CHALLENGES AND OPPORTUNITIES FOR FEDERAL 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 somehow be able to direct the vehicles to illegally speed and make illegal maneuvers. In

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

2 John R. Treat 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 Alexandra S. Mueller 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).

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]

Automated vehicles also have the potential to significantly reduce traffic congestion. Brookings Institution economist Clifford Winston and lawyer Quentin Karpilow modeled the economic impacts of congestion reduction in a scenario of widespread automated vehicle adoption in their recent book, *Autonomous Vehicles: The Road to Economic Growth?*[6] They estimate that a large reduction in travel delays from automated vehicles could raise the annual economic growth rate of the U.S. by at least one percentage point.[7] While this might seem small, a conservative estimate would still translate to hundreds of billions of dollars in additional annual growth to the economy.

We are still years away from wide-scale deployment of self-driving taxis and delivery vehicles that have captured the popular imagination, and current projections are highly speculative. Despite recent bipartisan efforts, comprehensive federal policy has yet to be enacted. In this environment, a number of states have begun to occupy the policy vacuum created by federal inaction, which in turn has increased risks posed by a growing patchwork of state policy.

This policy brief aims to provide guidance to federal policymakers as they work to develop a pro-innovation national framework for automated vehicles. The brief begins with

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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 Marc Scribner, "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).

6 Clifford Winston and Quentin Karpilow, *Autonomous Vehicles: The Road to Economic Growth?* (Washington: Brookings Institution Press, 2020). 69–77.

7 Ibid.

definitions of key automated vehicle terms and concepts, continues with a survey of federal automated vehicle policy development activities, and concludes with recommendations for federal policymakers to promote automated vehicle innovation while protecting the public interest.

PART 2

DEFINING AUTOMATED VEHICLES

Known colloquially as “driverless cars” and “self-driving cars” at higher levels of automation, 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.”[8]

8 Bryant Walker Smith, “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.

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.

The National Highway Traffic Safety Administration (NHTSA) published its "Preliminary Statement of Policy Concerning Automated Vehicles" in 2013.[9] 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.[10]

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.[11] Congress has adopted SAE J3016 in yet-to-be-enacted draft federal automated vehicle legislation.[12] States and local policymakers are now generally using SAE J3016 levels of

9 "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).

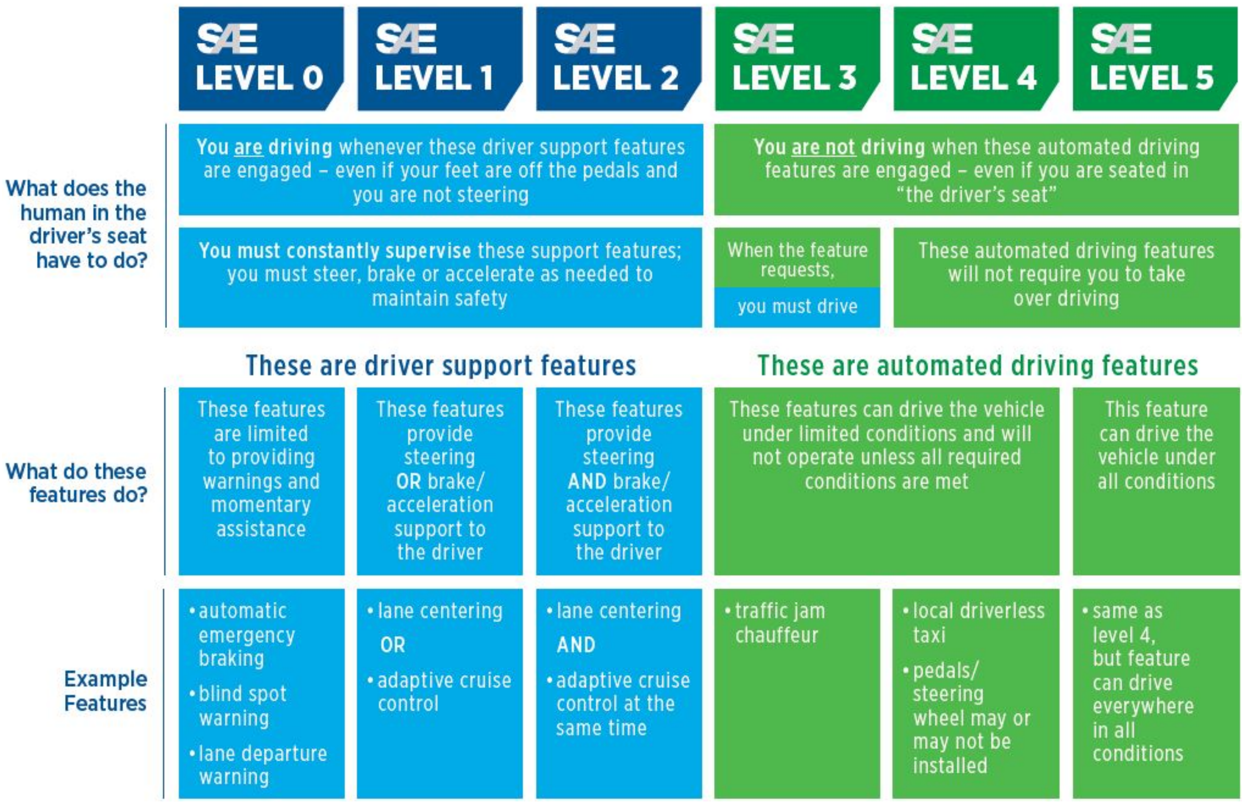
10 Author's calculation based on review of the National Institute of Standards and Technology's Standards Incorporated by Reference (SIBR) Database, https://sibr.nist.gov/ (last updated 16 Aug. 2016).

11 "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).

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

automation. SAE International has produced the graphic in Figure 1 to aid policymakers and the public in understanding technology capabilities and driver responsibilities at various levels of automation:

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 an automated driving system.

SAE International's definitions make an important distinction relevant to many policymakers: the difference between a driving automation system and an automated driving system. 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 a combination of 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. Vehicles equipped with SAE Levels 3-5 have been termed highly automated vehicles (HAVs) in legislation introduced in Congress, and this designation is likely to persist in future policymaking. This term 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. 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. Tesla's SAE Level 2 Autopilot feature has been 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.[13] 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.[14] While most developer prototypes rely heavily on LIDAR, Tesla has distinguished itself in its opposition to LIDAR in favor of radar and camera

[13] "Autopilot," *Tesla.com*, Tesla. https://www.tesla.com/autopilot (26 Aug. 2020).

[14] "What Is Sensor Fusion?" *Aptiv.com*, Aptiv. https://www.aptiv.com/newsroom/article/what-is-sensor-fusion (26 Aug. 2020).

sensors for its current SAE Level 2 Autopilot system and planned automated driving system.[15] Most experts do not share Tesla's approach.[16]

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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. However, for lower-level driver assistance and especially higher-level automated driving systems, onboard sensors typically 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 contains 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.

15 Timothy B. Lee, "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 Sep. 2020).

16 Ibid.

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

2.2.1 LEVELS OF AUTOMATION

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.[17] 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.[18] 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.

Peloton Technology is currently piloting its SAE Level 1 heavy-duty truck platooning system.[19] This allows two trucks to coordinate braking and throttling via vehicle-to-vehicle communications in order to safely reduce the interval between the trucks and thus reduce

17 Kathi Jackson, "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 Aug. 2020).

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

19 "Platoon Pro," *Peloton-tech.com*, Peloton Technology. https://peloton-tech.com/platoon-pro/ (26 Aug. 2020).

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.[20] 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 accidents 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.[21]

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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[22] and Toyota's Safety Sense.[23] 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

[20] Rebecca Heilweil, “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 Aug. 2020).

[21] Ibid.

[22] “Super Cruise: Hands-Free Driving, Cutting Edge Technology,” *Cadillac.com*, General Motors. https://www.cadillac.com/ownership/vehicle-technology/super-cruise (26 Aug. 2020).

[23] “Toyota Safety Sense,” *Toyota.com*, Toyota Motor Sales U.S.A. https://www.toyota.com/safety-sense/ (26 Aug. 2020).

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 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.[24]

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.[25] 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. At this level of automation, humans are completely relieved of responsibility for control 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 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

24 Natasha Merat 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.

25 Kirsten Korosec, "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 Aug. 2020).

such as steering wheels, brake and accelerator pedals, and even windows can in principle be eliminated. This could allow for dramatic vehicle redesigns.

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.

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.[26] A number of cost uncertainties, from sensor costs to cleaning costs, 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.

At SAE Level 4 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 comprising modified conventional vehicles equipped with an SAE Level 4 system in suburban East Valley of the Phoenix, Arizona metropolitan area.[27] 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, which is now delivering groceries in Houston, Texas after having previously piloted the same vehicles in suburban Phoenix.[28] 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

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

27 "FAQ," *Waymo.com*, Waymo. https://waymo.com/faq/ (29 Oct. 2020).

28 "Frequently Asked Questions," *Nuro.ai*, Nuro. https://nuro.ai/faq (29 Oct. 2020).

countries.[29] Several companies are currently developing long-haul trucks and large transit buses, both of which are equipped with SAE Level 4 or only following vehicles that coordinate with manually driven lead vehicles, but those have not yet seen significant 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.

Given the wide diversity of road network operating conditions, achieving SAE Level 5 poses significant challenges.

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.

29 "EZ10," *Easymile.com*, EasyMile. https://easymile.com/solutions-easymile/ez10-autonomous-shuttle-easymile/ (26 Aug. 2020).

PART 3

FEDERAL AUTOMATED VEHICLE POLICY DEVELOPMENT ACTIVITIES

To date, national safety, performance, and testing requirements for automated vehicles have not been established. However, the federal executive and legislative branches have engaged in a variety of activities related to automated vehicle policy. This part surveys those past and ongoing activities.

3.1 GUIDANCE

In recent years, the federal government has sought to define automated vehicles and develop policy priorities. The first publication was the National Highway Traffic Safety Administration's (NHTSA) Preliminary Statement of Policy Concerning Automated Vehicles, which was released in 2013.[30] As was noted in section 2.1, the Preliminary Statement of Policy established government-unique definitions of various automation levels. The

[30] "Preliminary Statement of Policy Concerning Automated Vehicles," National Highway Traffic Safety Administration, *Nhtsa.gov*, 26 May 2013. http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf (21 Aug. 2020).

subsequent guidance discussed in this section discarded those 2013 NHTSA automation definitions in favor of the automation levels defined by SAE International Recommended Practice J3016.

Since NHTSA's Preliminary Statement of Policy, the federal government has issued four nonbinding guidance documents focused on automated vehicles, which are listed in Table 2.

TABLE 2: FEDERAL AUTOMATED VEHICLE GUIDANCE DOCUMENTS

Year	Guidance Document Title	Published By
2016	Federal Automated Vehicles Policy	National Highway Traffic Safety Administration
2017	Automated Driving Systems 2.0	National Highway Traffic Safety Administration
2018	Automated Vehicles 3.0	U.S. Department of Transportation (DOT)
2020	Automated Vehicles 4.0	DOT, National Science and Technology Council

3.1.1 FEDERAL AUTOMATED VEHICLES POLICY

The Federal Automated Vehicles Policy (FAVP), the first formal guidance document from the federal government on automated vehicles, was released by NHTSA in September 2016.[31] This rollout included an op-ed by President Barack Obama published in the *Pittsburgh Post-Gazette*, in which the FAVP was described as "new rules of the road for automated vehicles."[32]

Like the president's casual conflation of a guidance document with rules in his op-ed, the FAVP suffers from a number of deficiencies largely related to the conflation of binding regulations and nonbinding guidance. The FAVP, like all federal guidance documents, is

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31 "Federal Automated Vehicles Policy," National Highway Traffic Safety Administration, *Nhtsa.gov*, 20 Sep. 2016. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/av_policy_guidance_pdf.pdf (20 Sep. 2020).

32 Barack Obama, "Self-driving, yes, but also safe," *Post-gazette.com*, *Pittsburgh Post-Gazette*, 19 Sep. 2016. https://www.post-gazette.com/opinion/Op-Ed/2016/09/19/Barack-Obama-Self-driving-yes-but-also-safe/stories/201609200027 (20 Sep. 2020).

legally non-binding.[33] However, the FAVP was structured in such a way that recommendations that are inherently nonbinding appear likely to impose specific requirements on regulated entities.

> *The FAVP, like all federal guidance documents, is legally non-binding. However, the FAVP was structured in such a way that recommendations that are inherently nonbinding appear likely to impose specific requirements on regulated entities.*

The FAVP contains a 15-point voluntary Safety Assessment. It envisions a scenario in which manufacturers will complete a brief summary letter signaling their compliance with the 15 points in one of three ways: "1) meets this guidance area; 2) does not meet this guidance area; 3) this guidance area is not applicable."

In practice, manufacturers are likely to feel compelled to offer lengthy and legalistic interpretive responses that will make compliance effectively impossible to discern. It is unclear what will constitute actual compliance with the 15 points. For instance, for a manufacturer to be "in compliance," will it be necessary for them self-certify that they have "met" the guidance in each area? Will NHTSA make a finding of compliance on the basis of the manufacturers' responses?

Despite repeated assurances in the FAVP that "[t]his Guidance is not mandatory"[34] and "is not intended for States to codify as legal requirement for the development, design, manufacture, testing, and operation of automated vehicles,"[35] NHTSA requests that states mandate compliance with the Safety Assessment letter as a condition for testing

[33] "Non-Binding Legal Effect of Agency Guidance Documents," U.S. House of Representatives Committee on Government Reform, H.Rept. 106-1009, *Govinfo.gov*, Government Publishing Office, 26 Oct. 2000. https://www.govinfo.gov/content/pkg/CRPT-106hrpt1009/html/CRPT-106hrpt1009.htm (20 Sep. 2020).

[34] "Federal Automated Vehicles Policy," National Highway Traffic Safety Administration.

[35] Ibid.

operations: "Mandate Safety Assessment: Implement a rule mandating the submission of the Safety Assessment letter identified in this guidance."[36]

This apparent contradiction is concerning because NHTSA explicitly recognizes that this guidance document does not carry the force of federal law, yet then argues that states should mandate "voluntary" guidance on its behalf. This suggests the agency may be attempting to avoid conducting the notice-and-comment rulemaking required under the Administrative Procedure Act while still forcing manufacturer compliance.

In the FAVP, NHTSA replaces its government-unique automation level definitions that are contained in the 2013 Preliminary Statement of Policy with those contained in SAE International's Recommended Practice J3016. In doing so, it defines "highly automated vehicles" as "SAE Levels 3-5 vehicles with automated systems that are responsible for monitoring the driving environment."[37] Although it was wise for NHTSA to adopt SAE J3016 in lieu of government-unique definitions, the FAVP incorrectly interprets the levels to define vehicles themselves rather than the automated systems with which vehicles may be equipped.

Although it was wise for NHTSA to adopt SAE J3016 in lieu of government-unique definitions, the FAVP incorrectly interprets the levels to define vehicles themselves rather than the automated systems with which vehicles may be equipped.

3.1.2 AUTOMATED DRIVING SYSTEMS 2.0

One year later, in September 2017, NHTSA issued a revised guidance document, Automated Driving Systems 2.0 (ADS 2.0).[38] ADS 2.0 significantly reduces the size and scope of

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[36] Ibid.

[37] Ibid.

[38] "Automated Driving Systems 2.0," National Highway Traffic Safety Administration, *Nhtsa.gov*, 12 Sep. 2017. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf (20 Sep. 2020).

guidance relative to the FAVP, providing improved clarity and greater conformity with consensus standards.

ADS 2.0 correctly incorporates SAE J3016 as referring to levels of automation for automated driving systems (ADS), rather than vehicles that may be equipped with ADS, as the FAVP had done with "highly automated vehicles."[39] This guidance also reduces ADS safety elements from 15 to 12, and marks the first appearance of "technology-neutral" as a guiding principle for federal automated vehicle policy.[40]

ADS 2.0 also repeatedly emphasizes that it is a voluntary guidance document. The word "voluntary" as an adjective to the guidance appears 53 times throughout the document, compared to no mention at all of it in the FAVP. While guidance documents are inherently nonbinding, the FAVP lacked clarity on this point.

In contrast to the FAVP, ADS 2.0 explicitly states: "NHTSA strongly encourages States not to codify this Voluntary Guidance (that is, incorporate it into State statutes) as a legal requirement for any phases of development, testing, or deployment of ADSs."[41] While the FAVP did caution states that its guidance was "not mandatory" and "not intended for States to codify as legal requirements for the development, design, manufacture, testing, and operation of automated vehicles," as previously noted, the FAVP simultaneously urged states to "Implement a rule mandating the submission of the Safety Assessment letter identified in this Guidance" as a condition for state permit approval.

3.1.3 AUTOMATED VEHICLES 3.0

In October 2018, the U.S. Department of Transportation (DOT) released a supplementary guidance document called Automated Vehicles 3.0 (AV 3.0).[42] Unlike ADS 2.0 released in 2018, AV 3.0 builds upon rather than replaces existing automated vehicle guidance.

39 Ibid.

40 Ibid.

41 Ibid.

42 "Automated Vehicles 3.0," U.S. Department of Transportation, *Transportation.gov*, 4 Oct. 2018. https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/automated-vehicles/320711/preparing-future-transportation-automated-vehicle-30.pdf (20 Sep. 2020).

Departing from the previous narrow focus on light-duty automated road vehicles, AV 3.0 provides DOT-wide guidance across all modal operating administrations.[43]

In terms of recommendations, AV 3.0's most important contribution is that it announces future rulemakings designed to modernize terms such as "driver" and "operator" to include non-human direction, such as through automated driving systems.

In terms of recommendations, AV 3.0's most important contribution is that it announces future rulemakings designed to modernize terms such as "driver" and "operator" to include non-human direction, such as through automated driving systems.[44] As a resource, AV 3.0 also includes an appendix containing potentially relevant technical standards and ongoing automation standardization efforts, allowing interested readers to more easily observe and track the technical standard development progress.[45]

3.1.4 AUTOMATED VEHICLES 4.0

In January 2020, DOT and the National Science and Technology Council released the latest federal automated vehicles guidance document, Automated Vehicles 4.0 (AV 4.0).[46] Like AV 3.0, AV 4.0 builds upon earlier guidance rather than replacing it. And similar to AV 3.0, AV 4.0 expands the scope of the guidance from DOT's modal operating administrations to reach across the entire federal government.

43 The U.S. Department of Transportation's eight modal operating administrations are: Federal Aviation Administration, Federal Highway Administration, Federal Motor Carrier Safety Administration, Federal Railroad Administration, Federal Transit Administration, Maritime Administration, National Highway Traffic Safety Administration, and Pipeline and Hazardous Materials Safety Administration.

44 Ibid.

45 Ibid.

46 "Automated Vehicles 4.0," U.S. Department of Transportation and National Science and Technology Council, *Transportation.gov*, 8 Jan. 2020. https://www.transportation.gov/sites/dot.gov/files/2020-02/EnsuringAmericanLeadershipAVTech4.pdf (20 Sep. 2020).

For practical purposes, there is little new in AV 4.0 that didn't appear in previous guidance documents. However, it does spell out 10 principles and three broader themes that will guide the federal government in developing automated vehicle policy, which are reproduced in Table 3.

TABLE 3: U.S. GOVERNMENT AUTOMATED VEHICLE TECHNOLOGY PRINCIPLES

Policy Theme	Policy Principle
I. Protect Users and Communities	1. Prioritize Safety
	2. Emphasize Security and Cybersecurity
	3. Ensure Privacy and Data Security
	4. Enhance Mobility and Accessibility
II. Promote Efficient Markets	5. Remain Technology Neutral
	6. Protect American Innovation and Creativity
	7. Modernize Regulations
III. Facilitate Coordinated Efforts	8. Promote Consistent Standards and Policies
	9. Ensure a Consistent Federal Approach
	10. Improve Transportation System-Level Effects

Source: Automated Vehicles 4.0 (2020)

These policy principles recognize aspects of automated vehicle technology that are likely inappropriate for traditional vehicle regulators to address. For instance, DOT has very little expertise in matters of cybersecurity or data privacy, whereas the National Institute of Standards and Technology and Federal Trade Commission have extensive expertise and experience. If challenges arise in the future that are outside DOT's areas of expertise, DOT must decide whether to defer to other agencies with the relevant expertise or develop that expertise in-house. In many cases, the former option may be preferable to avoid confusing interagency policy redundancies or contradictions.

Even in settings where it does not write and enforce particular policies related to automated vehicles, DOT could still serve as a useful policy information clearinghouse. DOT's AV TEST Initiative, a voluntary program that collects data from vehicle developers and government agencies, provides an example of how this could be done. In September 2020, NHTSA launched its AV TEST Initiative Tracking Tool, which aims to compile information related to existing automated vehicle testing activities and state-level policies.[47] A similar repository could be developed by DOT that covers a broader set of automated vehicle activities and policies to keep policymakers and members of the public better informed of issues that may span across various agencies and levels of government.

3.2 REGULATION

To date, the federal government has not promulgated binding regulations related to automated vehicles. This is largely due to the current state of consensus technical standards and test procedures, and how federal motor vehicle safety regulations are developed.

By and large, technical standards and standardized test procedures for automated driving systems (ADS) remain under development. Enduring federal policy—formally codified by the National Technology Transfer and Advance Act of 1995 and subsequent incorporating guidance from OMB Circular A-119—directs federal regulators to, whenever possible, incorporate voluntary consensus standards in lieu of writing government-unique standards. Thus, given the lack of published ADS-specific voluntary consensus standards and standardized test procedures, regulators currently lack the technical information needed to effectively regulate ADS technologies. How to better ensure that NHTSA's Federal Motor Vehicle Safety Standards (FMVSS) conform to modern technical standards as technology advances is discussed in section 4.1.

3.2.1 ADS RULEMAKING ACTIVITIES

While the status of standards development makes it premature to promulgate significant ADS safety and performance regulations, there are seven active ADS-specific rulemaking projects at NHTSA, including one that entered the final rule stage. These are highlighted in Table 4.

47 "AV TEST Initiative Tracking Tool," National Highway Traffic Safety Administration. *Nhtsa.gov*. https://www.nhtsa.gov/automated-vehicles-safety/av-test-initiative-tracking-tool (4 Sep. 2020).

TABLE 4: ACTIVE ADS RULEMAKING PROJECTS AT NHTSA

Rulemaking Project Title	Project Stage	RIN
Pilot Program for Collaborative Research on Motor Vehicles with High or Full Driving Automation	Prerule	2127-AL99
Removing Regulatory Barriers for Automated Driving Systems	Prerule	2127-AM00
Occupant Protection for Automated Driving Systems	Final Rule	2127-AM06
Considerations for Telltales, Indicators and Warnings in ADS Vehicles	Prerule	2127-AM07
Safety Principles for Automated Driving Systems	Prerule	2127-AM15
Passenger-Less Delivery Vehicles Equipped with Automated Driving Systems	Prerule	2127-AM18
Specialized Motor Vehicles with Automated Driving Systems	Prerule	2127-AM19

Source: Unified Agenda of Federal Regulatory and Deregulatory Actions, Fall 2020
Note: RIN = Regulation Identifier Number

Of these seven ADS-specific rulemaking projects, only one—Occupant Protection for Automated Driving Systems—has so far reached the final rule stage in which NHTSA adopts amended regulatory text. This occurred in January 2021 with the release of a draft final rule.[48] In this rule, NHTSA would amend 13 of its 25 crashworthiness 200 Series FMVSS to address barriers to self-certifying ADS-equipped vehicles that NHTSA identified.[49] Specifically, NHTSA's new rule aims to:

- Modify definitions related to the "driver" because a human driver may not be present in an ADS-equipped vehicle;
- Make a distinction between vehicles that carry passengers versus those that carry only cargo and tailor occupant protection requirements accordingly;
- Clarify that occupant protection requirements related to steering wheels or steering columns do not apply if no steering wheel or steering column is present in the vehicle; and

48 "Occupant Protection for Automated Driving Systems," Pre-publication draft final rule, National Highway Traffic Safety Administration, Docket No. NHTSA-2021-0003, 14 Jan. 2021, archived at https://web.archive.org/web/20210117142037/https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ads_cw_final_rule_01142021.pdf.

49 NHTSA's Federal Motor Vehicle Safety Standards are generally organized into three categories: 100 Series crash avoidance regulations; 200 Series crashworthiness regulations; and 300 Series post-crash survivability regulations.

- Address possible vehicle designs where an ADS-equipped vehicle may have no driver seat and multiple outboard seats.[50]

This proceeding would result in the first substantive federal regulatory change related to ADS. However, with the change in administrations, a federal-wide "regulatory freeze" to allow new political appointees to review pending regulatory actions disrupted the publication of this final rule. NHTSA has removed the draft and accompanying press release from its website, and is not yet clear when or even if it will be published in the Federal Register and take effect. Given that research commissioned by NHTSA found that nearly half of its existing FMVSS may present self-certification challenges for ADS-equipped vehicles,[51] several more rulemakings of this sort will likely be needed to integrate ADS into the federal auto safety regulatory ecosystem.

Given that research commissioned by NHTSA found that nearly half of its existing FMVSS may present self-certification challenges for ADS-equipped vehicles, several more rulemakings of this sort will likely be needed to integrate ADS into the federal auto safety regulatory ecosystem.

3.2.2 FMVSS EXEMPTIONS

For ADS-equipped vehicles with novel designs that render them noncompliant with one or more FMVSS, temporary FMVSS exemptions are available. General FMVSS exemptions fall into four categories:

50 "Occupant Protection for Automated Driving Systems," Pre-publication draft final rule, National Highway Traffic Safety Administration, Docket No. NHTSA-2021-0003, 14 Jan. 2021, archived at https://web.archive.org/web/20210117142037/https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ads_cw_final_rule_01142021.pdf.

51 Anita Kim et al., "Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles," John A. Volpe National Transportation Systems Center, *Ntl.bts.gov*, National Transportation Library, 11 March 2016. https://rosap.ntl.bts.gov/view/dot/12260 (8 Oct. 2020).

1. Complying with an FMVSS would produce a "substantial economic hardship" after a manufacturer has made a good-faith compliance effort;[52]
2. Complying with an FMVSS would make it more difficult to develop or test a new safety feature, as long as the exemption ensures an equivalent or better level of safety as the FMVSS provides;[53]
3. Complying with an FMVSS would make it more difficult to develop or test a low-emission vehicle, as long as the exemption "would not unreasonably lower the safety level of that vehicle";[54] and
4. Complying with an FMVSS would prevent a manufacturer from selling a vehicle, as long as the exemption ensures an equivalent or better level of safety as the FMVSS provides.[55]

Manufacturers may produce up to 10,000 exempt vehicles per year if operating under the first (economic hardship) exemption, which may be granted for up to three years plus an additional renewal period of up to three years.[56] Manufacturers may produce only 2,500 exempt vehicles per year for the other exemption categories, which may be granted for up to two years plus an additional renewal period of up to two years.[57]

For the second (safety feature development and testing) and fourth (sales to the public) exemption categories, manufacturers must demonstrate to NHTSA that their noncompliant exempt vehicle would be *as safe as or safer than* a compliant vehicle. A noncompliant vehicle produced under the first (economic hardship) or third (low-emission vehicle development and testing) exemption categories is permitted to be *demonstrably less safe* than a compliant vehicle, although in the case of exempt low-emission vehicles, they may not "unreasonably lower the safety level."

In the case of noncompliant ADS-equipped vehicles, one developer has received a temporary FMVSS exemption to date. In October 2018, Nuro submitted a petition for exemption on three requirements of FMVSS No. 500, low-speed vehicles, which NHTSA

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52 49 U.S.C. § 30113(b)(3)(B)(i).

53 49 U.S.C. § 30113(b)(3)(B)(ii).

54 49 U.S.C. § 30113(b)(3)(B)(iii).

55 49 U.S.C. § 30113(b)(3)(B)(iv).

56 49 U.S.C. § 30113(d)–(e).

57 Ibid.

granted in February 2020.[58] Nuro was granted those exemptions under both the third (low-emission vehicle development and testing) and fourth (sale to the public) exemption categories, with NHTSA determining that exempting Nuro's noncompliant R2X ADS-equipped electric delivery vehicle would allow it to meet a level of safety equivalent to a compliant vehicle. Under the two-year exemption, Nuro will be able to produce up to 2,500 R2Xs each year, or up to 5,000 total.[59]

3.3 LEGISLATION

Over the last several decades, Congress has provided funding for road vehicle automation research. However, in the 115th Congress during 2017-2018, Congress made the first attempt to pass legislation intended to further the commercial integration of automated driving systems (ADS) into the vehicle fleet, with ADS-equipped vehicles being referred to as highly automated vehicles (HAVs). The House of Representatives was able to pass its bill for light-duty HAVs, the SELF DRIVE Act,[60] on a voice vote. The Senate's similar companion bill, the AV START Act,[61] was voted out of committee but failed to receive a floor vote.

"…during 2017-2018, Congress made the first attempt to pass legislation intended to further the commercial integration of automated driving systems (ADS) into the vehicle fleet, with ADS-equipped vehicles being referred to as highly automated vehicles (HAVs)."

58 "Nuro, Inc.; Grant of Temporary Exemption for a Low-Speed Vehicle With an Automated Driving System," National Highway Traffic Safety Administration, 85 Fed. Reg. 7,826, Docket No. NHTSA-2019-0017, 11 Feb. 2020.

59 Ibid.

60 Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution (SELF DRIVE) Act, H.R. 3388. 115th Congress, 1st Sess. (2017).

61 American Vision for Safer Transportation through Advancement of Revolutionary Technologies (AV START) Act, S. 1885. 115th Congress, 1st Sess. (2017)

Both bills would have preempted states on matters related to the design, construction, and performance of HAVs prior to the promulgation of FMVSS by NHTSA on these matters. In the current regulatory regime, states are preempted only after an FMVSS has been promulgated on a specific matter. The bills' proposed "pre-preemption" proved controversial among state government officials, who feared the bill would unduly restrict their traditional authorities.[62]

Each of the bills would have required that developers submit to NHTSA the safety assessment letters discussed in section 3.1. The House's SELF DRIVE Act would not have required making those manufacturer safety assessments public, while the Senate's AV START Act would have required NHTSA to make them publicly available within 60 days of receipt. However, both bills also prohibited NHTSA from conditioning developers' HAV testing or deployment on its review of the submitted safety assessment.

The SELF DRIVE and AV START Acts both attempted to spur FMVSS rulemaking action. The bills directed NHTSA to identify conflicts that existing FMVSS may pose to the self-certification of HAVs and new rulemakings on ADS-specific matters. The House's SELF DRIVE Act granted more deference to NHTSA, directing the agency to prioritize ADS rulemakings. In contrast, the Senate's AV START Act imposed a rulemaking deadline that could trigger an automatic update of any FMVSS found to present self-certification problems for HAVs.

"To be sure, Congress' intent to speed FMVSS modernization is laudable, but both bills failed to comprehend the current state of ADS-related voluntary consensus standards."

To be sure, Congress' intent to speed FMVSS modernization is laudable, but both bills failed to comprehend the current state of ADS-related voluntary consensus standards. The technical standards NHTSA needed for future incorporation into FMVSS do not exist and

62 Letter from National Governors Association, et al. to Sens. John Thune and Bill Nelson, and Rep. Gary Peters, 8 Nov. 2017. https://www.ncsl.org/Portals/1/Documents/standcomm/scnri/2017-11-08_State-Local_Letter_to_Senate_Commerce_on_AV_START_Act_FINAL_26427.pdf (7 Oct. 2020).

may not have existed in the rulemaking timeframes imposed by the bills. This issue is discussed in detail in section 4.1.

Both bills also made changes to FMVSS exemptions, as discussed in section 3.2. The House's SELF DRIVE Act created a new exemption class for HAVs that would have extended exemption and renewal terms to four years, with the annual cap rising from 25,000 in the first year to 50,000 in the second year, and to 100,000 in the third and subsequent years. Exemptions would only be granted if NHTSA made a safety equivalence finding. The Senate's AV START Act took a similar approach to FMVSS exemptions, with exemption caps rising from 15,000 in the first year to 40,000 in the second year, and 80,000 in the third and fourth year. After four years, a manufacturer could petition NHTSA for permission to produce more than 80,000 exempt HAVs during an additional two-year renewal period.

The bills included other provisions related to cybersecurity, privacy, consumer education, advisory committees, and other more minor matters. In September 2020, Rep. Bob Latta (Rep, Ohio) reintroduced the SELF DRIVE Act as a show of support for federal ADS legislation.[63] Although Congress has failed to pass comprehensive legislation related to ADS-equipped vehicles, it is likely to consider similar legislation in the future as the technology continues to progress.

63 Safely Ensuring Lives Future Deployment and Research In Vehicle Evolution (SELF DRIVE) Act, H.R. 8350. 116th Congress, 2nd Sess. (2020).

PART 4

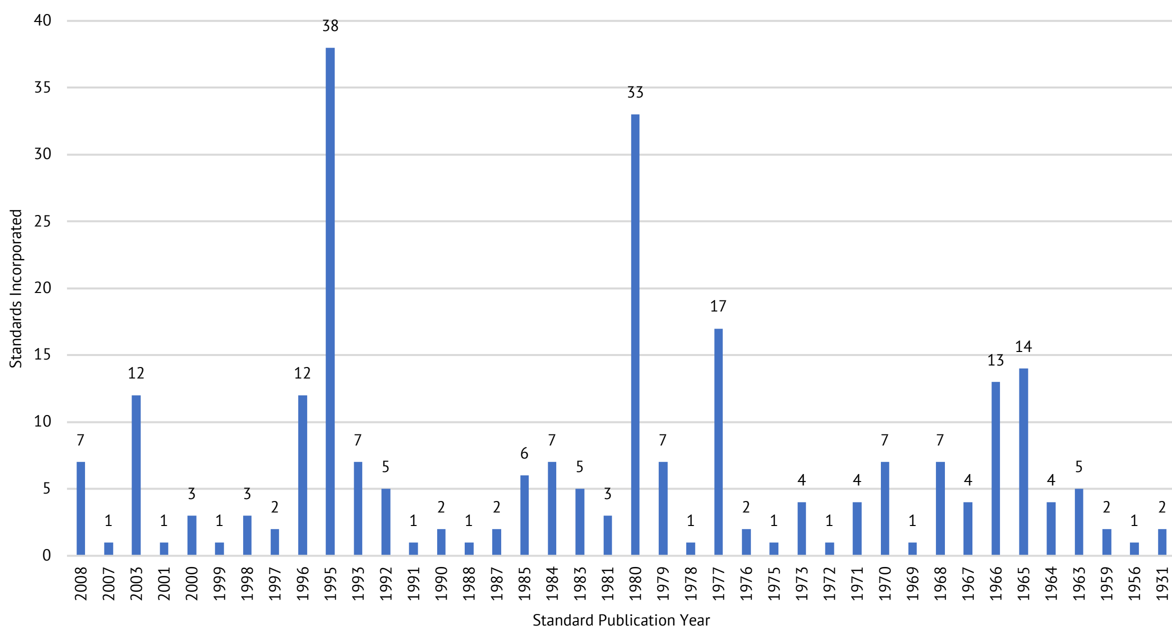
RECOMMENDATIONS FOR FEDERAL POLICYMAKERS

At this stage of automated vehicle development, uncertainty rules. Key technologies and corresponding technical standards are only beginning to emerge. As such, federal policymakers should focus on "no regrets" policies to further ongoing innovation while respecting public-interest considerations.

4.1 PROMOTE SOUND REGULATORY POLICY DEVELOPMENT

As noted in section 3.1, federal policy under the National Technology Transfer and Advancement Act and subsequent guidance from Office of Management and Budget Circular A-119 urge federal regulatory agencies to, whenever possible, rely on voluntary consensus technical standards in lieu of writing government-unique standards. In the case of NHTSA, it can take years to develop a consensus standard and then years more to complete an FMVSS rulemaking to incorporate that standard into regulation. And once that specific standard is incorporated, it tends to persist in regulation even when it is subsequently revised by the standards-developing organization. Figure 2 organizes the 255 nongovernmental technical standards incorporated by reference in NHTSA's 73 FMVSS by publication year, with the median publication year being 1980.[64]

FIGURE 2: PUBLICATION YEAR OF NONGOVERNMENTAL TECHNICAL STANDARDS INCORPORATED BY REFERENCE IN FEDERAL MOTOR VEHICLE SAFETY STANDARDS



Source: National Institute of Standards and Technology, Standards Incorporated by Reference Database, https://sibr.nist.gov/
Note: Excludes six standards coded as "NDG" (no date given)

Unlike peer countries in Europe and Asia that impose a form of premarket approval known as type approval, compliance with U.S. auto safety regulations is self-certified by automakers. Matters not covered by existing FMVSS are generally left up to automakers, provided their innovations do not interfere with FMVSS-required components and their operation. Increasingly, however, new technologies face barriers posed by existing FMVSS that limit these technologies' availability and performance.

64 The National Institute of Standards and Technology's (NIST) Standards Incorporated by Reference (SIBR) Database was last updated in August 2016. Correspondence between the author and NIST staff during July 2020 indicate the agency plans to relaunch the SIBR Database sometime in early 2021.

One recent example is adaptive driving beam (ADB) headlamps.[65] ADB headlamps eliminate the high- and low-beam distinction by using a lamp array containing dozens of individual LED bulbs that switch on and off depending on the driving conditions. The LED bulbs are computer-controlled to provide maximum visibility while minimizing glare to oncoming vehicles that are detected by onboard sensors. Drivers at night can then better avoid pedestrians, animals, or other hazards that may appear on roadways—enjoying the safety benefits of high-beam illumination without temporarily blinding oncoming drivers. This technology was widely adopted in Europe and Japan during the previous decade.

FMVSS No. 108 dictates vehicle lighting requirements. Some of the most significant headlamp technical standards incorporated in FMVSS No. 108 were published by the Society of Automobile Engineers (now SAE International) in the 1960s.[66] These standards presume discrete high- and low-beam headlamps. Regardless of whether or not the switch is manual or automatic, federal regulation requires that the headlamps in your car must be capable of binary switching between higher and lower illumination settings.

In 2013, Toyota petitioned NHTSA to amend FMVSS No. 108 to permit ADB headlamps.[67] SAE International and automakers argued that provisions related to semiautomatic beam-switching systems could allow ADB headlamps to be sold in the U.S., but NHTSA disagreed.[68] As a result of this regulatory resistance, SAE International published a new ADB headlamp standard in 2016, Recommended Practice J3069, to provide NHTSA with the necessary material to amend FMVSS No. 108 and legalize ADB headlamps.

In 2018, NHTSA finally granted Toyota's 2013 petition and published a notice of proposed rulemaking to amend FMVSS No. 108 to incorporate SAE International's ADB headlamp standard.[69] Although NHTSA most recently estimated publication to occur in October 2020, the final rule has still not been published. Total elapsed time from Toyota's initial request and NHTSA's implementation is seven years and counting.

65 Alex Leanse, "Get Lit With Adaptive Headlights—How Does the Tech Work?" *Motortrend.com*, Motor Trend, 26 May 2020. https://www.motortrend.com/news/get-lit-adaptive-headlights-tech-work/ (14 Oct. 2020).

66 49 C.F.R. § 571.108.

67 "Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices, and Associated Equipment," Notice of proposed rulemaking, National Highway Traffic Safety Administration, 83 Fed. Reg. 51,766. Docket No. NHTSA-2018-0090, 12 Oct. 2018.

68 Ibid.

69 Ibid.

This experience with ADB headlamps suggests NHTSA will have a difficult time modernizing its FMVSS regime to permit the wide range of potential automated driving system (ADS) use cases. Technical standards and standardized test procedures related to self-driving technologies remain under development. NHTSA itself has estimated that up to 45% of its FMVSS may present obstacles for developers seeking to self-certify ADS-equipped vehicles.[70] If left unchanged, U.S. auto safety regulation may significantly delay the wide deployment of what are expected to be far safer ADS-equipped vehicles.

Congressional reform is likely needed. One way to better ensure that FMVSS reflect modern technologies, technical standards, and test procedures has already been suggested by Congress in a non-automotive setting.

In regulating all-terrain vehicles (ATVs), Congress requires the Consumer Product Safety Commission to use an ATV standard developed by the American National Standards Institute (ANSI) and requires ANSI, or a successor organization, to notify the Consumer Product Safety Commission when it is considering a revision of the standard.[71] When ANSI or its successor notifies the CPSC of a revision to an ATV safety standard, the Commission has 120 days to either initiate a rulemaking proceeding "to include any such revision that the Commission determines is reasonably related to the safe performance of all-terrain vehicles" or "notify [ANSI] of any provision it has determined not to be so related."[72]

Congress could amend Chapter 301 of Title 49 of the U.S. Code to include a similar update trigger mechanism for NHTSA's FMVSS. Such a mechanism would not force NHTSA to adopt new or revised technical standards in regulation, but it would force a decision on whether to adopt or not—and if not, explain why not. For example, 49 U.S.C. § 30111 could be amended to add new subsection (g):

> (g) Revisions to Voluntary Consensus Standards:
>
>> (1) If a voluntary consensus standards body revises a voluntary consensus standard incorporated in whole, in part, or by reference in any motor vehicle safety standard prescribed under this chapter, it shall notify the Secretary of the revision. The Secretary shall publish a notice in the Federal Register to inform the public of the new voluntary consensus standard unless, within 90 days after receiving notice of

70 Anita Kim et al., "Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles."

71 15 U.S.C. § 2089.

72 Ibid.

> the new voluntary consensus standard and after opening a period for public comment on the new standard, the Secretary notifies the voluntary consensus standard body that the Secretary has determined that the new voluntary consensus standard or any provision thereof does not meet the need for motor vehicle safety, or is otherwise inconsistent with the purposes of this chapter.
>
> (2) If the Secretary does not reject a voluntary consensus standard revised by the voluntary consensus standard body as described in paragraph (1), the Secretary shall promptly make any conforming amendments to the regulations and standards of the Secretary that are necessary. The revised voluntary consensus standard shall apply for purposes of this chapter.

In addition to allowing superior, safer technologies to come to market more rapidly, refocusing NHTSA on keeping its auto safety regulations reflective of ever-improving technology could reduce its discretion to initiate extraneous rulemaking projects and provide greater transparency to the motor vehicle safety regulatory process. ADS standards development remains at an early stage, so reforming the process by which NHTSA incorporates voluntary consensus technical standards into FMVSS could yield substantial benefits when ADS-related technical standards are published and revised in the future. Congress and NHTSA should investigate the resource needs required by NHTSA to carry out this reformed process.

As it stands, technical standards and standardized test procedures for ADS remain under development. Numerous international standards-developing organizations are working on various ADS technical standards. Most notably, SAE International has convened the Automated Vehicle Safety Consortium to establish safety and testing principles related to on-road operations, data collection and sharing for event reconstruction, and interactions with first responders.[73] Few if any technical standards are ripe for regulatory incorporation by NHTSA today, but safety regulators and members of Congress should monitor these activities closely to ensure that future legislation and regulations reflect engineering best practices.

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[73] "Automated Vehicle Safety Consortium," *Sae-itc.org*, SAE International Industry Technologies Consortia, 3 April 2019. https://avsc.sae-itc.org/ (21 Oct. 2020).

4.2

PROVIDE TEMPORARY REGULATORY RELIEF FOR DEVELOPERS

As noted in section 4.1, NHTSA's experience with past rulemakings suggests ADS-related FMVSS modernization may take years even after relevant voluntary consensus technical standards are published. ADS developers wishing to bring their technologies to market prior to the promulgation of new or amended safety regulations will likely need to seek temporary FMVSS exemptions.

Under current law, FMVSS exemptions limit ADS developers to 2,500 vehicles per year for two years, with an opportunity to renew the exemption for another two years, as discussed in section 3.2. For comparison, established parcel carriers operate hundreds of thousands of delivery vehicles, and ride-hailing firms have more than a million drivers in the U.S. A recent report commissioned by Nuro estimates that approximately a quarter million to two million ADS-equipped delivery vehicles will be needed to meet U.S. customer demand by 2030.[74] Ten thousand exempt vehicles over four years per manufacturer is not nearly enough to allow providers of ADS-enabled services such as taxis and last-mile delivery to scale nationwide.

Both the SELF DRIVE and AV START Acts highlighted in section 3.3 would have substantially increased the annual FMVSS exemption cap for ADS-equipped vehicles from 2,500 to 100,000 and at least 80,000, respectively. Both would have also increased the length of the exemption period from two years to four years, with the potential for renewing the exemption for an additional four years.

Raising the annual FMVSS exemption cap is the most important action Congress could take to support safe deployment in the near-term while technical standards and FMVSS remain under development. Requiring developers to demonstrate an equivalent level of safety or better prior to granting an exemption—a condition long required under most conventional exemption categories—should be maintained for noncompliant ADS-equipped vehicles. Coupled with this mandated safety assurance, Congress should increase the annual FMVSS exemption cap for ADS-equipped vehicles to at least 100,000 to ensure that the public is not denied safer and more-efficient transportation options prior to the promulgation of ADS-specific FMVSS.

[74] "Economic Impacts of Autonomous Delivery Services in the US," *Steergroup*.com, Steer Davies & Gleave Limited, 10 Sep. 2020. https://www.steergroup.com/sites/default/files/2020-09/200910_%20Nuro_Final_Report_Public.pdf (21 Oct. 2020).

4.3

ENSURE UNIFORMITY IN VEHICLE SAFETY AND PERFORMANCE POLICY

In the absence of federal ADS-specific legislation and regulation, states have begun to occupy the policy field. In 2011, Nevada became the first U.S. state to enact automated vehicle legislation.[75] 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.[76] Of those, 30 have successfully enacted legislation.[77] Table 5 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.[78]

TABLE 5: ENACTED STATE AUTOMATED VEHICLE LEGISLATION BY TYPE, 2017-2020

Legislation Type	Number of States with Enacted Legislation
Commercial	22
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 Testing	11

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

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 NHTSA and the Federal Motor Carrier Safety

75 "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 (21 Oct. 2020).

76 Ibid.

77 Ibid.

78 "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 (21 Oct. 2020).

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 ADS developers to decamp to states that do respect the traditional divisions of authority and competence between the various levels of government.

A patchwork of state and local laws and regulations on matters where state and local governments lack expertise would likely hamper ADS development and deployment. When ADS-equipped vehicles are demonstrated to be safer than conventional manually driven vehicles, such a haphazard ADS policy environment would likely translate into additional fatalities, injuries, and property damage that could have otherwise been prevented.

Congress attempted to address the dangers of an ADS policy patchwork in the SELF DRIVE and AV START Acts, but faced resistance from state and local officials, which is discussed in section 3.3. In the absence of ADS-specific FMVSS, federal policymakers should be careful to balance the benefits of uniform national safety and performance policies with the risks of overstepping traditional divisions of motor vehicle regulatory authority rightfully and expertly wielded by state and local governments. Any “pre-preemption” included in future federal ADS legislation should be careful to respect existing state and local authorities in driver licensing, vehicle registration, traffic operations, insurance, and liability determination.

4.4 AVOID COLLATERAL POLICY DAMAGE

At this nascent stage of innovation, government failure looms large as a threat to ADS development and deployment. During the public debate over the SELF DRIVE and AV START Acts of the 115th Congress, lobbyists representing trial lawyers objected to the legislation because it failed to create a new special exemption from the Federal Arbitration

Act of 1925 for future ADS-equipped vehicle operators.[79] At the behest of labor unions representing workers in driver occupations, the bills arbitrarily excluded heavy-duty vehicles from their proposed regulatory frameworks.[80] An entity representing itself as a group of highway safety advocates publicly endorsed and then publicly opposed the same legislation.[81]

With all of this confusion sowed by outside special-interest groups, it is no surprise that Congress failed to advance comprehensive ADS policy. Going forward, Congress should endeavor to remain focused on the few ADS policy subjects where sufficient information is available to evaluate and act upon. For instance, it is widely accepted that the current FMVSS rulemaking process is likely to significantly lag technology development over the medium term, so Congress should work to modernize those administrative processes. It is also widely accepted that existing FMVSS temporary exemption caps will prevent large-scale, near-term deployments if ADS-equipped vehicles are demonstrated to be safer than conventional vehicles, so Congress should increase the annual exemption cap.

In the case of Congress' past arbitrary bifurcation of light-duty and heavy-duty ADS-equipped vehicles, Congress should not allow unsubstantiated fears about secondary workforce impacts to hinder technological and highway safety progress. Many promising applications of ADS involve large freight and passenger vehicles. In recent years, Congress has repeatedly expressed a variety of concerns about motor carrier driver safety. Intentionally undercutting the development and deployment of ADS-equipped heavy-duty vehicles by excluding them from a national regulatory framework is wholly inconsistent with a safety-focused approach, and forgoes the potential consumer and business benefits.

Legacy special-interest groups have numerous and often competing biases such that meeting all of their demands will prove to be impossible. The proprietary nature of many ADS technologies, along with the lack of consensus technical standards and standardized test procedures, means that policymakers seeking to do too much too early are likely to fail to meet their public interest objectives.

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PART 5

CONCLUSION

With so much uncertainty around developer testing progress, deployment dates, and technical standardization, federal policymakers have a difficult task ahead of them in crafting automated vehicle policies. Despite this uncertainty, federal lawmakers and regulators can chart a path forward. Federal policymakers should:

- **Promote Sound Regulatory Policy Development:** Policymakers should adhere to longstanding federal policy and generally rely on voluntary consensus technical standards that are developed by independent standards-developing bodies, rather than attempting to write government-unique standards, to modernize automated vehicle safety and performance regulations.
- **Provide Temporary Regulatory Relief for Developers:** As safety and performance regulations are being modernized, Congress should raise the annual cap on temporary regulatory exemptions and require that exempt automated vehicles under the higher cap meet an equivalent level of safety or better.
- **Ensure Uniformity in Vehicle Safety and Performance Policy:** Policymakers should be careful to balance the benefits of uniform national safety and performance policies with the risks of overstepping traditional divisions of motor vehicle regulatory authority rightfully and expertly wielded by state and local governments.
- **Avoid Collateral Policy Damage:** Legacy special-interest groups have numerous and often competing biases such that meeting all of their demands will prove to be impossible. The proprietary nature of many ADS technologies, along with the lack of consensus technical standards and standardized test procedures, means that

policymakers seeking to do too much too early are likely to fail to meet their public interest objectives.

The 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. Modernizing the regulatory framework to allow for the more rapid uptake of technology knowledge must be paired with the recognition that this effort will take time to bear fruit, which necessitates a related modernization of exemptions from that regulatory framework as a safety valve.

Going forward, there will be much more policymaking and fine-tuning of existing policies to better match the technological, economic, and social challenges 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.

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