of following-distance requirements.

7.7. Reckless driving. Any person who in willful or wanton disregard for the safety of persons or property initiates, permits, or tampers with automated operation of a vehicle is guilty of reckless driving.

7.8. Unsafe vehicles. No person shall operate any vehicle that is unsafe, improperly equipped, or otherwise unfit to be operated.

7.9. Vehicular felonies. No person shall be guilty of any felony specified in [this title] without a culpability at least equal to that specified or, if none is specified, [gross negligence].

7.10. Vehicular misdemeanors. No person shall be guilty of any misdemeanor specified in [this title] without a culpability at least equal to that specified or, if none is specified, [negligence].

7.11. Due care in vehicles under automated operation. Notwithstanding other provisions of [this title] or of any local ordinance, every driver or occupant of a vehicle under automated operation shall exercise due care as circumstances require to avoid injury to any other natural person.

NHTSA Policy Update

“DOT/NHTSA POLICY STATEMENT CONCERNING AUTOMATED VEHICLES” 2016 UPDATE to “PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES”

DOT and NHTSA policy is to facilitate and encourage wherever possible the development and deployment of technologies with the potential to save lives. To that end, NHTSA will use all available tools to determine the safety potential of new technologies; to eliminate obstacles that would prevent or delay technology innovations from realizing that safety potential; and to work with industry, governmental partners at all levels, and other stakeholders to develop or encourage new technologies and accelerate their adoption where appropriate.

The rapid development of emerging automation technologies means that partially and fully automated vehicles are nearing the point at which widespread deployment is feasible. Essential to the safe deployment of such vehicles is a rigorous testing regime that provides sufficient data to determine safety performance and help policymakers at all levels make informed decisions about deployment. Industry plays a key role in this process by both conducting such testing and in providing data that establish the safety benefits of automation technologies that exceed the current level of roadway safety. Within six months, NHTSA will propose best-practice guidance to industry on establishing principles of safe operation for fully autonomous vehicles (vehicles at Level 4 on the scale established in NHTSA’s 2013 preliminary policy statement).

DOT/NHTSA will continue to work with the States, with other governmental entities and with industry to help ensure that this testing takes place in a way that protects safety on today’s roads while increasing safety for tomorrow. The agency will work with states to craft and propose model policy guidance that helps policymakers address issues in both the testing and the wider operational deployment of vehicles at advanced stages of automation and offers a nationally consistent approach to autonomous vehicles. For policymakers at all levels, the governing principal should be that technologies with proven, data-supported benefits that would make roads safer should be encouraged. DOT/NHTSA is committing to proposing this model policy within six months.

NHTSA will continue its extensive research program to maintain its broad and deep understanding of new technologies. This knowledge base is essential in the agency’s efforts to determine what new tools might be necessary to ensure advanced technologies achieve their life-saving potential.

NHTSA will continue its efforts, in concert with other entities within and outside DOT, to incentivize the development and adoption of technologies using vehicle-to-vehicle and vehicle-to-infrastructure communications, so that Americans enjoy the full benefits of connected-vehicle safety technology.

NHTSA will fully utilize its currently available regulatory tools, such as interpretations and exemptions, to more rapidly enable safety innovations. The agency encourages manufacturers to, when appropriate, seek use of NHTSA’s existing exemption authority to field test fleets that

can demonstrate the safety benefits of fully autonomous vehicles. However, it is becoming clear that existing NHTSA authority is likely insufficient to meet the needs of the time and reap the full safety benefits of automation technology. Through these processes, NHTSA will determine whether its authorities need to be updated to recognize the challenges autonomous vehicles pose.

This is an area of rapid change, which requires DOT and NHTSA to remain flexible and adaptable as new information and technologies emerge. Amid that rapid change, the North Star for DOT and NHTSA remains safety. All the department's activities in the area of automated and connected vehicles will keep its life-saving mission as their focus.

Model State Policy

1. Administrative

- a. Each State should identify a lead agency responsible for consideration of any testing of HAVs.
- b. Each State should create a jurisdictional automated safety technology committee that is launched by the designated lead agency and which includes representatives from the governor's office, the motor vehicle administration, the State department of transportation, the State law enforcement agency, the State Highway Safety Office, office of information technology, State insurance regulator, the State office(s) representing the aging and disabled communities, toll authorities, and transit authorities.
- c. Other stakeholders should be consulted as appropriate, such as transportation research centers located in the State, the vehicle manufacturing industry, and groups representing pedestrians, bicyclists, consumers and other interested parties.
- d. The designated lead agency should keep its state automated safety technology committee informed of the requests from manufacturers to test in their jurisdiction and the status of the designated agency's response to the manufacturers.
- e. The designated lead agency should take necessary steps to use or establish statutory authority to implement a framework and regulations. Each jurisdiction should examine its laws and regulations in the areas of: (1) licensing/registration; (2) driver education/training; (3) insurance and liability; (4) enforcement of traffic laws/regulations; and (5) administration of motor vehicle inspections, in order to address unnecessary barriers to safe testing, deployment, and operation of HAVs.
- f. Each State should develop an internal process that includes an application for manufacturers to test in the jurisdiction as described in sections 2 and 3 below.
- g. The motor vehicle agency should establish an internal process for issuing test vehicle permits as described in sections 2 and 3 below.
- h. The designated lead agency should review State statutes to identify any legal issues that need to be addressed prior to the deployment and operation of automated vehicles.

2. Application for Manufacturers or Other Entities to Test HAVs on Public Roadways

- a. A "manufacturer" is an individual or company that manufactures HAVs for testing and deployment on public roadways. Manufacturers include original equipment manufacturers (OEMs), multiple- and final-stage manufacturers, alterers (individuals or companies making changes to a complete vehicle prior to first retail sale or deployment), and modifiers (individuals or companies making changes to existing vehicles after first retail sale or deployment).
- b. An "other entity" is any individual or company that is not a manufacturer, and is involved with designing, supplying, testing, selling, operating, deploying, or helping to manufacture HAVs.
- c. Each manufacturer or other entity should submit an application to the designated lead agency in each jurisdiction in which they plan to test their HAVs.

- d. The application should state that each vehicle used for testing by manufacturers or other entities follows the Performance Guidance set forth by NHTSA and meets applicable Federal Motor Vehicle Safety Standards.
- e. The application should include the name of the manufacturer or other entity, the corporate physical and mailing addresses of the manufacturer or other entity, the in-State physical and mailing addresses of manufacturer, if different than corporate address, the name of the program administrator/director and the contact information for the program administrator/director.
- f. The application should identify each vehicle that will be used on roadways for testing purposes by VIN, vehicle type, and other unique identifiers such as the year, make, and model.
- g. The application should identify each test operator, their driver's license number, and the jurisdiction or country in which the operator is licensed.
- h. The application should include the manufacturer's or other entity's safety and compliance plan for testing vehicles, which should include a self-certification of testing and compliance to NHTSA's Vehicle Performance Guidance for the technology in the test vehicles under controlled conditions that simulate the real-world conditions (various weather, types of roads, times of the day and night, etc.) to which the applicant intends to subject the vehicle on public roadways (e.g., a copy of the summary Safety Assessment submitted to NHTSA per the Vehicle Performance Guidance).
- i. The application should include evidence of the manufacturer's or other entity's ability to satisfy a judgment or judgments for damages for personal injury, death, or property damage caused by a vehicle in testing in the form of an instrument of insurance, a surety bond, or proof of self-insurance, for no less than 5 million U.S. dollars.
- j. The application should include a summary of the training provided to the employees, contractors, or other persons designated by the manufacturer or other entity as operators of the test vehicles. Approval should be granted by the designated lead agency if evidence of insurance, operator training, and self-certification is demonstrated.

3. Jurisdictional Permission to Test

- a. Each jurisdiction's lead agency should involve the jurisdictional law enforcement agency before responding to the request from the manufacturer or other entity.
- b. The lead agency may choose to grant authorization to test in a jurisdiction with restrictions, and/or may prohibit manufacturers or other entities from testing in certain areas or locations, such as school zones, construction zones, or other safety-sensitive areas.
- c. The authorization may be suspended if the manufacturer or other entity fails to comply with the State insurance or driver requirements, or fails to comply with its self-certification compliance plan.
- d. The lead agency may request additional information or require the manufacturer or other entity to modify its application before granting authorization.
- e. The lead agency should issue a letter of authorization to the manufacturer or other entity to allow testing in the State, and the State's motor vehicle agency should

issue a permit to each test vehicle. The authorization and permits may be renewed periodically. The jurisdiction may determine that it is appropriate to charge fees for the application and for each vehicle-specific permit.

- f. The vehicle-specific permit must be carried in the test vehicle at all times.
- g. Each test vehicle should be properly registered and titled in accordance with the State's laws.

4. Testing by the Manufacturer or Other Entity

- a. Manufacturers or other entities must comply with Federal law and applicable NHTSA regulations before operating vehicles on public roadways, whether or not they are in testing or in "normal" operation.
- b. The vehicle used in testing must be operated solely by persons designated by the manufacturer or other entity, who have received training and instruction concerning the capabilities and limitations of the vehicle. The training provided to the persons designated by the manufacturer or other entity must be summarized and submitted to the lead agency.
- c. The operators testing the vehicles must hold a valid State driver's license.
- d. Before being allowed to operate a test vehicle, the persons designated by the manufacturer or other entity as operators of the test vehicles, may be subjected to a background check including, but not limited to, a driver history review and a criminal history check.
- e. The test operators are responsible for following all traffic rules and will be responsible for all traffic violations.
- f. All crashes involving test vehicles must be reported in accordance with the State laws in which the crash occurred.

5. Deployed Vehicles: "Drivers"

- a. States regulate human drivers. Licensed drivers are necessary to perform the driving functions for motor vehicles equipped with automated safety technologies that are less than fully automated (SAE Levels 3 and lower). A licensed driver has responsibility to operate the vehicle, monitor the operation, or be immediately available to perform the driving task when requested or the lower level automated system disengages.
- b. Fully automated vehicles are driven entirely by the vehicle itself and require no licensed human driver (SAE levels 4 and 5), at least in certain environments or under certain conditions. The entire driving operation (under specified conditions) is performed by a motor vehicle automated system from origin to destination.
- c. In order to make the transition from human-driven motor vehicles equipped with automated safety technologies to fully automated vehicles, gaps in current regulations should be identified and addressed by the States (with the assistance of NHTSA). Some examples are:
 - Law enforcement/emergency response
 - Occupant safety

- Motor vehicle insurance
- Crash investigations/crash reporting
- Liability (tort, criminal, etc.)
- Motor vehicle safety inspections
- Education and training
- Vehicle modifications and maintenance
- Environmental impacts

6. Deployed Vehicles: Registration and Titling

- a. HAV technologies that allow the vehicle to be operated without a human driver either at all times or under limited circumstances should be identified on title and registration documentation by States, using the code HAV in a new data field.
- b. When HAV technologies that allow the vehicle to be operated without a human driver either at all times or under limited circumstances is installed on a vehicle after the initial purchase of the vehicle, the motor vehicle agency should be notified by the installer. The vehicle registration and title should be marked with the code HAV in a new data field.
- c. Regulations governing labeling and identification for HAVs should be issued by NHTSA.

7. Law Enforcement Considerations

It is important for first responders and law enforcement to understand how HAVs may affect their duties. In addition, there will be a growing need for the training and education of law enforcement regarding their interaction with drivers/operators in both the testing and deployment of these technologies.

For vehicles that offer less than full automation capabilities, there is potential for increased distracted driving. Dangerous activities that contribute to distracted driving such as using an electronic device, eating, drinking, and conversing with passengers could significantly increase in HAVs. Regulations to limit these activities, especially in vehicles providing less than full self-driving capabilities, should be consistent across jurisdictions. The States should work together to develop a consistent regulatory scheme to limit potential driver distraction. In addition, States should develop methodologies for enforcement to discourage hazardous vehicle operation for the safety of the motoring public. Once HAVs are deployed and operated on roadways, State regulations need to keep pace with the changing technology.

Although HAVs are expected to provide significant safety benefits by reducing human errors, motor vehicles currently equipped with automation technologies are already involved in traffic crashes and will continue to be, especially during the years of initial introduction and integration with existing motor vehicles. Responders to crashes of HAVs may be placed at risk if they are not trained for unique hazards that they may encounter. These hazards may include, for example, silent operation, self-initiated or remote ignition, high voltage, and unexpected movement. In the interest of safety, it is essential that first responders—including those in police, fire, emergency medical services, and tow and recovery services—receive information and training regarding the potential hazards they may face.

8. Liability and Insurance

States are responsible for determining liability rules for HAVs. States should consider how to allocate liability among HAV owners, operators, passengers, manufacturers, and others when a crash occurs. For example, if an HAV is determined to be at fault in a crash then who should be held liable? For insurance, States need to determine who (owner, operator, passenger, manufacturer, etc.) must carry motor vehicle insurance.

Determination of who or what is the “driver” of an HAV in a given circumstance does not necessarily determine liability for crashes involving that HAV. For example States may determine that in some circumstances liability for a crash involving a human driver of an HAV should be assigned to the manufacturer of the HAV.

Rules and laws allocating tort liability could have a significant effect on both consumer acceptance of HAVs and their rate of deployment. Such rules also could have a substantial effect on the level and incidence of automobile liability insurance costs in jurisdictions in which HAVs operate.

In the future, the States may identify additional liability issues and seek to develop consistent solutions. It may be desirable to create a commission to study liability and insurance issues and make recommendations to the States.

Arizona Executive Order 2015-09

Self-Driving Vehicle Testing and Piloting in the State of Arizona; Self-Driving Vehicle Oversight Committee

WHEREAS, with the development of new technologies, it is now possible to adapt vehicles with “self-driving technology,” meaning a technology installed on a motor vehicle that provides the motor vehicle with the capability to drive without the direct or active control or monitoring by a human operator;

WHEREAS, it is in Arizona's interest to support the development of these technologies, by allowing testing and operation of self-driving vehicles on certain public roads, in order to continue to advance the technology;

WHEREAS, the State believes that the development of self-driving vehicle technology will promote economic growth, bring new jobs, provide research opportunities for the State's academic institutions and their students and faculty, and allow the State to host the emergence of new technologies;

WHEREAS, the State has the view that the testing and operation of self-driving vehicles could produce transformational social benefits such as the elimination of traffic and congestion, a dramatic increase in pedestrian and passenger safety, the reduction of parking facilities, and the facilitation of movement of residents across the State, and could beneficially contribute to other activities related to the State's transportation; and

WHEREAS, the State has a shared vision that the future of transportation and commerce relies on innovative technologies that could result in more passenger and pedestrian safety, increase mobility options, and foster economic productivity.

NOW, THEREFORE, I, Douglas A. Ducey, Governor of the State of Arizona, by virtue of the authority vested in me by the Constitution and laws of the State of Arizona, hereby order as follows:

(1) The Department of Transportation, Department of Public Safety, and all other agencies of the State of Arizona with pertinent regulatory jurisdiction shall undertake any necessary steps to support the testing and operation of self-driving vehicles on public roads within Arizona.

(2) Pilot programs will be enabled on campuses of selected universities in partnership with entities that are developing technology for self-driving vehicles, whereby an operator with a valid driver's license may direct a vehicle's movement, regardless of whether the operator is physically present in the vehicle or is providing direction remotely while the vehicle is operating in self-driving mode.

(3) Testing and operation of self-driving vehicles in such pilot programs shall abide by the following rules:

- (a) Vehicles may be operated only by an employee, contractor, or other person designated or otherwise authorized by the entity developing self-driving technology.
- (b) Vehicles shall be monitored and an operator shall have the ability to direct the vehicle's movement if assistance is required.
- (c) The individuals operating vehicles shall be licensed to operate a motor vehicle in the United States.
- (d) The vehicle owner shall submit proof of financial responsibility, in an amount and on a form established by the Director of the Arizona Department of Transportation.

(4) The Director of the Department of Transportation may promulgate additional rules considered necessary to implement this Executive Order.

(5) There shall be established within the Office of the Governor a Self-Driving Vehicle Oversight Committee (the "Committee") to advise the Department of Transportation, the Department of Public Safety, the selected universities, and any other pertinent agencies how best to advance the testing and operation of self-driving vehicles on public roads.

- (a) The Committee shall consist of one or more representatives from the Governor's Office, the Department of Transportation, the Department of Public Safety, the selected universities, and any other pertinent agency.
- (b) Members shall be appointed by and serve at the pleasure of the Governor.
- (c) To the extent necessary, the Committee may, based upon the results of the pilot programs, propose clarifications or changes to State policies, rules or statutes to facilitate the expanded operation of self-driving vehicles on public roads in Arizona.

Best Practice Recommendations for Texas DOT

Short-Term Practices

- 1) The Department should establish a department-wide working group to:
 - a) Coordinate and provide to the Legislature technical advice as well as recommendations for legislative policy making and changes or additions to the Texas Transportation Code and Texas Administrative Code applicable to Connected and Autonomous Vehicles (CAVs);
 - b) Oversee continuing research and testing needed to assess the technically feasible and economically reasonable steps for TxDOT to pursue over time, with emphasis on those actions that will encourage early CAV market penetration;
 - c) Create and update annually a CAV policy statement and plan;
 - d) Create and update annually a policy statement and plan for non-CAV vehicle support and operations during the transition to CAVs; and
 - e) Coordinate CAV issues with AASHTO, other states, Transportation Research Board (TRB) committees, the Texas Department of Motor Vehicles, and the Texas Department of Public Safety.
- 2) The Traffic Operations Division (TRF), in coordination with other divisions, the districts, and other stakeholders, should establish and lead a team to:
 - a) Oversee research and testing on additional or changed traffic control devices and signage that will enhance the operations of CAVs;
 - b) Coordinate with industry in the short term on basic items in the MUTCD that are proving challenging in CAV development and deployment, such as sensor-compatible lane striping, road buttons, and machine-readable signage;
 - c) Monitor and oversee development of Cooperative Intersection Collision Avoidance System (CICAS) technology and assist in test deployments on Texas highways and major arterial roads; and
 - d) Monitor Cooperative-Adaptive Cruise Control and Emergency Stop device deployment and assess what steps TxDOT will need to take to assist in extending and translating this technology into throughput, such as improved platooning on trunk routes.
- 3) The Transportation Planning and Programming (TPP) Division, in coordination with other divisions, the districts, and other stakeholders, should establish and lead a team to:
 - a) Develop and continuously maintain a working plan for facilitating early adaptors of CAV technology, in particular the freight and public transportation industries;
 - b) Identify and begin planning with MPOs for the impacts of expected additional VMT driven by CAV adoption, particularly for assessing impacts on conformity demonstrations in non-attainment areas of the state;
 - c) Begin assessment for and development of a series of TxDOT-recommended VMT management and control incentives for responding to the likely CAV-induced VMT increases; and
 - d) In coordination with the Public Transportation Division (PTN), begin to monitor and assess the impacts of SAVs on the department.

Mid-Term Practices

- 1) The Department's department-wide working group should continue to:
 - a) Create and update annually the CAV policy statement and plan;
 - b) Create and update annually the plan for non-CAV vehicle support and operations during the transition to CAVs;
 - c) Coordinate CAV issues with AASHTO, other states, TRB committees, the Texas Department of Motor Vehicles, and the Texas Department of Public Safety; and
 - d) Coordinate and provide to the Legislature technical advice as well as recommendations for legislative policy making and changes or additions to the Texas Transportation Code and Texas Administrative Code.
- 2) The TRF Division, in coordination with other divisions, the districts, and other stakeholders, should:
 - a) Continue research and testing for CAV-enabled smart intersections, expanding from off-road test facilities to actual intersections;
 - b) Initiate research and testing for CAV-appropriate lane management operations, initially for platooning and CAV-only lanes;
 - c) Expand CAV control device research and testing specific to construction zone, detour, and nighttime operations; and
 - d) In cooperation with the engineering design divisions and the Maintenance Division (MNT), begin updating the various TxDOT manuals that will be impacted by CAVs.
- 3) The TPP Division, in coordination with other divisions, the districts, and other stakeholders, should:
 - a) Research, test, and recommend incentives (for example, micro-tolling, time of day operations restrictions, etc.) for the control of congestion as well as increased VMT induced by CAVs;
 - b) In coordination with PTN and local governments, assess the impact of AVs in public transportation operations, leading to recommendations appropriate to the Department's goal of congestion relief; and
 - c) Begin research and testing of area-wide traffic demand management operations made possible by CAV technology.

Long-Term Practices

- 1) TxDOT's department-wide working group should continue to:
 - a) Create and update annually the CAV policy statement and plan;
 - b) Create and update annually the plan for non-CAV vehicle support and operations during the transition to CAVs;
 - c) Coordinate CAV issues with AASHTO, other states, TRB committees, the Texas Department of Motor Vehicles, and the Texas Department of Public Safety; and
 - d) Coordinate and provide to the Legislature technical advice as well as recommendations for legislative policy making and changes or additions to the Texas Transportation Code and Texas Administrative Code.
- 2) TRF and TPP should continue steps needed to identify the optimal traffic demand management strategies that are economically feasible and environmentally compliant, giving particular thought to centralized and automated allocation of routing and timing, as well as required use of SAVs operated to minimize VMT.

- 3) TRF, in coordination with the other engineering design divisions (Design Division, Bridge Division) and MNT, should research, test, and ultimately adopt changes to the department manuals optimized for CAV/SAV operations.
- 4) The engineering design divisions should research, test, and ultimately adopt roadway design elements that allow high-speed, but safe, CAV roadway operations in rural and uncongested suburban areas.
- 5) Finally, TPP, in coordination with TRF, PTN, and the engineering design divisions, should develop and recommend a series of options to the TxDOT administration and Texas Transportation Commission for aggressive traffic demand management in the major metro areas and along congested trunk routes.