10 BEST PRACTICES FOR STATE AUTOMATED VEHICLE POLICY

by Marc Scribner

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PART 1

INTRODUCTION

In a 2009 TED Talk, Director of the Stanford Artificial Intelligence Laboratory and Google Vice President Sebastian Thrun set off a firestorm of interest over automated vehicle technology in his announcement that Google was pursuing a world where human beings no longer drive cars.[1] Since then, Google has been joined by numerous technology startups as well as traditional automakers in a joint quest to replace human beings in the driver seat with sensor arrays and computers.

Improving safety has been a top stated priority and is especially significant given the long-recognized fact that more than 90% of automobile crashes involve driver error or misbehavior.[2] A recent study from the Insurance Institute for Highway Safety estimated that vehicle automation systems could potentially prevent just 34% of crashes.[3] However, this study was heavily criticized for inaccurately assuming riders of automated vehicles would

1 Thrun, Sebastian. "Rethinking the Automobile." TEDx Brussels 2010. *TEDx Talks*, 12 Jan. 2011. https://www.youtube.com/watch?v=r_T-X4N7hVQ 8 June 2020.

2 Treat, John R. et al. "Tri-level study of the causes of traffic accidents: Volume 1, Causal factor tabulations and assessments." National Highway Traffic Safety Administration. *Bts,gov*, Bureau of Transportation Statistics. May 1979. 28. https://rosap.ntl.bts.gov/view/dot/1243 8 June 2020.

3 Mueller, Alexandra S. et al. *What humanlike errors do autonomous vehicles need to avoid to maximize safety?* Washington: Insurance Institute for Highway Safety (May 2020). https://www.iihs.org/topics/bibliography/ref/2205 12 June 2020.

somehow be able to direct the vehicles to illegally speed and make illegal maneuvers. In reality, automated vehicle developers are designing their systems to obey traffic laws and potentially only violate them in order to prevent crashes—and where riders play no role in this decision-making. Properly recalculated using standard automated vehicle engineering assumptions, the estimate for potentially preventable crashes rises to 73%.[4]

The technology also offers great promise for traditionally mobility-disadvantaged groups who—either by disability or lack of income—are unable to drive their own vehicles and then suffer the consequences of reduced access to jobs, medicine, and leisure that poor substitutes such as mass transit cannot come close to matching.[5]

We are still years away from wide-scale deployment of self-driving taxis and delivery vehicles that have captured the popular imagination. Comprehensive federal policy has yet to be enacted. In this environment, a number of states have taken the lead in charting a policy path for automated vehicles. This policy brief aims to provide needed guidance to state policymakers in these efforts.

The brief begins with definitions of key automated vehicle terms and concepts, continues with a survey of existing state automated vehicle policies, and follows with 10 policy recommendations for state policymakers to promote automated vehicle innovation while protecting the public interest.

4 "On The Life Saving Potential of Autonomous Vehicles." Partners for Automated Vehicle Education. *Medium.com*, Medium. 4 June 2020. https://medium.com/pave-campaign/on-the-life-saving-potential-of-autonomous-vehicles-b002a668b530 12 June 2020.

5 Scribner, Marc. Comments of the Competitive Enterprise Institute to the Office of the Secretary of Transportation in the matter of Impact of Automated Vehicle Technologies on Workforce. *Cei.org*, Competitive Enterprise Institute. 1 Nov. 2018. Appendix A. https://cei.org/sites/default/files/Marc_Scribner_-_CEI_Comments_to_OST_on_AV_Workforce_Study_Scope.pdf 8 June 2020.

PART 2

DEFINING AUTOMATED VEHICLES

At higher levels of automation, automated motor vehicles are known colloquially as "driverless cars" and "self-driving cars." This part provides basic definitions related to automated motor vehicles and explains how these concepts can be applied to various use cases.

2.1 DRIVING AUTOMATION SYSTEMS AND AUTOMATED DRIVING SYSTEMS

Early in the last decade, it was recognized that a common terminology around automated vehicles was needed to ensure clarity among policymakers and practitioners in various disciplines prior to public policy development. As University of South Carolina law professor Bryant Walker Smith put it, "Sensibly defining these systems [...] requires thoughtful dialogue between the technical and legal domains: Lawyers and engineers can—and should—speak the same robot language."[6]

[6] Smith, Bryant Walker. "Lawyers and engineers should speak the same robot language." *Robot Law*. Eds. Ryan Calo, A. Michael Froomkin and Ian Kerr. Northampton, Mass.: Edward Elgar Publishing, 2016. 78–101.

The National Highway Traffic Safety Administration (NHTSA) published its "Preliminary Statement of Policy Concerning Automated Vehicles" in 2013.[7] This document defined road vehicle automation through a range of levels from Level 0 (No Automation) to Level 4 (Full Self-Driving Automation).

NHTSA's initial effort to define road vehicle automation was followed by SAE International (formerly the Society of Automotive Engineers), which in 2014 released the first version of Recommended Practice J3016, *Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems*. SAE International is the leading voluntary consensus standards body for the automotive sector, accounting for 55% of total nongovernmental consensus standards incorporated into NHTSA's Federal Motor Vehicle Safety Standard regulations.[8]

Since then, despite some criticism, SAE International's Recommended Practice J3016 has provided the standard driving automation definitions used by policymakers, industry, and academia. When NHTSA published its first formal automated vehicles guidance policy in 2016, it abandoned its 2013 levels of automation in favor of those defined in SAE J3016.[9] Congress has adopted SAE J3016 in yet-to-be-enacted draft federal automated vehicle legislation.[10] States and local policymakers are now generally using SAE J3016 levels of automation. SAE International has produced the graphic depicted in Figure 1 to aid policymakers and the public in understanding technology capabilities and driver responsibilities at various levels of automation:

7 "Preliminary Statement of Policy Concerning Automated Vehicles." National Highway Traffic Safety Administration. *NHTSA.gov*. 30 May 2013. http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf 21 May 2020.

8 Author's calculation based on review of the National Institute of Standards and Technology's Regulatory Standards Incorporated by Reference (R-SIBR) Database, https://sibr.nist.gov/ (last updated 16 Aug. 2016).

9 "Federal Automated Vehicles Policy." National Highway Traffic Safety Administration. *Nhtsa.gov*. 20 Sept. 2016. https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016 21 May 2020.

10 AV START Act. S.1885. 115th Congress, 1st session (2017).

FIGURE 1: SAE J3016 LEVELS OF DRIVING AUTOMATION

Source: SAE International

SAE International's definitions make an important distinction relevant to many policymakers: the difference between a driving automation system and automated driving systems. Anything within the full range of SAE Levels 1-5 is some kind of driving automation system. This begins with single-function sustained automation at Level 1, then combining Level 1 functions to work in unison as Level 2, and runs all the way to full self-driving automation without a restrictive "operational design domain" at Level 5. SAE Level 0 is not driving automation of any kind, since those features do not provide *sustained* automated operation, while SAE Levels 1-2 do provide sustained automated *assistance* for human drivers. In contrast, an automated driving system ranges from SAE Levels 3-5, with Level 3 being a system that can perform the entire driving task but requires manual human driving when it encounters a problem. SAE Level 4 allows full self-driving with no human intervention within a pre-defined operational design domain that could include limits on geography, weather, time of day, or other operating conditions.

Much of the attention from policymakers and the public to date has focused on automated driving systems (SAE Levels 3-5), which is discussed in Part 3. However, most actual driving automation systems deployed to date have been SAE Levels 1-2. Both kinds of automated capabilities are important to understand the range of systems and the human driver responsibilities required during operation.

2.2 PRESENT AND POSSIBLE FUTURE USE CASES

> *Road vehicle automation is already available to U.S. consumers, albeit at lower levels of automation.*

Road vehicle automation is already available to U.S. consumers, albeit at lower levels of automation. SAE Levels 1-2 driver assistance features are becoming increasingly standard in automobiles, with SAE Level 1 adaptive cruise control widely available from traditional automakers and Tesla's SAE Level 2 Autopilot feature being available since 2015, with the company claiming it will phase in higher levels of automation in the future via wireless updates while continuing to use existing sensors.[11] All of these systems rely on a variety of onboard sensor arrays that may include radars, lasers (LIDAR), ultrasound, and cameras. Some driver assistance systems that perform the same function may rely on different sensors depending on the individual developer. For instance, SAE Level 1 adaptive cruise control marketed to consumers has variously relied on radar, camera, LIDAR, or some combination known as sensor fusion.[12] While most developer prototypes rely heavily on LIDAR, Tesla has distinguished itself in its opposition to LIDAR in favor of radar and camera sensors for its current SAE Level 2 Autopilot system and planned automated driving system.[13] Most experts do not share Tesla's approach.[14]

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11 "Autopilot." *Tesla.com*, Tesla. https://www.tesla.com/autopilot 26 May 2020.

12 "What Is Sensor Fusion?" *Aptiv.com*, Aptiv. https://www.aptiv.com/newsroom/article/what-is-sensor-fusion 26 May 2020.

13 Lee, Timothy B. "Elon Musk: 'Anyone relying on lidar is doomed.' Experts: Maybe not." *Arstechnica.com*, Ars Technica. 6 Aug. 2019. https://arstechnica.com/cars/2019/08/elon-musk-says-driverless-cars-dont-need-lidar-experts-arent-so-sure/ 10 June 2020.

14 Ibid.

In addition to onboard sensors, some driving assistance systems make use of wireless communications to augment sensor information with external data such as GPS (Global Positioning System) coordinates, high-resolution road maps, and vehicle-to-vehicle (V2V) communications.

In addition to onboard sensors, some driving assistance systems make use of wireless communications to augment sensor information with external data such as GPS (Global Positioning System) coordinates, high-resolution road maps, and vehicle-to-vehicle (V2V) communications. V2V and vehicle-to-everything (V2X) communications will be discussed in more detail in Part 4. However, it is generally true for lower-level driver assistance and especially higher-level automated driving systems that onboard sensors provide the most critical information for automated operation. Automated driving systems currently under development tend to rely on sensor fusion from a combination of inputs to generate high-resolution, real-time representations of the local environment.

Table 1 shows example use cases across the spectrum of driving automation that are either available to consumers today or under development. These examples do not encompass all possible use cases but are generally the most prominent and worthy of attention for policymakers.

TABLE 1: DRIVING AUTOMATION SYSTEM USE CASE EXAMPLES

SAE Level	Example Use Cases
1	Adaptive cruise control*, lane centering*, platooning (speed/brake coordination only)†
2	Tesla Autopilot*, hands-free traffic jam assistance*, platooning with lane centering
3	Highway pilot
4	Urban taxicab†, last-mile urban delivery†, fixed-route transit†, long-haul freight
5	Utility vehicles

Notes: * presently available to consumers † presently in limited public pilot project operation

SAE Level 1: Consumers today are able to purchase many vehicles equipped with adaptive cruise control, first introduced to U.S. consumers in 1999 with Mercedes-Benz's Distronic system, whereby drivers select a speed and interval from the vehicle ahead. The adaptive cruise control system then applies the brake or throttle to maintain that desired following distance.[15] Hyundai's Lane Following Assist is an example of SAE Level 1 lane centering, which automatically adjusts steering to keep the moving vehicle centered in the traffic lane.[16] This is in contrast to lane departure assistance or automatic emergency braking, which are considered SAE Level 0 because they only provide momentary rather than sustained automated assistance to drivers.

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Peloton Technology is currently piloting its SAE Level 1 heavy-duty truck platooning system.[17] This allows two trucks to coordinate braking and throttling via vehicle-to-vehicle

15 Jackson, Kathi. "Smart Cruise: Mercedes is first with adaptive cruise control system." *Wardsauto.com*, Ward's. 1 Dec. 1998. https://www.wardsauto.com/news-analysis/smart-cruisemercedes-first-adaptive-cruise-control-system 26 May 2020.

16 "Driver Assistance." *Hyundai.com*, Hyundai Motor Company. http://webmanual.hyundai.com/PREM_GEN5/AVNT/FE/KOR/English/driverassistance001.html 26 May 2020.

17 "Platoon Pro." *Peloton-tech.com*, Peloton Technology. https://peloton-tech.com/platoon-pro/ 26 May 2020.

communications in order to safely reduce the interval between the trucks and thus aerodynamic drag, thereby improving fuel economy. As Peloton's current system is SAE Level 1, both drivers must still steer without assistance for the entire trip.

SAE Level 2: Tesla's Autopilot has generated a great deal of attention and controversy, with many arguing the company has oversold the Autopilot's capabilities and underplayed the requirement that drivers must maintain awareness and control at all times.[18] Autopilot allows drivers to select a destination and the system will direct both longitudinal braking/throttling and lateral steering controls, including changing lanes to enter or exit highways and to steer around slow-moving vehicles. Widely publicized and sometimes fatal incidents involving Tesla Autopilot operators sleeping, lounging in the back seat, or otherwise not paying appropriate attention to the driving task have led some to question whether Autopilot should be marketed to consumers differently or permitted on the market at all absent modifications to reduce risks associated with misuse.[19]

Less-controversial deployments of SAE Level 2 systems continue. A number of automakers have released advanced SAE Level 2 hands-free traffic jam assistance features, most notably General Motors' Super Cruise[20] and Toyota's Safety Sense.[21] These systems combine SAE Level 1 adaptive cruise control and SAE Level 1 lane centering to work in unison, temporarily relieving drivers of some responsibilities under certain conditions. They typically allow the driver to take her hands off the steering wheel and foot off the pedals in congested low-speed traffic while she still actively monitors her vehicle and surrounding traffic. The similar combination of longitudinal and latitudinal cooperative automation for heavy-duty truck platooning is currently under development.

SAE Level 3: Interest from developers may be waning for this lowest level of automated driving systems, frequently referred to as highway pilot systems. Like automated driving at SAE Levels 4 and 5, an SAE Level 3 automated driving system can automate the entire dynamic driving task. But unlike automated driving at SAE Levels 4 and 5, an SAE Level 3 system hands off responsibility to an awaiting human—either an in-vehicle or remote

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18 Heilweil, Rebecca. "Tesla needs to fix its deadly Autopilot problem." *Vox.com*, Vox. 26 Feb. 2020. https://www.vox.com/recode/2020/2/26/21154502/tesla-autopilot-fatal-crashes 26 May 2020.

19 Ibid.

20 "Super Cruise: Hands-Free Driving, Cutting Edge Technology." *Cadillac.com*, General Motors. https://www.cadillac.com/ownership/vehicle-technology/super-cruise 26 May 2020.

21 "Toyota Safety Sense." *Toyota.com*, Toyota Motor Sales U.S.A. https://www.toyota.com/safety-sense/ 26 May 2020.

driver—after a warning and transition period when it encounters a situation the onboard computer cannot handle. The problem is that human-factors research using driving simulators has found that it can take up to 40 seconds for drivers to retake manual control and stabilize steering, suggesting that the hand-off period from automated to manual may be too long to allow drivers to safely mitigate hazards.[22]

Safety risks that manifest during the hand-off period also generate increased liability exposure for manufacturers. This has resulted in most legacy automakers and new automated driving developers planning to avoid SAE Level 3 altogether in favor of SAE Level 4, where the human is taken out of the driving loop.

Safety risks that manifest during the hand-off period also generate increased liability exposure for manufacturers. This has resulted in most legacy automakers and new automated driving developers planning to avoid SAE Level 3 altogether in favor of SAE Level 4, where the human is taken out of the driving loop. The most recent example was Audi, which canceled the planned introduction of its SAE Level 3 Traffic Jam Pilot in 2020, based on stated liability concerns.[23] There are currently no SAE Level 3 automated driving systems available on the market.

SAE Level 4: Vehicles equipped with automated driving systems at SAE Level 4 might be called true driverless vehicles. It is at this level of automation that humans are completely relieved of responsibility of control during the operation of the system throughout the entire dynamic driving task. SAE Level 4 is defined by restrictive operational design domains, which can vary greatly in terms of permissible geography, time of day, road type, and weather conditions. If the system encounters a situation it cannot handle, it triggers a

22 Merat, Natasha et al. "Transition to manual: Driver behaviour when resuming control from a highly automated vehicle." *Transportation Research Part F: Traffic Psychology and Behaviour* 27 Part B (Nov. 2014). 274–282.

23 Korosec, Kirsten. "The Station: Audi punts on Level 3, Lyft layoffs and Nio's $1 billion deal." *Techcrunch.com*, TechCrunch. 4 May 2020. https://techcrunch.com/2020/05/04/the-station-audi-punts-on-level-3-lyft-layoffs-and-nios-1-billion-deal/ 26 May 2020.

fallback to a safe state where the vehicle will automatically exit the roadway. This is in contrast to SAE Level 3's hand-off to a human driver when the system encounters such a situation. Internal controls and devices such as steering wheels, brake and accelerator pedals, and even windows can in principle be eliminated. This could allow for dramatic vehicle redesigns.

With costly human labor eliminated, taxicabs, last-mile delivery vehicles, fixed-route transit, and long-haul trucking could see operating costs plummet.

SAE Level 4 also offers promise for a variety of business models. With costly human labor eliminated, taxicabs, last-mile delivery vehicles, fixed-route transit, and long-haul trucking could see operating costs plummet. One team of Swiss researchers estimated that costs could fall so low that a hypothetical single-passenger automated taxicab may be less costly to operate per passenger-mile than a hypothetical automated bus at average occupancy levels, both of which are estimated to operate below the costs of automated passenger rail and all conventional manned road and rail vehicles.[24] There are a number of cost uncertainties, from sensor costs to cleaning costs, that will significantly impact total operating costs for such taxicabs. This low-cost scenario has a variety of possible societal implications, ranging from greatly expanded job access for the transit-dependent poor to large increases in vehicle-miles traveled and urban traffic congestion, but all are highly speculative.

It is at SAE Level 4 where we observe most of the attention from developers. Alphabet's Waymo subsidiary (formerly the Google Self-Driving Car Project) is currently operating a taxi service composed of modified conventional vehicles equipped with an SAE Level 4 system in suburban Phoenix, Arizona.[25] Nuro, a company founded by former employees of the Google Self-Driving Car Project, has developed a purpose-built unmanned cargo vehicle equipped with an SAE Level 4 system that is now delivering groceries in Houston, Texas,

24 Bösch, Patrick M. et al. "Cost-based analysis of autonomous mobility services." *Transport Policy* 64 (May 2018). 76–91.

25 "FAQ." *Waymo.com*, Waymo. https://waymo.com/faq/ 26 May 2020.

after having previously piloted the same vehicles in suburban Phoenix.[26] EasyMile has piloted low-speed, low-mass, geographically restricted passenger shuttles equipped at SAE Level 4 in a number of locations in the U.S. and two dozen other countries.[27] Several companies are currently developing SAE Level 4 long-haul trucks and large transit buses—both where all vehicles are equipped with SAE Level 4 or only following vehicles that coordinate with manually driven lead vehicles—but those have not yet seen formal public pilot deployments in the U.S.

SAE Level 5: In contrast to SAE Level 4's restrictive operational design domain, SAE Level 5—the highest level of automation—is defined by its lack of restrictive operational design domain. Vehicles equipped with SAE Level 5 automation would need to be able to travel wherever and whenever conventional manually driven vehicles can currently operate, such as rural gravel roads during nighttime snow flurries. Given the wide diversity of road network operating conditions, achieving SAE Level 5 poses significant challenges. However, the inability to go "anytime, anywhere" may not severely impact taxi-style passenger services or last-mile delivery vehicles, where business models tend to be inherently localized around high-quality surface streets and expressways. Similarly, SAE Level 4 long-haul freight between distribution centers or fixed-route transit will be operated under predictable conditions.

This is not to say that SAE Level 5 vehicles are useless compared to relatively unrestricted SAE Level 4 vehicles that can handle most, but not all, operating environments. One example is utility vehicles. For instance, snowplows and boom trucks for power line repair do need to operate in hazardous, unpredictable conditions. Residents of rural areas—where taxi-style, last-mile delivery, and transit services are difficult to profitably operate at scale and road networks are less developed—may appreciate SAE Level 5 private vehicles that could be kept at home in much the same way as conventional vehicles are today.

26 "Frequently Asked Questions." *Nuro.ai*, Nuro. https://nuro.ai/faq 26 May 2020.

27 "EZ10." *Easymile.com*, EasyMile. https://easymile.com/solutions-easymile/ez10-autonomous-shuttle-easymile/ 26 May 2020.

PART 3

EXISTING STATE AUTOMATED VEHICLE POLICIES

States were the early movers on automated vehicle policy. They continue to fill a policy vacuum created by the absence of federal legislation and regulation on automated vehicle safety and performance that would be administered by the National Highway Traffic Safety Administration much like the agency does today with conventional vehicles. This part surveys existing state automated vehicle policies.

"States were the early movers on automated vehicle policy."

3.1 LEGISLATION

In 2011, Nevada became the first U.S. state to enact automated vehicle legislation.[28] Since then, the National Conference of State Legislatures (NCSL) reports that at least 41 states and the District of Columbia have considered legislation related to automated vehicles.[29] Of those, 30 have successfully enacted legislation.[30] Table 2 below summarizes enacted automated vehicle legislation by type from January 2017 to June 2020 based on a review of NCSL's Autonomous Vehicles State Bill Tracking Database.[31]

TABLE 2: ENACTED STATE AUTOMATED VEHICLE LEGISLATION BY TYPE, 2017-2020

Legislation Type	Number of States with Enacted Legislation
Commercial	22
Cybersecurity of Vehicle	0
Definitions	22
Infrastructure and Connected Vehicles	5
Insurance and Liability	8
Licensing and Registration	3
Operation on Public Roads	14
Operator Requirements	11
Other	8
Privacy of Collected Vehicle Data	1
Request for Study	7
Vehicle Inspection Requirements	0
Vehicle Testing	11

Source: National Conference of State Legislatures' Autonomous Vehicles State Bill Tracking Database

More-modest legislation has focused merely on providing definitions and explicitly authorizing automated vehicle operations, exempting platooning vehicles from following-

28 "Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation." National Conference of State Legislatures. *Nnsl.org*. 18 Feb. 2020. https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx 26 May 2020.

29 Ibid.

30 Ibid.

31 "Autonomous Vehicles State Bill Tracking Database." National Conference of State Legislatures. *Ncsl.org*. 20 March 2020. https://www.ncsl.org/research/transportation/autonomous-vehicles-legislative-database.aspx 1 June 2020.

too-closely requirements, or establishing study commissions. On the other end of the spectrum is legislation creating detailed regulatory frameworks for types of future automated vehicle business models, such as ride-hailing. The 13 examples in Table 3, while not all-inclusive of enacted automated vehicle legislation, provide a good representation of the range of automated vehicle lawmaking in the states.

TABLE 3: ENACTED STATE AUTOMATED VEHICLE LEGISLATION EXAMPLES

State	Bill Number (Year)	Summary
Alabama	SJR 81 (2016)	Creates automated vehicle legislative study committee
California	SB 1298 (2012)	Creates a comprehensive automated vehicle regulatory framework
California	AB 1184 (2018)	Authorizes San Francisco, subject to voter approval, to enact a fare tax of up to 3.25% on automated vehicle taxi trips originating in the county
Colorado	SB 213 (2017)	Defines and explicitly authorizes automated vehicle operations
Florida	HB 1207 (2012)	Defines "autonomous technology," recognizes legality of automated vehicle operations
Florida	HB 311 (2019)	Replaces earlier "autonomous technology" definitions with SAE J3016 definitions, integrates automated ride-hailing with existing ride-hailing framework, establishes automated vehicle insurance requirements, preempts localities from discriminating against automated driving systems
Georgia	HB 472 (2017)	Exempts platoon following vehicles from following-too-closely requirements
Illinois	HB 791 (2017)	Preempts localities from prohibiting automated driving systems
Nevada	AB 511 (2011)	Creates automated vehicle driver's license endorsement
Oklahoma	SB 365 (2019)	Preempts localities from legislating or regulating the use of driving automation systems in a manner different than non-automated vehicles
Texas	SB 2205 (2017)	Defines automated driving system, preempts local regulation of automated driving systems and vehicles equipped with ADS, explicitly authorizes automated vehicles
Virginia	HB 454 (2016)	Exempts operators of automated vehicles from the general prohibition against visible displays being visible to vehicle operators
Washington, D.C.*	DC B 19-0931 (2012)	Defines "autonomous vehicle," requires manual handoff, prohibits aftermarket automation of vehicles manufactured more than four years prior to conversion

***While a federal district and not a state, Washington, D.C. acts as a state in most contexts under the federal District of Columbia Home Rule Act of 1973.**

Early movers such as California and Florida have enacted significantly more automated vehicle laws than other states, in part to conform to new industry and federal definitions and best practices as they become available. In that sense, there has been a legislative penalty for states that attempted to define key automated vehicle terms and concepts prior to the development of consensus standards—states which must then look back and clean up their motor vehicle codes to conform to these standards. Unlike Florida, however, California imposes detailed regulatory requirements that must be met prior to automated vehicle operations, as well as ongoing reporting requirements during permitted operations, which are discussed in Section 3.2 of this report.

A number of states have acted to clarify the roles of various levels of government in relation to automated vehicle development and deployment. The majority of these have preempted localities from enacting ordinances that restrict vehicles equipped with SAE Level 3-5 automated driving systems, such as in Florida and Illinois. Oklahoma went further, prohibiting county and municipal governments from discriminating against vehicles equipped with any driving automation system, extending preemption down to SAE Level 1 features that are currently on the market.

“*Washington, D.C.’s enacted legislation diverges from other jurisdictions in that it effectively prohibits SAE Level 4 vehicles envisioned by developers, since it requires automated vehicles to be capable of immediately allowing manual control by a licensed driver seated in the driver seat.*”

Washington, D.C.’s enacted legislation diverges from other jurisdictions in that it effectively prohibits SAE Level 4 vehicles envisioned by developers, since it requires automated vehicles to be capable of immediately allowing manual control by a licensed driver seated in the driver seat. An early version of this legislation went even further in its specific prescriptions, requiring that all automated vehicles be powered by alternative fuels and then imposing a special vehicle-miles traveled tax on those vehicles based on the assumption these alternative fuel vehicles would not pay conventional fuel taxes.[32]

[32] Scribner, Marc. “Driverless cars are on the way. Here’s how not to regulate them.” *The Washington Post.* 2 Nov. 2012.

3.2 REGULATION

The previously discussed examples of enacted legislation vary in their interactions with the executive branch. Most of these laws are self-executing and require no further implementation action from administrative agencies. Others, most notably in California, require detailed regulations to be written and enforced by executive branch administrators.

Under current California law, the state Department of Motor Vehicles (DMV) is able to issue three classes of automated vehicle permits:

- Testing with a driver, under regulations that became effective on September 16, 2014;[33]
- Testing without a driver, under regulations that became effective on April 2, 2018;[34] and
- Deployment on public roads, under regulations that became effective on April 2, 2018.[35]

On January 16, 2020, new rules came into effect that allow light-duty (less than 10,001 pounds) automated delivery trucks to test and deploy on California's public roads, vehicles that were previously excluded from California's automated vehicle testing and deployment permitting regimes.[36] Heavy-duty vehicles are still prohibited from enrolling in any California automated vehicle program.

At least in theory, California allows a wide range of automated vehicle operations on public roads. However, restrictive regulatory provisions have led California-based automated vehicle developers to focus the testing of their latest vehicle and service prototypes in other, less-restrictive states.

Prior to testing or deploying automated vehicles, California requires developers to submit a permit application for approval by the DMV. The California Code of Regulations Articles 3.7 and 3.8 for automated vehicle testing and deployment require that those wishing to test or deploy their vehicles must demonstrate compliance with more than a dozen requirements

33 13 CCR § 227.04.

34 13 CCR § 227.18.

35 13 CCR § 228.06.

36 13 CCR § 227.28(a)(5).

prior to approval—including a $5 million insurance requirement—with additional regulations dictating ongoing reporting duties, administrative appeals, and permit renewals. For the latter post-permitting requirements, the filing of so-called “disengagement reports”—documentation made publicly available on when the automated driving system was turned off for whatever reason—has generated significant controversy.

On its face, the reporting of such disengagements would seem to make sense. Wouldn’t regulators want to know how often a system fails? The problem is that disengagement reports tell you little about what conditions brought about a disengagement.[37] Developers use different definitions and different technologies, and choose to operate in different regions on different road types. As a result, California’s disengagement reporting requirement provides a perverse incentive for developers to operate in less-complex traffic environments in order to minimize reported disengagements. This make apples-to-apples comparisons between automation system capabilities extremely difficult. Moreover, complex traffic environments provide the best learning opportunities for automation systems. If developers are strategically avoiding more-challenging environments to put on a better face for regulators, this will likely slow the development and ultimate deployment of automated driving systems.

In contrast to California’s complex automated vehicle regulatory regime, Florida’s approach is generally characterized by self-executing legislation that imposes straightforward minimum standards and requires no further regulatory implementation. Central to Florida’s approach is its minimum insurance requirement, which requires companies wishing to deploy SAE Level 4 and 5 automated vehicles for the purpose of providing on-demand or prearranged rides to purchase at least $1 million in primary liability coverage.[38] Florida state Sen. Jeff Brandes, the author of this requirement, noted that “ultimately the insurer needs to be the Good Housekeeping seal of approval that the technology is safe enough to deploy.”[39]

Fortunately, rather than focus testing and deployment in California’s onerous regulatory environment, developers have shifted their most advanced testing to states without such

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37 Adams, Ian. “Self-driving cars should disengage from public reporting.” *Thehill.com*, The Hill. 7 Feb. 2017. https://thehill.com/blogs/pundits-blog/technology/318184-self-driving-cars-should-disengage-from-public-reporting 1 June 2020.

38 Fla. Stat. § 627.749 (2019).

39 Scribner, Marc. “How Florida Hit the Gas on Self-Driving Car Development.” *The Journal of the James Madison Institute* 62 (Fall 2019). 62–68.

burdensome requirements. Many have set up shop in the Phoenix metropolitan area, where Arizona lacks statewide automated vehicle regulation and instead operates under provisions specified by way of executive order, which is discussed in Section 3.3.

3.3 EXECUTIVE ORDERS

Another form of automated vehicle policy in the states has come by way of governors' executive orders. To date, 11 states have issued 14 executive orders related to automated vehicles, which are listed in Table 4 below.

TABLE 4: STATE EXECUTIVE ORDERS RELATED TO AUTOMATED VEHICLES

State	E.O. Number (Date)	Summary
Arizona	2015-09 (Aug. 25, 2015)	State agencies should coordinate on testing and operation of automated vehicles on public roads
Arizona	2018-04 (March 1, 2018)	Requires automated vehicles to be in compliance with federal and state safety regulations
Arizona	2018-09 (Oct. 11, 2018)	Establishes the Institute of Automated Mobility
Delaware	14 (Sep. 5, 2017)	Establishes the Advisory Council on Connected and Autonomous Vehicles
Hawaii	17-07 (Nov. 22, 2017)	Establishes automated and connected vehicle policy point of contact within the governor's office and orders state agencies to facilitate testing
Idaho	2018-01 (Jan. 2, 2018)	Establishes the Autonomous and Connected Vehicle Testing and Deployment Committee to examine policy best practices as well as barriers to testing and deployment
Illinois	2018-13 (Oct. 25, 2018)	Establishes automated vehicle testing program within the Illinois Department of Transportation
Maine	2018-001 (Jan. 17, 2018)	Establishes the Maine Highly Automated Vehicles Advisory Committee
Massachusetts	572 (Oct. 20, 2016)	Establishes a working group to develop automated vehicle policy recommendations
Minnesota	18-04 (March 6, 2018)	Establishes the Governor's Advisory Council on Connected and Automated Vehicles
Ohio	2018-01K (Jan. 18, 2018)	Establishes DriveOhio policy center
Ohio	2018-04K (March 9, 2018)	Establishes automated vehicle testing and pilot programs and requires registration with DriveOhio
Washington	17-02 (June 7, 2017)	Establishes interagency working group to develop automated vehicle pilot programs throughout the state
Wisconsin	245 (May 18, 2017)	Establishes the Governor's Steering Committee on Autonomous and Connected Vehicle Testing and Deployment

Most of these executive orders merely organize internal operations of government, generally by establishing lines of communication between agencies, in order to collaborate on non-binding policy recommendations. This is the normal function of governors' executive orders.

However, both Arizona and Ohio have invoked executive orders to bind private parties not directly engaged in the business of government. In the case of Arizona, the governor himself ordered a halt to Uber's public road testing following a fatal pedestrian crash in 2018.[40] In Ohio, the governor used an executive order to mandate a de facto permitting regime for developers wishing to conduct testing on public roads. While neither has been challenged in court as abuses of authority, it remains to be seen if these unusual uses of governors' executive orders will ultimately withstand judicial scrutiny.

"Despite Arizona's unorthodox use of executive orders to bind automated vehicle developers, the Phoenix metropolitan area has become the most popular automated vehicle testing ground in America."

Despite Arizona's unorthodox use of executive orders to bind automated vehicle developers, the Phoenix metropolitan area has become the most popular automated vehicle testing ground in America, most notably being the sole operating domain of Waymo One's automated ride-hailing service. Metropolitan Phoenix's clear weather and modern road network play a role, but so does the lack of a California-style automated vehicle regulatory regime, which is what brought Uber's automated vehicle testing to Arizona in 2016.[41]

40 Randazzo, Ryan. "Arizona Gov. Doug Ducey suspends testing of Uber self-driving cars." *Azcentral.com,* The Arizona Republic. 26 March 2018. https://www.azcentral.com/story/news/local/tempe-breaking/2018/03/26/doug-ducey-uber-self-driving-cars-program-suspended-arizona/460915002/ 4 June 2020.

41 Carson, Biz. "Uber's self-driving cars quit California and leave for Arizona on the back of a self-driving truck." *Businessinsider.com*, Business Insider. 12 Dec. 2016. https://www.businessinsider.com/uber-self-driving-cars-leave-california-for-arizona-2016-12 4 June 2020.

It is worth noting that aside from certain exceptions—such as New York's unique requirement that one hand or prosthetic device be on the steering wheel at all times while the vehicle is in motion[42]—automated vehicles with safety drivers were generally legal to operate on public roads in the U.S. prior to the proliferation of specific automated vehicle policies in recent years.[43]

42 NY Veh & Traf L § 1226.

43 Smith, Bryant Walker. "Automated Vehicles Are Probably Legal in the United States." *Texas A&M Law Review* 1 (2014). 411–521.

PART 4

RECOMMENDATIONS FOR STATE POLICYMAKERS

While the federal government has still not enacted comprehensive automated vehicle legislation or promulgated national auto safety regulations pertaining to automated vehicles, states should not seek to occupy the entire policy field that has been left empty through federal inaction. This part provides "no regrets" recommendations on productive state automated vehicle policies that should be considered regardless of future anticipated federal actions. For all of these recommendations, policymakers should tailor any policy to the particulars of their state's administration of the vehicle code, which often involves multiple agencies such as the department of transportation, department of motor vehicles, and state police.

"…policymakers should tailor any policy to the particulars of their state's administration of the vehicle code, which often involves multiple agencies such as the department of transportation, department of motor vehicles, and state police."

4.1 ADOPT A STANDARD VOCABULARY

States should strive for clarity of terminology in any proposed automated vehicle policy. Part 2 described the evolution of definitions used by policymakers for these technologies and functions. As it stands, SAE International's Recommended Practice J3016 is the current consensus standard used for these purposes. SAE J3016 has been updated several times since its initial release in 2014, so definitions today may be superseded by subsequent revisions.

If a general reference to SAE J3016 is included, policymakers should take care to incorporate it in such a manner that when a revision by SAE International occurs, it does not automatically bind private parties to any new terms in the revision. This would raise issues related to the delegation of lawmaking to private parties. However, rather than incorporating SAE J3016 by reference, policymakers seeking to avoid these potential problems can simply include the text of SAE J3016's core definitions of driving automation systems (DAS) and/or automated driving systems (ADS), which are much less likely to materially change over time.

4.2 RECOGNIZE THE LEGALITY OF AUTOMATED VEHICLES

Legislation that merely affirms the legality of operating automated vehicles on public roads is quite simple to accomplish. Florida's first enacted automated vehicle law in 2012 stated the legislature "finds that the state does not prohibit or specifically regulate the testing or operation of autonomous technology in motor vehicles on public roads."[44] This statement is true in virtually every state, with the exception of New York due to the previously noted requirement that a driver's hand or prosthetic device remain on the steering mechanism at all times during motion.

Coupled with the definitions of DAS and/or ADS from SAE J3016 noted in Section 4.1, policymakers can enact basic legislation to send a signal to automated vehicle developers that they are open for business without imposing complex regulatory requirements on the operation of such vehicles that may deter development and deployment. Policymakers could also consider Florida's approach, discussed in Section 3.2, where the state imposes a $1 million insurance requirement in lieu of prescriptive automated vehicle performance and permitting regulations.

44 Florida Legislature. Vehicles with Autonomous Technology, HB 1207 (2012).

4.3

RESPECT COMPETENCIES AT VARIOUS LEVELS OF GOVERNMENT

Federal, state, and local governments all possess specific areas of expertise in the broader landscape of motor vehicle regulation. The federal government focuses on safety and performance requirements administered by the National Highway Traffic Safety Administration (NHTSA) and the Federal Motor Carrier Safety Administration, as well as funding and coordinating road infrastructure investments through programs administered by the Federal Highway Administration.

State authorities have expertise in constructing and managing infrastructure, as well as driver licensing, vehicle registration, traffic operations, insurance, and liability determination. Municipal and county authority expertise overlaps with that of state authorities in constructing and managing infrastructure, and traffic management and enforcement.

A few states, namely California, have attempted to mimic the motor vehicle safety and performance regulatory expertise of the federal government in the context of automated vehicles. These efforts have little to show for them, other than causing automated vehicle developers to decamp to states that do respect the traditional divisions of authority and competence between the various levels of government.

"It is unlikely any state can transform its Department of Motor Vehicles into a well-run state version of NHTSA, and they should not attempt such ambitious reorganizations."

It is unlikely any state can transform its Department of Motor Vehicles into a well-run state version of NHTSA, and they should not attempt such ambitious reorganizations. Even if a state were to expend the immense resources and attract the necessary talent for such a plan to succeed, it would ultimately be preempted whenever NHTSA does eventually issue Federal Motor Vehicle Safety Standards pertaining to automated vehicles. Rather than attempt to upend the longstanding motor vehicle regulatory ecosystem, states should instead focus on modernizing their traditional authorities to accommodate automated vehicles.

4.4 AUDIT MOTOR VEHICLE CODES FOR EXISTING BARRIERS

State motor vehicle codes reflect the legacy of automotive technologies introduced over the last few generations. Some of these provisions made sense at the time, when it was entirely reasonable to assume that a human driver would always be behind the wheel. However, this no longer holds true when human beings are taken out of the driving loop and we are left solely with machine operations.

A number of overly prescriptive provisions contained in state motor vehicle codes present barriers to the testing and deployment of automated vehicles, especially those with higher-level systems (SAE Level 4+), novel vehicle designs, and battery electric propulsion.

A number of overly prescriptive provisions contained in state motor vehicle codes present barriers to the testing and deployment of automated vehicles, especially those with higher-level systems (SAE Level 4+), novel vehicle designs, and battery electric propulsion. In addition to the aforementioned New York State requirement that a driver's hand or prosthetic device hold the steering wheel during motion, other outdated, overly prescriptive provisions currently on the books include:

- Driver duties upon striking unattended vehicles;[45]
- Prohibitions on following-too-closely in a platoon;[46]

[45] W. Va. Code § 17C-4-4.

[46] Scribner, Marc. *Authorizing Automated Vehicle Platooning: A Guide for State Legislators, 2019 Edition*. Issue Analysis 2019 #2. Washington, D.C.: Competitive Enterprise Institute, July 2019. https://cei.org/content/authorizing-automated-vehicle-platooning-2019 5 June 2020.

- Horn switches must be readily accessible to the operator;[47]
- Inspection requirements related to steering wheels and brake pedals;[48]
- Rearview mirrors;[49]
- Mufflers;[50]
- Safety belts;[51]
- Operational speedometers;[52]
- Steering mechanisms;[53]
- Windshields;[54] and
- Windshield wipers.[55]

The scope of this problem is significant. State policymakers should undertake careful audits of their existing codes to identify conflicts with automated vehicles. Once conflicts are identified, lawmakers and regulators can resolve them by explicitly exempting automated vehicles from these provisions.

4.5 DISTINGUISH BETWEEN VEHICLE TYPES

When conducting the motor vehicle code audits described in Section 4.4 and developing automated vehicle policy, lawmakers and regulators should take care to distinguish between vehicle types. For instance, Nuro's automated delivery vehicles by design do not require manual controls, mirrors, windshields, and other features and instruments traditionally associated with motor vehicles.

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47 Haw. Code R. § 19-133.2-33.

48 Haw. Code R. § 19-133.2-31

49 Ala. Code § 32-5-214.

50 Ark. Code Ann. § 27-37-601.

51 625 Ill. Comp. Stat. 5/12-603.

52 La. Admin. Code tit. 55, § 813(B).

53 19A N.C. Admin. Code 3D.0535.

54 Del. Code Ann. tit. 21 § 4312.

55 Ala. Code § 32-5-215.

Low-speed, low-mass, geographically restricted passenger shuttles and last-mile delivery vehicles equipped with ADS should not be held to the same standards as ADS-equipped highway vehicles.

Low-speed, low-mass, geographically restricted passenger shuttles and last-mile delivery vehicles equipped with ADS should not be held to the same standards as ADS-equipped highway vehicles. The federal government and many states have traditionally made distinctions between low-speed vehicles and highway vehicles. As new novel vehicle types are developed to serve various automated vehicle business models, policymakers should allow maximum flexibility if these vehicles are able to meet an equivalent level of safety as conventional vehicles operating under the same operational design domains (ODDs).

4.6 REMAIN NEUTRAL ON FUTURE BUSINESS MODELS

Developing even modest state automated vehicle policy is no easy task. Policymakers must consider how decisions made today may distort the ongoing and future development and deployment of automated driving system technologies. In doing so, they should be cautious not to codify the limits of their imaginations by dictating detailed business model structures.

The Uniform Law Commission has been active for several years in developing a model uniform policy on automated vehicles for states. In 2019, it published the Uniform Automated Operation of Vehicles Act.[56] This model legislation makes a number of sensible recommendations. However, Section 6 limits the types of entities that qualify as "automated driving providers." In order to qualify, an entity must meet one of three requirements:

- "have participated in a substantial manner in the development of an automated driving system";

[56] "Uniform Automated Operation of Vehicles Act." *Uniformlaws.org*, Uniform Law Commission. 3 Dec. 2019. https://www.uniformlaws.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=a78d1ab0-fac8-9ea1-d8f2-a77612050e6e&forceDialog=0 8 June 2020.

- "have submitted to the United States National Highway Traffic Safety Administration a safety self-assessment or equivalent report for the automated driving system as required or permitted by the United States National Highway Traffic Safety Administration"; or
- "be registered as a manufacturer of motor vehicles or motor vehicle equipment under the requirements of the United States National Highway Traffic Safety Administration."[57]

ADS developers certainly qualify under the above conditions, but rental car companies are excluded as they play no role in the development or manufacturing of vehicles and instead purchase large numbers of vehicles from manufacturers. This is peculiar because rental car companies not only have expressed interest in becoming automated vehicle providers in the future,[58] but they arguably have the most experience in managing large fleets of vehicles that are presumed for a number of potential automated vehicle business models.

It does not appear to be the case that the Uniform Law Commission intentionally excluded rental car companies from their automated vehicle policy framework; rather, this episode underscores that inattentive policymaking can have unintended consequences.

It does not appear to be the case that the Uniform Law Commission intentionally excluded rental car companies from their automated vehicle policy framework; rather, this episode underscores that inattentive policymaking can have unintended consequences. To date, only Washington State has considered—but not enacted—the Uniform Automated

[57] Ibid.

[58] Wahba, Phil. "A Fork in the Road for Avis." *Fortune.com*, Fortune. 29 Oct. 2018. https://fortune.com/longform/a-fork-in-the-road-for-avis/ 8 June 2020.

Operation of Vehicles Act.[59] State policymakers should avoid such missteps by striving to remain as neutral as possible with respect to future automated vehicle business models.

4.7 AVOID QUESTIONABLE LEGAL FRAMEWORKS

As was noted in Section 3.3, a number of states have relied on executive orders to implement automated vehicle policy. While most exercise this authority in the traditional manner, whereby governors issue executive orders to implement internal government policies, Arizona and Ohio have used executive orders to confer duties on private parties. These appear to carry the force of law, much like enacting legislation or promulgating regulations do. Neither of these executive orders has been challenged in court as impermissibly binding the public to adhere to the terms of these orders, but it remains an atypical and questionable use of government power that may not survive litigation if challenged.

Similarly, the Pennsylvania Department of Transportation has issued what is supposedly nonbinding guidance on automated vehicle testing in the state.[60] This approach has been hailed by some as pro-innovation "soft law" that bypasses the rigid strictures of legislation and regulation "hard law."[61]

However, this supposed nonbinding guidance explicitly requires the submission of a testing application, a Safety and Risk Mitigation Plan, and agreement to abide by a number of strict testing protocols.[62] Rather than bypass "hard law," it appears this claimed "soft law" approach merely imposes "hard law" conditions without the requisite procedural protections and accountability that comes from conventional legislation and regulation.

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59 "Legislative Report by Act – 2020." *Uniformlaws.org*, Uniform Law Commission. 5 June 2020. https://www.uniformlaws.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=4ec7fd07-60bf-f30c-2596-0690a769f485&forceDialog=0 8 June 2020.

60 "Automated Vehicle Testing Guidance." *Penndot.gov*, Pennsylvania Department of Transportation. 23 July 2018. https://www.penndot.gov/ProjectAndPrograms/ResearchandTesting/Autonomous%20_Vehicles/Documents/PennDOT%20HAV%20Testing%20Guidance.pdf 8 June 2020.

61 Huddleston, Jennifer and Adam Thierer. "Pennsylvania's Innovative Approach to Regulating Innovation." *Mercatus.org*, Mercatus Center at George Mason University. 5 Sept. 2018. https://www.mercatus.org/bridge/commentary/pennsylvanias-innovative-approach-regulating-innovation 8 June 2020.

62 "Automated Vehicle Testing Guidance." *Penndot.gov*, Pennsylvania Department of Transportation.

Like the questionable use of executive orders noted earlier, this questionable use of a guidance document has not been challenged in court, but Pennsylvania may face difficulties and litigation risk if it ever attempted to enforce the provisions of this guidance document. State policymakers should avoid these questionable automated vehicle legal frameworks in favor of conventional legislation or regulation—or perhaps forgo altogether a detailed automated vehicle legal framework for the time being.

4.8 FOCUS ON INFRASTRUCTURE STATE OF GOOD REPAIR

An adjacent discussion taking place in the automated vehicle conversation is that of connected vehicles. Like automation, vehicle connectivity spans a wide spectrum of technologies and use cases. In recent years, and most relevant to the policy debate, federal and state government officials have taken an interest in vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X) communication safety applications.

“In recent years, and most relevant to the policy debate, federal and state government officials have taken an interest in vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X) communication safety applications.”

The idea behind most of these concepts is to send and receive basic safety messages (BSMs) between vehicles, infrastructure, pedestrians, etc. to alert road users to upcoming hazards, such as red-light running or a disabled vehicle in the traffic lane ahead. In 2017, NHTSA even proposed mandating that all new vehicles be equipped with V2V radios designed to alert human drivers to certain hazards through the transmission of BSMs.[63] After numerous flaws were highlighted with this approach, including from some automated vehicle developers, NHTSA paused its V2V rulemaking and has to date not proceeded with

[63] National Highway Traffic Safety Administration. “Federal Motor Vehicle Safety Standards; V2V Communications.” *Notice of Proposed Rulemaking*. Docket No. NHTSA–2016–0126, 82 Fed. Reg. 3854 (12 Jan. 2017).

any V2X policymaking.[64] Making matters more complicated is the Federal Communications Commission's current consideration of halving the dedicated radio spectrum available to V2X communications, which some V2X advocates claim threatens their ability to deploy any V2X applications at scale.[65]

Prominent automated vehicle technologist Brad Templeton argues the small safety benefits that may arise from wide-scale deployment of V2X communications are greatly outweighed by the introduction of new cybersecurity and privacy risks, which in part undermine the modest V2X safety case.[66] Templeton further notes that NHTSA's favored approach of mandating in-vehicle V2X radios will slow the evolution of vehicle technologies by effectively locking in connected vehicle technologies for the life of the vehicle—perhaps two decades.[67] If V2X is to be considered at all, it should complement sensor-based vehicle automation and be deployed in a form that allows for rapid, iterative technological progress, such as by cellular phones that tend to be replaced by consumers every few years.[68]

Princeton University professor Alain Kornhauser, another prominent expert on road vehicle automation, expressed similar criticisms of NHTSA's approach. "Getting the 'entire fleet' equipped in a reasonable time scale would require a nationwide retrofit mandate on existing vehicles, not only new vehicles," said Kornhauser. "Unfortunately, the mandated V2V architecture is likely to be obsolete before the entire fleet is equipped."[69]

Another issue with deploying V2X communications networks is the added cost faced by infrastructure owners and managers. State departments of transportation and local public works departments are struggling to keep up with a growing road maintenance backlog. Adding a new, costly equipment burden in the form of installation and ongoing

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64 Scribner, Marc. "V2V Mandate Nixed: DOT Ends Second Most Costly U.S. Regulatory Proposal." *Cei.org*, Competitive Enterprise Institute. 1 Nov. 2017. https://cei.org/blog/v2v-mandate-nixed-dot-ends-second-most-costly-us-regulatory-proposal 8 June 2020.

65 Federal Communications Commission. "Use of the 5.850-5.925 GHz Band." *Notice of Proposed Rulemaking*. ET Docket No. 19–138. 85 Fed. Reg. 6841 (6 Feb. 2020).

66 Templeton, Brad. "V2V and the challenge of cooperating technology." *Templetons.com,* Brad Templeton's Home Page. https://www.templetons.com/brad/robocars/v2vdata.html 8 June 2020.

67 Ibid.

68 Ibid.

69 Kornhauser, Alain. "Summary of the Testimony by the Witnesses." *Orfe.princeton.edu*, Princeton University Department of Operations Research and Financial Engineering. 19 Nov. 2013. https://orfe.princeton.edu/~alaink/SmartDrivingCars/HouseHearing_119113/SummaryOfTestimony_HouseHearing_111913.pdf 11 June 2020.

maintenance of V2X roadside networks will likely divert resources away from basic road maintenance and reconstruction. This could negatively impact the landscape for automated vehicles, as high-quality, well-maintained road networks are critical to the wide-scale deployment of automated vehicles.

Instead of pursuing expensive "smart roads," state policymakers wishing to promote automated vehicle development and deployment should fulfill their traditional duties by focusing on the state of good repair of their existing road infrastructure.

4.9 DESIGNATE A LEAD AUTOMATED VEHICLE POLICY OFFICE

In carrying out the recommendations above, it would be wise for states to designate a lead automated vehicle policy office to serve as a clearinghouse and coordinating body for the variety of policy decisions that must be made across a number of agencies. Following the lead of states that have enacted automated vehicle policy to date, such an office could exist within the governor's office, state department of transportation, or department of motor vehicles. While we previously discussed the inappropriate use of executive orders in automated vehicle policymaking in Section 4.7, designating the lead automated vehicle policy office within a state would be an appropriate and lawful use of a governor's executive order powers.

"While we previously discussed the inappropriate use of executive orders in automated vehicle policymaking in Section 4.7, designating the lead automated vehicle policy office within a state would be an appropriate and lawful use of a governor's executive order powers."

4.10 PREPARE FOR AN EXTENDED PERIOD OF UNCERTAINTY

A fundamental assumption behind all of these recommendations is that automated vehicle policy priorities may change as new information materializes from ongoing testing and early deployments. Voluntary consensus standards bodies, such as SAE International and the International Organization for Standardization, continue to develop technical standards that may be ripe for regulatory incorporation in the future. Policymaking—especially policymaking undertaken through legislation—may be slow to adapt to new facts as they arise.

For automated vehicle policymaking, less can be more. State policymakers should focus on discrete known problems and avoid codifying their predictions about the direction of these technologies or possible use cases. As these technologies remain highly proprietary and with development largely taking place in an environment of intense corporate secrecy, it may be difficult to determine how quickly testing and deployment milestones will be met to enable wide-scale deployment of automated vehicles.

As such, state policymakers should adopt a general principle for crafting automated vehicle policies in a manner that respects this uncertainty and allows for flexibility to adapt when new information is available. Locking in hard rules that seem sensible today may prove unwise in the near future.

…state policymakers should adopt a general principle for crafting automated vehicle policies in a manner that respects this uncertainty and allows for flexibility to adapt when new information is available. Locking in hard rules that seem sensible today may prove unwise in the near future.

PART 5

CONCLUSION

State policymakers have a difficult task ahead of them in crafting automated vehicle policies with so much uncertainty around developer testing progress, deployment dates, and technical standardization. This uncertainty is compounded by the lack of automated vehicle policymaking at the federal level, which not only leaves a policy vacuum that states will be tempted to fill but also creates substantial risk to state policymaking that is likely to be preempted by federal authorities in the future.

The 10 recommendations contained in this brief are "no regrets" policies that policymakers can undertake with minimal risk to either automated vehicle development or the public interest.

Despite this uncertainty, state policymakers can chart a path forward. The 10 recommendations contained in this brief are "no regrets" policies that policymakers can undertake with minimal risk to either automated vehicle development or the public interest. States that have yet to act on automated vehicle policy can learn from the positive and negative experiences of states that moved early—perhaps too early.

Going forward, there will be much more policymaking and fine-tuning of existing policies to better match the technological, economic, and social issues that may arise from automated vehicle deployment. Fortunately, while the pace of development has been rapid, policymakers still have plenty of time to get automated vehicle policy right to maximize the benefits of the technology while minimizing the social costs of counterproductive policy.

ABOUT THE AUTHOR

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Scribner's work focuses on a variety of public policy issues related to transportation, land use, and urban growth, including infrastructure investment and operations, transportation safety and security, risk and regulation, privatization and public finance, urban redevelopment and property rights, and emerging transportation technologies such as automated road vehicles and unmanned aircraft systems. He frequently advises policymakers on these matters at the federal, state, and local levels.

Scribner has testified before Congress at the invitation of both Democrats and Republicans on issues including highway revenue collection, traffic congestion management, and airport financing.

He has appeared on television and radio programs in outlets such as Fox Business Network, National Public Radio, and the Canadian Broadcasting Corporation, and has also written for numerous publications, including *USA Today*, *The Washington Post*, *Wired*, CNN.com, MSNBC.com, *Forbes*, and *National Review*. And his work has been featured by *The Wall Street Journal*, *New York Times*, *Washington Post*, *Los Angeles Times*, *Scientific American*, *Congressional Quarterly*, *Washington Monthly*, POLITICO, CNN, Bloomberg, BBC, C-SPAN, and other print, television, and radio outlets.

Scribner joined Reason Foundation after more than a decade at the Competitive Enterprise Institute, where he was a senior fellow in transportation policy. He received his undergraduate degree in economics and philosophy from George Washington University.