NEW MEXICO LAW REVIEW

Volume 47
Issue 1 *Winter*

Winter 2017

How Governments Can Promote Automated Driving

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I. ABSTRACT

This Article presents steps that governments can take now to encourage the development, deployment, and use of automated road vehicles. After providing technical and legal context, it describes key administrative, legal, and community strategies to promote automated driving. It concludes by urging policymakers to facilitate automated driving in part by expecting more from today's drivers and vehicles.

II. INTRODUCTION

This Article responds to a frequent question from public officials at all levels of government in the United States and abroad: "What can we do to get self-driving cars here now?" This question reflects a generalized desire to encourage a set of technologies that could fundamentally redefine society's relationship with mobility. It also reflects a more specific desire that the research, development, demonstration, and deployment of these automated driving technologies happen "here" rather than elsewhere.

The strategies presented in this Article address both desires. These strategies are directed primarily at state and local governments in the United States, but many are also relevant to the federal government and to governments in other countries. The focus is not on regulating automated driving, which is a topic considered elsewhere,[1] but rather on encouraging it. Positively affecting automated driving is also distinct from actually effecting it: Outstanding technical and quasi-technical challenges mean that a government could not will full driving automation into existence even by mandating it.

Overcoming these challenges will require tremendous technological advances in design as well as in assurance. No serious developers claim that their automated driving systems are "ready" for unsupervised operation across a wide

1. *See, e.g.*, JAMES M. ANDERSON ET AL., RAND CORP., AUTONOMOUS VEHICLE TECHNOLOGY: A GUIDE FOR POLICYMAKERS (2016), http://www.rand.org/pubs/research_reports/RR443-2.html; INT'L TRANSP. FORUM, ORG. FOR ECON. CO-OPERATION AND DEV. (OECD), AUTOMATED AND AUTONOMOUS DRIVING: REGULATION UNDER UNCERTAINTY 593 (May 2015) [hereinafter OECD, REGULATION UNDER UNCERTAINTY], http://www.itf-oecd.org/sites/default/files/docs/15cpb_autonomousdriving.pdf (Bryant Walker Smith & Joakim Svensson, principal contributing authors); Bryant Walker Smith, *Regulation and the Risk of Inaction*, *in* AUTONOMES FAHREN: TECHNISCHE, RECHTLICHE UND GESELLSCHAFTLICHE ASPEKTE (Markus Maurer et al. eds., 2015) [hereinafter Smith, *Risk of Inaction*]; Bryant Walker Smith, *Automated Vehicles Are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411 (2014) [hereinafter Smith, *Automated Vehicles are Probably Legal*].

range of complex driving environments.[2] Indeed, no such developer has even publicly clarified what readiness actually entails. Eventually, however, a company will candidly explain how it "(a) defines reasonable safety, (b) will satisfy itself that its system is reasonably safe, and (c) will continue to do so over the lifetime of the system."[3] At that point, automated driving will be imminent.

Governments can anticipate—and possibly even accelerate—this watershed by taking some or all of the actions described in this Article. These strategies, which were identified through extensive discussions with developers and regulators of automated driving systems as well as other emerging technologies, are roughly organized into three overlapping categories:

- **Administrative strategies** include preparing government agencies, preparing public infrastructure, leveraging procurement, and advocating for safety mandates.
- **Legal strategies** entail carefully analyzing and, as necessary, clarifying existing law as it applies to automated driving; many of these strategies would also internalize more of the costs of conventional driving in a way that could properly incentivize automated driving.
- **Community strategies** involve identifying specific local needs, opportunities, and resources that may be relevant to automated driving—and that could inform applications for public and private grants that may soon be announced.

Critically, these strategies do not include passing the kind of superficial "autonomous driving law" that has been popular in statehouses. By increasing the inconsistency and incoherence of state vehicle codes, such laws can actually stymie rather than encourage automated driving.

In contrast, more useful actions start with a nuanced understanding of the relevant technologies, their applications, and the existing laws that they implicate. Accordingly, this Article begins with social, legal, and technical overviews. It also relies on the levels of driving automation developed by SAE International, which provide a common vocabulary for developers, regulators, and policymakers.[4]

Although different forms of automated driving merit different policy responses, an overarching theme of this Article is that policymakers can encourage automated driving by expecting more from today's drivers and vehicles. This is a crucial message with implications for other emerging technologies: New

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2. *See* Bryant Walker Smith, *A Legal Perspective on Three Misconceptions in Vehicle Automation*, *in* LECTURE NOTES IN MOBILITY: ROAD VEHICLE AUTOMATION 85, 85 (2014) [hereinafter Smith, *Three Misconceptions*].

3. Bryant Walker Smith, *New Years Resolutions for Developers of Automated Vehicles*, CTR. FOR INTERNET & SOC'Y (Jan. 10, 2016, 9:03 AM) [hereinafter Smith, *New Years Resolutions*], https://cyberlaw.stanford.edu/blog/2016/01/new-years-resolutions-developers-automated-vehicles; *see also* Smith, *Risk of Inaction*, *supra* note 1.

4. *See* SAE INT'L, J3016: TAXONOMY AND DEFINITIONS FOR TERMS RELATED TO ON-ROAD MOTOR VEHICLE AUTOMATED DRIVING SYSTEMS (Jan. 16, 2014) [hereinafter SAE J3016]. I was one of the primary authors of this document as well as of the forthcoming revision.

technologies are still part of this world, and governments seeking to promote or regulate them should do so with a clearer and more critical understanding of today's legal and policy structures.

III. IN CONTEXT

A. A Future Different from the Present

The Jetsons fallacy[5] describes predictions made by extrapolating individual items of interest into the future while holding everything else in the world—other technologies, laws, norms, values, and markets—constant. In this way, although The Jetsons (a 1960s television show set a century in the future)[6] features flying cars, these cars are manually driven by men, and an entire episode revels in the sexist trope that women are bad drivers.[7] The writers essentially launched the 1960s into space.

Policymakers should strive to avoid the Jetsons fallacy by checking and noting their assumptions about the present as well as the future. In the context of automated driving, this means liberating visions of automated systems from conventional notions about the design, operation, and ownership of cars.

Consider, for example, potential transportation options for someone who, years from now, needs to buy a set of contact lenses. They may walk or bike to a convenience store—a trip that might be safer and more enjoyable if automated vehicles properly yield the right of way to them. They might manually drive their personal car, direct that car to drive them, or get picked up by a robotaxi that they share simultaneously or sequentially with others. Alternately, they might have the lenses delivered by sidewalk robot, take delivery by aerial drone, or simply print the lenses on their 3D printer. A vision of the future in which vehicles are simply robotic versions of "your father's Oldsmobile"[8] fails to capture this potential diversity.

A broader vision can also challenge economic assumptions about automated driving. On one hand, wealthy car owners may be the first to use advanced driver assistance systems. As these systems become more advanced, they may compete with airlines (and trains and even hotels) for long-distance travel. On the other hand, a wider range of people living in dense urban areas, bus-dependent suburbs, retirement communities, and military bases could conceivably be some of the first to routinely use driverless shuttles that are initially restricted to particular geographic areas.

This broader vision also suggests that the rash of recent studies purporting to measure consumer demand for automated driving provides little insight into the

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5. *See, e.g.*, Lisa Mundy, *The Jetson Fallacy: Much Longer Lifespan Could Explode the Nuclear Family*, SLATE (Oct. 21, 2013), http://www.slate.com/articles/technology/future_tense/2013/10/jetson_fallacy_if_we_live_to_150_the_nuclear_family_will_explode.html.

6. *The Jetsons*, HANNA-BARBERA WIKI, http://hanna-barbera.wikia.com/wiki/The_Jetsons (last visited Mar. 11, 2016).

7. Matt Novak, *Jane Jetson and the Origins of the "Women are Bad Drivers" Joke*, SMITHSONIAN (Feb. 14, 2013), http://www.smithsonianmag.com/history/jane-jetson-and-the-origins-of-the-women-are-bad-drivers-joke-17672597/.

8. Edward McClelland, *It Really Was My Father's Oldsmobile*, SALON (Apr. 2, 2009, 6:30 AM), https://www.salon.com/2009/04/02/oldsmobile/.

actual appeal of automated systems.[9] These systems could eventually serve a broad range of consumers, including those who cannot, cannot yet, or can no longer drive; those who cannot afford to drive as well as those who can earn more by not driving; and those who discover that relaxing in a car or even at home is preferable to driving. Businesses may also turn to automated systems to perform delivery and other logistics functions that may depend less on individual consumer beliefs about automated driving. In short, governments should plan on the basis of tomorrow's potential utility, not today's purported perception.

Internet access illustrates how state and local governments might approach policy choices regarding automated driving. Imagine a municipality in the 1990s deciding whether and how to aggressively pursue Internet access for its residents. Many of these residents, if surveyed, might report little interest in such access because they had yet to realize its broad utility and eventual appeal.[10]

The local government might accordingly decline to make any infrastructure investments and defer to private infrastructure operators. The result would be, much as it is today, higher speeds in areas that are wealthier, denser, and otherwise more economically attractive with lower speeds—even dial-up—to others.[11]

That government might instead decide to deploy a citywide broadband network. The result could be a smattering of communities with Gigabit speeds and the unique opportunities that such speeds create. These communities can be found all across the United States today.[12]

Alternatively, that government might recognize the potential of broadband but, rather than developing a municipal network, hope to become a flagship center for a private company's efforts. Many communities have actually made this gamble, and some of them have been rewarded by projects such as Google Fiber.[13]

Finally, at the same time that communities are considering, developing, or competing for these networks, another technology—like high-speed cellular—may emerge as an unexpected alternative. This, in many areas, has also happened.[14]

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9. *E.g.*, BRANDON SCHOETTLE & MICHAEL SIVAK, UNIV. OF MICH. TRANSP. RESEARCH INST., A SURVEY OF PUBLIC OPINION ABOUT AUTONOMOUS AND SELF-DRIVING VEHICLES IN THE U.S., THE U.K., AND AUSTRALIA (July 2014), https://deepblue.lib.umich.edu/bitstream/handle/2027.42/108384/103024.pdf; Press Release, Inst. of Elec. & Elecs. Eng'rs (IEEE), IEEE Survey Indicates When it Comes to Driverless Cars—You can Take Me, but not My Kids (Oct. 15, 2015), https://www.ieee.org/about/news/2015/15october_2015.html; Press Release, World Econ. Forum, Self-Driving Vehicles in an Urban Context 3 (Nov. 24, 2015), http://www3.weforum.org/docs/WEF_Press%20release.pdf.

10. *See* SUSANNAH FOX & LEE RAINIE, PEW RESEARCH CTR., THE WEB AT 25 IN THE U.S., at 9–10 (Feb. 27, 2014), http://www.pewinternet.org/2014/02/27/part-1-how-the-internet-has-woven-itself-into-american-life/.

11. See *2016 Broadband Progress Report: Residential Fixed 25 Mbps/3 Mbps Broadband Deployment*, FCC, https://www.fcc.gov/reports-research/maps/bpr-2016-fixed-25mbps-3mbps-deployment/ (last updated Jan. 29, 2016).

12. *Broadband USA: Connecting America's Communities*, NAT'L TELECOMM. & INFO. ADMIN. (NTIA), U.S. DEP'T OF COM., http://www2.ntia.doc.gov/ (last visited Nov. 2, 2016); *Community Network Map*, INST. FOR LOC. SELF-RELIANCE, http://www.muninet works.org/communitymap (last updated Oct. 2015); NAT'L BROADBAND MAP, https://www.broadbandmap.gov/technology (last updated June 30, 2014).

13. *Expansion Plans,* GOOGLE FIBER, https://fiber.google.com/newcities/ (last visited Nov. 2, 2016).

14. NAT'L BROADBAND MAP, *supra* note 12.

These scenarios foreshadow the public opportunities and challenges in encouraging vehicle automation. Some state and local governments will do nothing, while others will move aggressively. All will encounter surprises.

The result will likely be a mixture of optional luxury features as well as standard safety devices, publicly supported transit systems as well as privately managed mobility services, and localized deployments as well as (nominally) nationwide networks.

Because the opportunities available to a particular community may depend in part—though by no means exclusively—on policies that find their expression in law, the next part considers this legal context.

B. The Legal Context

Automated vehicles[15] will confront a complex web of existing law about their design, marketing, and operation. Some of this law may hinder deployment of these vehicles, some may help deployment, some may have an uncertain effect, and some will have no effect at all. Two related points are critical to understanding the role of this existing law.

First, details matter. A 2012 review of relevant law found a variety of rules that could conceivably complicate the legal operation of automated vehicles.[16] New York, for example, requires a driver to keep at least one hand on the steering wheel while her vehicle is in motion.[17] Other states specify minimum following distances that would be incompatible with automated vehicle platoons.[18] California requires insurers to base their rates on factors that may make little sense in a world of automated vehicles.[19] And the Federal Transit Act could complicate federally funded projects that eliminate existing transit jobs.[20]

Second, the broader social context will shape many of these details. Laws can change even though their text remains the same.[21] Whether automated driving is consistent with state provisions requiring vehicles to be safe and drivers to act prudently, for example, could depend on whether society embraces or rejects automation. Societal views, for their part, will depend at least as much on compelling stories, pictures, and numbers as they will upon the realities of the technologies.

New laws could likewise help or hinder automated driving. A key corollary is that passage of an automated driving bill actually says very little about a state's

15. An automated vehicle is one for which the real-time driving task is automated. Although this term has been criticized, *see, e.g.*, SAE J3016, *supra* note 4, once defined it is useful shorthand for this broad category of vehicles.

16. Smith, *Automated Vehicles Are Probably Legal*, *supra* note 11, at 413.

17. *Id.* at 485 (citing N.Y. VEH. & TRAF. LAW § 1226 (McKinney 2013)).

18. *Id.* at 519–21.

19. Robert W. Peterson, *New Technology—Old Law: Autonomous Vehicles and California's Insurance Framework*, 52 SANTA CLARA L. REV. 1341, 1345–46 (2012).

20. *See* Federal Transit Act, 49 U.S.C. § 5333(b) (2012) (also known as Section 13(c)); *see also* Daniel Duff et al., Transit Coop. Research Program (TCRP), *Legal Aspects Relevant to Outsourcing Transit Functions Not Traditionally Outsourced*, *in* 38 LEGAL RESEARCH DIGEST 3–4 (July 2011), http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_lrd_38.pdf.

21. *See, e.g.*, Nicholas S. Zeppos, *Judicial Candor and Statutory Interpretation*, 78 GEO. L.J. 353, 357 (1989).

preparation for or promotion of automated driving. Michigan, for example, enacted a statute that expressly prohibits any automated driving other than for research and development.[22] California required its Department of Motor Vehicles (DMV) to develop regulations for general consumer operation that are now over a year overdue and have only increased uncertainty about the legal status of automated driving in that state.[23]

Key developers of automated systems have either opposed or declined to support many state bills on automated driving.[24] These developers are generally wary of both process (legislative and potentially administrative efforts in multiple states) and product (disparate legal regimes that create confusion, inconsistency, and unintended impediments to innovation). A legislator who introduces a bill without consulting these developers may get their attention—but probably not their affection.

In contrast, useful legislation will come from "legal research and development."[25] Established developers of automated systems should be conducting legal research commensurate with their technical research. When they are ready to publicly test or deploy a system, they should understand what specific legal changes (if any) are necessary or helpful. Google requested and closely shaped bills in Nevada and, to a lesser extent, California.[26] A truck platooning developer, Peloton, requested a specific bill in Utah.[27] Years earlier, Segway took a similar approach nationwide.[28] Uber has largely succeeded (at least in the United States) in codifying its argument that it is materially different from a traditional taxi dispatch company.[29] This pattern will happen again: A prominent company will announce an automated driving product or service and will then describe any specific legal changes necessary for its deployment. If the message (or messenger) is powerful, many states will likely accede.

22. MICH. COMP. LAWS ANN. § 257.244 (West 2014).

23. *Compare* S. Rules Comm., S.B. 1298, 112th Cong. (Cal. 2012), http://www.legislature.ca.gov/cgi-bin/port-postquery?bill_number=sb_1298&sess=1112&house=B&author=padilla (specifying a January 2015 deadline for a final rule), *with Deployment of Autonomous Vehicles for Public Operation*, STATE OF CAL. DEP'T OF MOTOR VEHICLES, https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto (last visited Nov. 2, 2016) (releasing an early draft of that rule in December 2015).

24. *E.g.*, Aman Batheja, *Self-Driving Car Bill Stalled by Google, Carmakers*, TEX. TRIB. (Apr. 22, 2015), https://www.texastribune.org/2015/04/22/self-driving-car-bill-stalled-google-carmakers/.

25. *See, e.g.*, Smith, *Risk of Inaction*, *supra* note 1.

26. Justin Pritchard, *How Google Got States to Legalize Driverless Cars*, ASSOCIATED PRESS (May 30, 2014, 8:15 PM), http://bigstory.ap.org/article/how-google-got-states-legalize-driverless-cars.

27. *See* H.B. 373, 2015 Gen. Sess., 114th Cong. (Utah 2015), http://le.utah.gov/~2015/bills/static/HB0373.html.

28. *See Become Familiar with the Regulations in Your State*, SEGWAY, http://www.segway.com/support/regulatory-information (last visited Nov. 7, 2016) (providing the regulatory information regarding Segways for various states).

29. *See, e.g.*, Alison Griswold, *Uber Pulled Off a Spectacular Political Coup and Hardly Anyone Noticed*, QUARTZ (Jan. 21, 2016), http://qz.com/589041/uber-pulled-off-a-spectacular-political-coup-and-hardly-anyone-noticed/; Heather Somerville & Dan Levine, *Uber Winning Make or Break Legal Battles Across America*, REUTERS (Dec. 11, 2015, 8:55 am), http://www.reuters.com/article/us-uber-statelaws-idUSKBN0TT2MZ20151211. *But see* David Hellier, *From Rio to Paris—Uber is Fighting Battles Across the Globe*, GUARDIAN (Oct. 2, 2015, 12:27 PM), http://www.theguardian.com/technology/2015/oct/02/uber-global-battles-from-rio-paris-amsterdam.

Public actors can also undertake legal research and development.[30] Some developers may be too small to obtain sufficient legal advice or too politically powerless to obtain legal change. California's process, for example, disadvantaged particular systems—like automated trucks[31] and delivery robots[32]—that Google was not publicly pursuing. In these cases, legal R&D may identify useful legal changes that more established developers may not need or even want.

This kind of policy work may also identify public interests that are challenged either by specific technologies or by bills that would ostensibly advance those technologies. The first generation of automated driving bills saw disagreements about certifying safety, reporting incidents, collecting data, and limiting liability that involved conflicts in values and interests.[33] Legal R&D undertaken by or for government can inspire and inform these policy discussions.

Legal R&D can also help to match legal tools to policy goals. Legislation is only one of these tools: Law can also be made or shaped through agency rules, executive orders, legal opinions, and policy guidance. Moreover, as the strategies in this Article demonstrate, policymaking is much broader than classic lawmaking.

As noted at the outset, this Article does not recommend a comprehensive policy toward automated driving. Instead, it identifies strategies for state and local governments that want to encourage this set of technologies and applications. The next part explains these technologies and applications by reference to three pathways to fully automated driving.

C. Three Pathways to Fully Automated Driving

Full automation entails the complete replacement of the human driver under all roadway and environmental conditions.[34] Although a fully automated vehicle does not yet exist,[35] there are at least three development pathways that could eventually lead to such a vehicle: advanced driver assistance systems, automated emergency intervention systems, and driverless systems.

An **advanced driver assistance system** (ADAS) supports a human driver by performing some combination of steering, braking, and accelerating over a sustained period. Many such systems are already available in production vehicles:

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30. *See infra* text accompanying note 31.

31. *See* CAL. CODE REGS., tit. 13, § 227.52 (2014), https://www.dmv.ca.gov/portal/wcm/connect/d48f347b-8815-458e-9df2-5ded9f208e9e/adopted_txt.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=d48f347b-8815-458e-9df2-5ded9f208e9e (excluding any "vehicle with a gross vehicle weight of 10,001 or more pounds" from the state's automated driving testing regime).

32. *See id.* § 227.34 (requiring the operator of an automated test vehicle to be "seated in the vehicle's driver seat").

33. *See generally* Gabriel Weiner & Bryant Walker Smith, *Automated Driving, Legislative and Regulatory Action*, CTR. FOR INTERNET & SOC'Y (Oct. 2, 2016 5:06 PM), https://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action.

34. SAE J3016, *supra* note 4. SAE's levels of driving automation describe driving automation systems rather than vehicles, but for simplicity this paper refers directly to vehicles equipped with such systems.

35. Smith, *Three Misconceptions*, *supra* note 2.

Under optimal conditions, some luxury vehicles from Daimler,[36] Nissan,[37] Volvo,[38] and Tesla,[39] among others,[40] can adjust their speed based on traffic conditions, maintain lane position even through gradual curves, and come to a complete stop to avoid or mitigate a crash. Many automakers are likely to introduce similar features on more models in the next few years.

Moreover, the capabilities of these systems are likely to improve in the future. SAE International's levels of driving automation describe the respective roles of the driving automation system and the human driver for present as well as potential driving automation systems.[41]

The production systems described above currently achieve no more than level two automation; at any moment the human driver may need to resume actively steering, accelerating, or decelerating.

A particularly significant jump will occur at level three when, as a technical matter, the human driver need not monitor the driving environment while the automated driving system is engaged.[42] This is also the point at which state automated-driving laws probably apply.[43] Even at this point, however, the human driver may still play an important role by actively driving in situations outside of the particular system's design parameters. In this way, the human driver acts as a backup to the automated driving system.

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36. *S-Class Sedan*, MERCEDES-BENZ, https://www.mbusa.com/mercedes/vehicles/class/class-S (last visited Nov. 15, 2016).

37. *2017 Q50 Sedan*, INFINITI, http://www.infinitiusa.com/sedan/q50/highlights/technology.html (last visited Nov. 15, 2016).

38. *2017 XC 90*, VOLVO, http://www.volvocars.com/us/cars/new-models/all-new-xc90 (last visited Nov. 15, 2016).

39. *Your Autopilot Has Arrived*, TESLA MOTORS (Oct. 14, 2015), https://www.teslamotors.com/blog/your-autopilot-has-arrived.

40. *See generally* MYCARDOESWHAT.ORG, https://mycardoeswhat.org (last visited Nov. 15, 2016)

41. *See* SAE J3016, *supra* note 4; Bryant Walker Smith, *SAE Levels of Driving Automation*, CTR. FOR INTERNET & SOC'Y (Dec. 18, 2013, 10:33 am), cyberlaw.stanford.edu/loda.

42. Because of the difficult human factors issues discussed below, however, SAE level 3 automated driving systems will likely be deployed in only a limited set of lower-risk scenarios, if at all.

43. SAE J3016, *supra* note 4, at 2 ("[SAE Level 3 is defined as] the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene."). State laws on the research-and-development testing of automated vehicles generally define an automated vehicle as one that is capable of operating without the active monitoring of a human driver – and yet many of the research vehicles that have been tested on public roads still do need active monitoring precisely because they are only research vehicles.

SAE Levels of Driving Automation (J3016)

SAE International's levels of *driving automation* are descriptive rather than normative and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. In this table, "system" refers to the *driving automation system* or *automated driving system (ADS)*, as appropriate. Information Report J3016 fully describes each level and defines each of the Italicized terms.

Level and name		Definition	*Dynamic Driving Task (DDT)*		*DDT fallback*	*Operational Design Domain (ODD)*
			Sustained lateral and longitudinal vehicle motion control	*Object and Event Detection and Response (OEDR)*		
Driver* performs part or all of the *DDT						
0	**No Automation**	The performance by the driver of the entire *DDT*, even when enhanced by active safety systems.	*Driver*	*Driver*	*Driver*	n/a
1	**Driving Assistance**	The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*.	*Driver* and *System*	*Driver*	*Driver*	Limited
2	**Partial Automation**	The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the driver *supervises* the *driving automation system*.	***System***	*Driver*	*Driver*	Limited
***ADS* ("*System*") performs the entire *DDT* (while *engaged*)**						
3	**Conditional Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is receptive to *ADS*-issued *requests to intervene*, as well as to malfunctions in other *vehicle* systems, and will respond appropriately.	*System*	***System***	*Fallback-ready user*	Limited
4	**High Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback*, without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	***System***	Limited
5	**Full Automation**	The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will response to a *request to intervene*.	*System*	*System*	*System*	**Unlimited**

In contrast, an **automated emergency intervention system** (AEIS)[44] acts as a backup to a human driver by intervening to warn of, mitigate, or even prevent a crash or other potentially dangerous situation.[45] The most common of these systems is electronic stability control, which has been required on all new passenger vehicles in the United States since 2012[46] and will eventually be required on all new large trucks and buses.[47] Although other advanced systems have also entered the market, currently they are standard on only a tiny fraction of new vehicles and wholly unavailable on most.[48] However, the U.S. National Highway Traffic Safety Administration (NHTSA) has announced that its New Car Assessment Program (NCAP) will endorse crash-imminent braking[49] and that some automakers will voluntarily equip their vehicles with this feature.[50] The U.S. National Transportation Safety Board (NTSB), for its part, has called for more aggressive action to promote collision avoidance technologies for years.[51]

As with advanced driver assistance systems, automated emergency intervention systems are likely to improve significantly.[52] At this point, they cannot substitute for a vigilant and capable human driver. However, an eventual result of these improvements may be vehicles that are nominally driven by a human but are

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44. Automated emergency intervention systems are part of a larger set of technologies generally called active safety.

45. Including, for example, skidding (antilock braking system) or inadvertently leaving a lane (lane departure warning). SAE's levels of driving automation exclude automated emergency intervention systems. *See generally* SAE J3016, *supra* note 4; Bryant Walker Smith, *Lawyers and Engineers Should Speak the Same Robot Language*, *in* ROBOT LAW 78, 96–97 (Ryan Calo, A. Michael Froomkin, & Ian Kerr eds., 2016) [hereinafter Smith, *Lawyers and Engineers*] (discussing the relationships between the two kinds of systems).

46. Electronic Stability Control Systems for Light Vehicles, 49 C.F.R. § 571.126 (2015); Electronic Stability Control System Phase-In Reporting Requirements 49 C.F.R. § 585.85 (2014).

47. Electronic Stability Control Systems for Heavy Vehicles, 49 C.F.R. § 571.136 (2015).

48. *See* NAT'L TRANSP. SAFETY BOARD, SPECIAL INVESTIGATION REP.: THE USE OF FORWARD COLLISION AVOIDANCE SYSTEMS TO PREVENT AND MITIGATE REAR-END CRASHES 37-38 (May 19, 2015), http://www.ntsb.gov/safety/safety-studies/Documents/SIR1501.pdf; *see also* Safety Feature Links: By Car Manufacturer, MYCARDOESWHAT.ORG, https://mycardoeswhat.org/manufacturers/ (last visited Feb. 1, 2017).

49. Press Release, Nat'l Highway Traffic Safety Admin., Transportation Secretary Foxx Announces Plan to Add Two Automatic Emergency Braking Systems to Recommended Vehicle Advanced Technology Features (Jan. 22, 2015), http://www.nhtsa.gov/About-NHTSA/Press-Releases/NHTSA-sets-AEB-plans,-highlights-lives-saved-report.

50. Press Release, Nat'l Highway Traffic Safety Admin., DOT and IIHS Announce Historic Commitment from 10 Automakers to Include Automatic Emergency Braking on All New Vehicles (Sept. 11, 2015), http://www.nhtsa.gov/About-NHTSA/Press-Releases/nhtsa_iihs_commitment_on_aeb_09112015.

51. *See, e.g.*, NAT'L TRANSP. SAFETY BD., NTSB/SIR-15/01, SPECIAL INVESTIGATION REPORT: THE USE OF FORWARD COLLISION AVOIDANCE SYSTEMS TO PREVENT AND MITIGATE REAR-END CRASHES 37–38 (May 19, 2015), http://www.ntsb.gov/safety/safety-studies/Documents/SIR1501.pdf; Press Release, Nat'l Transp. Safety Bd., NTSB Calls for Immediate Action on Collision Avoidance Systems for Vehicles; Cites Slow Progress as Major Safety Issue (June 8, 2015), http://www.ntsb.gov/news/press-releases/Pages/PR20150608b.aspx.

52. The SAE taxonomy introduced above applies only to automated driving systems and expressly excludes automated emergency intervention systems. *See* SAE J3016, *supra* note 4. However, a similar taxonomy could apply. Smith, *Lawyers and Engineers*, *supra* note 45, at 17 n.87.

subject to routine automatic interventions to avoid dangerous behaviors and situations.

Both advanced driver assistance systems and automated emergency intervention systems present difficult questions of human-machine interaction.[53] The transition between the automated driving system and the human driver is challenging: A human driver needs time and context to regain the situational awareness necessary to actively drive. In addition, some of these systems could encourage overreliance by the human driver or lead to the degradation of manual driving skills. Commercial aviation is already struggling with each of these challenges.[54]

One response to this "'mushy middle' of automation"[55] is a truly **driverless system**. Such a system avoids these human factors issues by performing all of the driving; the human occupants, if any, are merely passengers for the entirety of the trip. Driverless vehicles that are currently being tested or demonstrated include the latest iteration of Google's cars,[56] Induct's Navia,[57] and the showcase projects of the European Union's CityMobil initiatives.

As with testing and demonstration, initial deployments of SAE level four systems will likely be characterized by some combination of *slow* speeds, *simple* environments, and *supervised* operations. Slow speeds can reduce the likelihood and magnitude of harm, simple environments can reduce the complexity of the design challenge, and some kind of supervised operations can help to identify and address problems. Evolution of these driverless systems will bring higher speeds, more complex environments, and less real-time oversight.

53. *See generally* Smith, *Three Misconceptions*, *supra* note 2.

54. Three incidents in particular each reflect a particular "human factors" concern: BUREAU D'EQUETES ET D'ANALYSES POUR LA SECURITE DE L'AVIATION CIVILE, FINAL REPORT: ON THE ACCIDENT ON 1ST JUNE 2009 TO THE AIRBUS A330-203 REGISTERED F-GZCP OPERATED BY AIR FRANCE FLIGHT AF 447 RIO DE JANEIRO—PARIS, at 200–201 (July 2012), https://www.bea.aero/docspa/2009/f-cp090601.en/pdf/f-cp090601.en.pdf (noting overstimulation may have contributed to the 2009 crash of Air France Flight 447 over the Atlantic Ocean); NAT'L TRANSP. SAFETY BD., OPERATIONAL FACTORS/HUMAN PERFORMANCE GROUP CHAIRMAN'S FACTUAL REPORT (Dec. 4, 2009), http://dms.ntsb.gov/public/48000-48499/48456/431893.pdf (noting understimulation may have contributed to a 2009 incident in which Northwest Flight 188 overflew the Minneapolis airport by 150 miles); NAT'L TRANSP. SECURITY BD., NTSB/AAR-14/01, ACCIDENT REPORT: DESCENT BELOW VISUAL GLIDEPATH AND IMPACT WITH SEAWALL, ASIANA AIRLINES FLIGHT 214, BOEING 777-200ER, HL7742, SAN FRANCISCO, CALIFORNIA, at 74 (July 6, 2013), http://www.ntsb.gov/investigations/AccidentReports/Reports/AAR1401.pdf (noting that skills degradation may have contributed to the 2013 crash of Asiana Airlines Flight 214 at the San Francisco Airport).

55. Smith, *Three Misconceptions*, *supra* note 2, at 86.

56. The speed of these cars is capped at 25 mph. *FAQ: Google Self-Driving Car Project*, GOOGLE, http://www.google.com/selfdrivingcar/faq/#q7 (last visited Nov. 19, 2016) ("How do the vehicles behave on the road?")

57. Induct's Navia is an automated shuttle that is designed to shuttle up to ten people and can accommodate a user in a wheelchair. Andrew Del-Colle, *CES 2014: The Navia Driverless Electric Shuttle Could Be the First Autonomous Vehicle You Meet*, POPULAR MECHANICS (Jan. 10, 2014), http://www.popularmechanics.com/cars/hybrid-electric/a9912/ces-2014-the-navia-driverless-electric-shuttle-could-be-the-first-autonomous-vehicle-you-meet-16367628/. The shuttle can travel up to 12.5 mph. *Id.*

For example, a university campus, a central business district, or a military base may host an early system of automated shuttles or robotic taxis that travel at low speeds while being remotely monitored by a team of specialists. Later, this system may be gradually deployed to other geographic areas, on more roadway types, in more difficult traffic and weather conditions, at higher speeds, and without nearby technical specialists. For a long time, however, location will matter.

Dedicated short-range communications (DSRC) may play a role in each of these three pathways toward full driving automation.[58] Platooning—in which convoys of closely spaced and coordinated vehicles travel together on a highway—typically relies on dedicated short-range communications and advanced driver assistance systems. Dangers that are not in the line of sight may be mitigated by automated emergency intervention systems that are DSRC-capable. And driverless systems operating in central business districts and other limited geographic areas might use these wireless communications to supplement other navigational data. Indeed, DSRC may eventually function as another form of infrastructure supporting applications that have yet to be conceived.

However, automated systems may also develop without DSRC. None of today's production vehicles and only a minority of today's automated research platforms are DSRC-capable.[59] Other forms of connectivity—including cellular-based telematics—are increasingly common in production vehicles, are essential to most automated vehicles, and are probably sufficient for many applications.[60] For these reasons, dedicated short-range communications are best understood as complementary to automation.[61]

With or without DSRC, the three pathways to full automation—advanced driver assistance systems, automated emergency intervention systems, and driverless systems—are likely to support varied use cases and business cases.

Advanced driver assistance systems will likely remain the domain of conventional automakers and their suppliers. The most advanced ADAS features will likely debut as options on higher-end vehicle models and then filter down to lower-cost models. Startup firms and individual hobbyists may also seek to modify

58. DSRC refers to the technologies and channels that enable the fast and reliable transfer of information between vehicles (V2V), between a vehicle and part of the roadway infrastructure (V2I), or—more broadly—between a vehicle and another transportation element (V2X). In the United States, the National Highway Traffic Safety Administration is moving toward likely requiring that new vehicles be DSRC-capable. *See generally Vehicle-to-Vehicle Communications*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., http://www.safercar.gov/v2v/index.html (last visited Oct. 9, 2016) (noting that V2V technology "shows great promise in transforming the way Americans travel"). However, although the FCC allocated part of the wireless spectrum exclusively for these transportation communications in 1999, it may decide to open this space to unlicensed uses, including those that are unrelated to transportation. *See, e.g.*, Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §§ 6101–02, 126 Stat. 156 (Feb. 22, 2012) (providing for the spectrum auction authority of the FCC); *see also* Michael O'Rielly, Comm'r, FCC, The Road to Gigabit Wi-Fi: Can We Share the 5.9 GHz 'Car Band'? (Jan. 12, 2016), https://transition.fcc.gov/Daily_Releases/Daily_Business/2016/db0112/DOC-337254A1.pdf (discussing the implications of sharing the upper 5 GHz range with non-automotive users).

59. *See* Smith, *Three Misconceptions*, *supra* note 2, at 89-90.

60. *Cf. id.* at 90 (referring to the use of cellular-based telematics in today's vehicles for "emergency assistance, vehicle monitoring, and the provision of entertainment and navigation services").

61. *Cf. id.* (discussing how automated vehicles will depend on connection to real-world data like DSRC vehicles).

production vehicles by adding or changing these systems. If these systems rely on complex roadway maps or other data that must be kept current, they may be offered as subscription services.

These systems may have unique applications for trucks and buses. Platooning could help trucking firms substantially reduce their fuel costs (because vehicles traveling closer together generally experience less drag).[62] Automated lane centering could help bus drivers navigate tight corridors and carefully align their vehicles with passenger platforms.[63]

Automated emergency intervention systems will likewise become more common on conventional cars and trucks. As they become more widespread and if their safety benefits are demonstrated, the National Highway Traffic Safety Administration may move to require automakers to include these features in new vehicles. Indeed, the European Union already requires automakers to equip all new trucks and buses with advanced emergency braking systems and lane departure warning systems.[64] Although SAE International's taxonomy of driving automation expressly excludes automated emergency intervention systems from its conception of automation,[65] these systems should be understood as part of broader efforts that may one day enable full automation.

Driverless systems are likely to be deployed and operated by private as well as public actors. Both Google[66] and Uber,[67] for example, could conceivably operate driverless taxi and delivery services. These delivery services might complement or compete with others that use aerial drones or sidewalk robots. University campuses, central business districts, business parks, military bases, retirement communities, amusement parks, airports, and similar facilities may provide or contract for on-demand shuttle services.[68] And public or quasi-public entities may operate automated systems as a supplement, alternative, or replacement to conventional public transit.

In some ways, these systems may resemble conventional utilities: They will require a complex digital infrastructure supported by physical elements like data servers and maintenance depots. Customers will likely pay for the services they use but may need to request extensions of the system into their private driveways,

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62. *See* MICHAEL LAMMERT, NAT'L RENEWABLE ENERGY LAB., ASSESSING THE FUEL-SAVING POTENTIAL OF SEMIAUTOMATED TRUCK PLATOONING (June 2015), http://www.nrel.gov/docs/fy15osti/64133.pdf.

63. *See* Dave Demerjian, *Look Ma, No Hands! Automated Bus Steers Itself*, WIRED (Sept. 9, 2008, 11:00 AM), http://www.wired.com/2008/09/look-ma-no-hand/; Press Release, Sara Yang, Media Relations, Univ. of Cal., Berkeley, Researchers Showcase Automated Bus that Uses Magnets to Steer Through City Streets (Sept. 5, 2008), https://berkeley.edu/news/media/releases/2008/09/05_autobus.shtml.

64. *Safety in the Automotive Sector*, EUROPEAN COMM'N, http://ec.europa.eu/growth/sectors/automotive/safety/index_en.htm (last updated Oct. 10, 2016).

65. SAE J3016, *supra* note 4; Smith, *Lawyers and Engineers*, *supra* note 45.

66. GOOGLE SELF-DRIVING CAR PROJECT, https://www.google.com/selfdrivingcar/ (last visited Nov. 15, 2016).

67. Press Release, Uber, Uber and Carnegie Mellon University: A Deeper Partnership (Sept. 9, 2015), https://newsroom.uber.com/cmupartnership/.

68. Smith, *Three Misconceptions*, *supra* note 2, at 3.

parking lots, or drive-through facilities—roughly analogous to the last few meters of an electrical connection.

For simplicity, these three pathways can be collapsed into two. Advanced driver assistance systems and automated emergency intervention systems can both be described as "**something everywhere**" automation that can do only some of the driving—but under many conditions. In contrast, driverless systems can be described as "**everything somewhere**" automation that can do all of the driving—but only under specific conditions.[69] Whereas "something everywhere" systems will largely depend on large national markets, "everything somewhere" systems will depend much more on local conditions.

This difference between "something everywhere" and "everything somewhere" systems is central to the strategies discussed in the remainder of this Article. The discussion that follows groups these strategies into three imperfect categories: administration, law, and community.

IV. ADMINISTRATIVE STRATEGIES

A. Prepare Government

Driving automation presents both challenges and opportunities for the public sector. The bills introduced in many states narrowly approach both sides of this ledger by focusing on the explicit regulation and implicit recruitment of research-and-development testing. A broader strategy would provide state and local agencies the impetus, the authority, and the resources to prepare for—and in some cases to promote—automated systems. This part identifies five steps that governments at all levels can undertake.

First, a government that wishes to encourage vehicle automation should publicly identify a single **point person** for the topic. At the state level, this person should have the authority and credibility to coordinate among the state's various administrative agencies, between the governor and the legislature, between federal and state authorities, and between state and local authorities. Moreover, this person should act as a liaison to the private sector. Companies and universities in the state may already be engaged in potentially relevant work. And if a large or small developer of automated systems is considering a jurisdiction for development, demonstration, or deployment, it should know precisely whom in government to call.

Second, government actors should **advance their understanding** of the relevant technologies, applications, and activities. This effort should involve not just vehicle regulators but also state and local authorities responsible for transportation, transit, parking, law enforcement, education, environmental protection, health and human services, commerce, workforce development, land use, zoning, and planning, among many others. Depending on the centrality of driving automation to their work, this understanding could range from general awareness (subject to the important caution that news reports and press releases are often misleading)[70] to specific proficiency. These authorities should also expect a similar level of understanding from their contractors and consultants.

69. OECD, REGULATION UNDER UNCERTAINTY, *supra* note 1, at 15.

70. Smith, *Three Misconceptions*, *supra* note 2, at 2.

Third, governments should **cultivate broader expertise** with respect to complex technical and social systems. Regardless of whether specific proficiency in the technical details of automated driving is practical or appropriate, governments should enhance their ability to manage the abstract issues of automated driving. For example, understanding arguments about the safety of an automated system may require systems engineers who can ask key questions about the design process. Similarly, anticipating challenges of and to automated driving may require social scientists who can point to successes and failures of governance during previous technological revolutions.

Fourth, governments should ensure that their **planning processes** begin to account for automated driving. Long-term assumptions should be revisited for land-use plans, infrastructure projects, building codes, bonds, and budgets. Procurement, which offers particular opportunities for encouraging automation, is discussed below.[71]

Finally, governments should develop **break-the-glass plans** for responding to automated driving incidents. Who will respond, and how? What relationships will be essential to effective coordination? What evidence and information will need to be preserved, and how? Especially if officials have publicly embraced the potential of these technologies, how will they address any fear or outrage that result from a high-profile crash, regardless of where it occurs? A government that addresses these issues proactively and ultimately positively signals its credibility as a potential technological partner.

These steps necessarily require **resources**. "In a sense, governments should approach policymaking with the same philosophy underlying public support of physical infrastructure and scientific research: Initiate what the private sector cannot or will not do."[72] Many of the strategies described in this Article would entail public dollars. At the same time, the bills introduced or passed in various statehouses are far from free. Reports and rulemakings are expensive, especially if an agency has no experience or expertise in advanced vehicle technologies. The Nevada DMV has incurred significant cost in developing its initial regulatory regime,[73] and California's ongoing rulemaking is likely many times more expensive.[74] Private developers have also focused time, money, and effort on defeating or otherwise influencing many state efforts.[75]

B. Prepare Infrastructure

Advanced driver assistance systems are mostly likely to be usable and useful in areas with good infrastructure. While infrastructure, broadly conceived,

71. *See infra* part IV.C.

72. Smith, *Risk of Inaction*, *supra* note 1, at 600.

73. *How an (Automated Driving) Bill Becomes Law*, THE CTR. FOR INTERNET & SOC'Y (Nov. 13, 2012), http://cyberlaw.stanford.edu/multimedia/how-autonomous-driving-bill-becomes-law-video [hereinafter *Automated Driving Bill Becomes Law*].

74. For example, in 2013 the California DMV agreed to pay the University of California–Berkeley $680,000 for assistance in developing automated driving regulations.

75. *See, e.g.*, *Automated Driving Bill Becomes Law*, *supra* note 73; Justin Pritchard, *How Google Got States to Legalize Driverless Cars*, ASSOCIATED PRESS (May 30, 2014, 8:15 PM), http://bigstory.ap.org/article/how-google-got-states-legalize-driverless-cars.

encompasses all kinds of supporting systems and institutions, this part focuses on six steps that governments can take with respect to the physical and the digital.

First, governments can prioritize the adequate **maintenance of roadways** under their jurisdiction. Roads—even major ones—in much of the United States are in poor condition.[76] Highway lane markings used by some lanekeeping systems are frequently faded or, worse, simply wrong. Potholes and other pavement deficiencies that are unlikely to be detected or avoided by current lane centering systems can be found even on major freeways. Debris and other foreign objects that could conceivably confuse an automated emergency intervention system litter roads and shoulders. Addressing these conditions could help to improve the effectiveness of near-term automated systems.

Second, governments can ensure that their **design policies** for signs, traffic signals, and pavement markings are sensible, clear, and—to the extent practical—consistent across jurisdictions. As automated systems become more advanced, they may begin processing more information about the driving environment. Sound design—a goal of both the Manual and Uniform Traffic Control Devices (for the United States)[77] and the Vienna Convention on Road Signs and Signals (for much of the rest of the world)—could make this task more manageable.

Third, governments can verify the **implementation of these policies**—in other words, they can check that their signs, signals, and markings actually conform to their design policies. Real-world implementation is far from standard (and, in some cases, cannot be), but substantial discrepancies between policies and practices could increase the chance of unwarranted assumptions or unexpected conditions. For example, traffic signals that are carefully installed and maintained in accordance with applicable design standards are much more likely to be correctly read by an automated system than those that are not.

Fourth—and for similar reasons—governments can verify that **roadway personnel**, including construction crews and emergency responders, are following pertinent policies when they are working on or near active roadways. Although roads cannot be made wholly predictable, limiting the frequency and magnitude of potentially risky variations can help automated systems as well as road users generally.

Fifth, governments can standardize their **management of data** concerning roadways, traffic, incidents, and construction. Both the public and the private sector play important roles in the collection, validation, and distribution of these data, which may be used by some automated driving systems to proactively identify situations where mapping updates or driver intervention will be needed.

Sixth, governments can update existing **vehicle registration databases** to include information about a vehicle's automation capabilities. This information may

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76. *See* AM. SOC'Y OF CIVIL ENG'RS, 2013 REPORT CARD FOR AMERICA'S INFRASTRUCTURE 7 (2013) (assigning a marginal grade of D to roads), http://ascelibrary.org/doi/pdf/10.1061/9780784478837.

77. *See* U.S. DEP'T OF TRANSP. FED. HIGHWAY ADMIN., MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES § 1A.03 (2009), http://mutcd.fhwa.dot.gov/htm/2009/part1/part1a.htm. Many states have their own particular implementation of these design best practices. *See, e.g.*, WIS. DEP'T OF TRANSP., WISCONSIN MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (2009), http://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/manuals-and-standards/wmutcd/wmutcd.aspx.

be useful in a variety of contexts, including administration of safety-based incentive programs, collection of relevant safety data, and enforcement of traffic safety laws. Consider, for example, a state that permits users of automated vehicles to text while in those vehicles.[78] If the registration database is properly updated (and perhaps coordinated), a police officer will be able to determine if a texting driver is acting lawfully by quickly running her license plate number.

Seventh, governments can coordinate with the U.S. Department of Transportation on **dedicated short-range communications** (DSRC) policies and opportunities. If the relevant agencies within the Department ultimately recommend particular infrastructure changes to facilitate vehicle-to-vehicle or vehicle-to-infrastructure communication, governments that have been closely following this topic may be able to move forward more quickly than those that have not. In the meantime, governments that install or replace traffic signals, variable message signs, and other electronic communications equipment should ensure that these installations either include or can be easily retrofitted with DSRC capabilities. These capabilities may be particularly useful to localized driverless systems.

Eighth, governments can encourage the deployment of robust **wireless communications networks**, including cellular, wi-fi, and eventually DSRC. Because many automated systems will require some form of connectivity,[79] communities that proactively address concerns about capacity and coverage (particularly in the case of urban canyons) may be better positioned to host or implement localized driverless systems.

Ninth, governments can use existing **congestion management tools**, including managed lanes,[80] onramp metering, and traffic signal prioritization, to create roadway conditions favorable to automated driving. By traveling together in closely spaced platoons or by simply crashing less frequently, vehicles with advanced driver assistance systems and emergency interventions systems could eventually contribute less to congestion and emissions per mile traveled than conventional vehicles. These benefits may justify giving these vehicles access to priority lanes on freeways and at onramps, even if this raises equity concerns. The case may be even stronger for exempting truly driverless systems that enable rides to be shared by multiple passengers. Indeed, some municipalities already permit taxis to operate where private vehicles are prohibited.[81]

Tenth, governments can emphasize elements of **neighborhood infrastructure** that may be useful to some kinds of driverless systems. Lower speed limits and modern traffic calming devices may create environments that are ideal for driverless systems operating at pedestrian-friendly speeds. These systems could, in turn, help slow down other vehicles using those same streets. Lanes for golf carts or, under the right circumstances, bicycles might also be used by small, light-weight

78. *See* FLA. STAT. § 316.305(3)(b)(7) (2015); NEV. REV. STAT. § 484B.165(7) (2014); *see also* Smith, *Three Misconceptions*, *supra* note 2.

79. Smith, *Three Misconceptions*, *supra* note 2.

80. *See Managed Lanes: A Primer* (last modified Oct. 20, 2015), http://ops.fhwa.dot.gov/publications/managelanes_primer/ (explaining that managed lanes include high-occupancy vehicle lanes and toll lanes).

81. *See, e.g.*, SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY, SAFER MARKET STREET, https://www.sfmta.com/projects-planning/projects/safer-market-street (last visited Nov. 15, 2016).

driverless vehicles operating at compatible speeds. Even sidewalks may be suitable for delivery robots traveling no faster than a human walks.

C. Plan Infrastructure

The significant uncertainty surrounding automated driving—particularly the nature and timing of its impacts—makes transportation planning extremely difficult.[82] Driving automation could conceivably lead to lower capacities (because of longer initial headways and less assertive behavior at intersections)[83] or to higher lane capacities (because of reduced headways, smoother flows, shorter lag times at signals, and fewer crashes).[84] Similarly, it could result in increased vehicle miles traveled (because travel is cheaper, trips are longer, other modes are less competitive, or vehicles have no occupants whatsoever)[85] or in decreased vehicle miles traveled (largely because ridesharing is more attractive and efficient).[86] Pavement distress could increase (as vehicles travel more frequently over a specific portion of the travel lane) or decrease (as vehicles move more smoothly and avoid pavement deficiencies). More localized traffic patterns and behaviors could also change in unexpected ways as vehicles queue at major origins and destinations, make zero-occupancy trips in the nonpeak direction, or shift bottlenecks.[87]

This uncertainty has particularly significant implications for long-range planning, including demand models, infrastructure plans, alternatives analyses, and financial projections. These exercises may fail to accurately predict the magnitude or even the direction of automation's impacts. Moreover, their treatment of automation—or the lack thereof—may occasion increased scrutiny by other actors, including courts reviewing environmental impact statements or private investors evaluating infrastructure bond offerings.

Governments cannot resolve this uncertainty, but they can begin to adjust their planning processes by identifying and incorporating a wide range of new automation scenarios. For example:

1. A metropolitan planning organization might consider the vehicle miles traveled impact of shifting half of trips on flights of less than 500 miles to single-occupancy motor vehicles;
2. A transit agency might consider the financial impact of shifting half of suburban bus trips to shared motor vehicles; and

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82. *See* Bryant Walker Smith, *Managing Autonomous Transportation Demand*, 52 SANTA CLARA L. REV. 1401, 1407 (2012) [hereinafter Smith, *Managing Autonomous Transportation*].

83. JANE BIERSTEDT ET AL., EFFECTS OF NEXT-GENERATION VEHICLES ON TRAVEL DEMAND AND HIGHWAY CAPACITY 4 (Jan. 2014).

84. *See* TODD LITMAN, VICTORIA TRANSP. POLICY INST., AUTONOMOUS VEHICLE IMPLEMENTATION PREDICTIONS: IMPLICATIONS FOR TRANSPORT PLANNING 4 (2015); ABDUL RAWOOF PINJARI ET AL., AUTOMATED VEHICLE INST., CTR. FOR URBAN TRANSP. RESEARCH, HIGHWAY CAPACITY IMPACTS OF AUTONOMOUS VEHICLES: AN ASSESSMENT 1–5 (Nov. 2013); ANDERSON ET AL., *supra* note 1, at xv.

85. *See* Smith, *Managing Autonomous Transportation*, *supra* note 82, at 1409–1410; BIERSTEDT ET AL., *supra* note 83, at 4; LITMAN, *supra* note 84, at 8; ANDERSON ET AL., *supra* note 1, at 5.

86. *See* Smith, *Managing Autonomous Transportation*, *supra* note 82, at 1410; LITMAN, *supra* note 84, at 8; RAPHAEL BARCHAM, GOLDMAN SCH. OF PUB. POLICY, UNIV. OF CAL., BERKELEY, CLIMATE AND ENERGY IMPACTS OF AUTOMATED VEHICLES 3 (June 2014).

87. *See* PINJARI ET AL., *supra* note 84, at 5–11.

3. A municipality might consider the congestion impact of shifting the origins or destinations of half of trips from parking facilities to building entrances.

If appropriately qualified and contextualized, these stylized examples—among many others—can focus discussions of assumptions as well as impacts. Rather than relying on high and low estimates, governments might instead speak in terms of probabilities and magnitudes. Likely scenarios with significant impacts, for example, might justify more policy and planning attention than unlikely scenarios with minor impacts or even likely scenarios with minor impacts.

D. Leverage Procurement

Governments, particularly in cooperation with each other, can use their purchasing power to expand the market for advanced driver assistance and advanced emergency intervention systems.

States, counties, and municipalities in the United States own nearly 1.5 million cars, 500,000 buses, and another 1.5 million trucks.[88] If the turnover rate for these fleets is ten percent,[89] then these governments purchase some 350,000 vehicles annually—five times more each year than Tesla has sold in its entire existence.[90] Because of contracts and concessions, the number of vehicles closely associated with government services is likely even greater.

Particularly influential authorities could establish procurement policies or preferences that favor advanced systems. These authorities might include the fleet managers of larger states, the transit operators for larger regions, and the taxi regulators in larger cities. They could also include smaller agencies acting in concert. Collaboration is especially important in the case of transit, where low volumes and high costs have likely slowed or discouraged some innovations.[91]

Purchasing only vehicles with advanced safety systems could entail higher upfront costs for these public entities (or the private actors they regulate). However, some of these upfront costs might be offset by reduced operating costs if these systems actually do result in fewer crashes, greater fuel efficiency, and less wear and tear. This is a promising, but nonetheless speculative, prospect.

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88. *See Table MV-7 Highway Statistics 2013: Publically Owned Vehicles*, DEP'T OF TRANSP. FED. HIGHWAY ADMIN. (Jan. 2015), http://www.fhwa.dot.gov/policyinformation/statistics/2013/mv7.cfm.

89. *See generally* P.S. Hu & M.Q. Wang, State Vehicle Fleets and their Potential Acquisition of Alternative Fueled Vehicles under EPACT 507, at 11, http://ntl.bts.gov/lib/000/700/722/507.pdf (unpublished manuscript) (estimating "the turnover [rate] in the state vehicle stock based on the annual percentage of the business fleet that is replaced") (emphasis omitted).

90. Press Release, Tesla Motors, Inc., Tesla Delivers 10,030 Vehicles in Q1 of 2015 (Apr. 3, 2015), http://www.marketwired.com/press-release/tesla-delivers-10030-vehicles-in-q1-of-2015-nas daq-tsla-2006611.htm.

91. *Cf.* NATIONAL CENTER FOR TRANSIT RESEARCH, EVALUATION OF AUTOMATED VEHICLE TECHNOLOGY FOR TRANSIT, (Jan. 2015), http://www.nctr.usf.edu/wp-content/uploads/2015/09/77975-Evaluation-of-Automated-Vehicle-Technology-for-Transit.pdf ("With the exception of Nova Bus/Volvo, none of the bus manufacturers contacted have plans to add AV technology.").

Regardless, these policies could help to create economies of scale for vehicle makers and their suppliers and to encourage the quicker introduction of advanced systems into less expensive vehicles.

E. Advocate for AEIS Mandates

In light of the potential safety benefits of automated emergency intervention systems,[92] state and local governments can push the federal government to move more aggressively in promoting and ultimately requiring more of these systems on new vehicles. NHTSA already has the authority and arguably the obligation to address these systems, but Congress could expedite this process by adequately funding NHTSA[93] and by statutorily relaxing the level of scrutiny that federal courts apply to the agency's rules.[94]

In addition to advocating for federal action, states can also encourage vehicle manufacturers to integrate more of these systems into more of their vehicles. State courts are likely to be an important forum for arguments that more vehicles of recent vintage should have included automated emergency intervention systems as standard equipment. These arguments may be especially persuasive to judges and juries when the injured person is a pedestrian or other bystander struck by an inattentive driver.[95]

V. LEGAL STRATEGIES

A. Analyze Existing Law

Governments can begin to analyze and, as necessary, clarify existing law in the context of automated driving. This bottom-up approach differs from the top-down approach of some early legislative efforts, which largely failed to meaningfully engage with existing law.[96] Indeed, because vehicle codes, insurance rules, and other potentially relevant laws vary by jurisdiction, merely enacting a uniform "automated driving law" without reference to these nuances could confuse as much as clarify.[97]

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92. *See supra* Part III.C (discussing automated emergency intervention systems).

93. *See generally* THE NAT'L ACADS., THE SAFETY PROMISE AND CHALLENGE OF AUTOMOTIVE ELECTRONICS: INSIGHTS FROM UNINTENDED ACCELERATION 123–29 (2012) (comparing NHTSA's funding and resources to other regulatory agencies including the Federal Aviation Administration, the Federal Railroad Administration, and the Federal Motor Carrier Safety Administration).

94. *See* Jerry L. Mashaw & David L. Harfst, *Regulation and Legal Culture: The Case of Motor Vehicle Safety*, 4 YALE J. ON REG. 257, 273–89 (1987).

95. Bryant Walker Smith, *Proximity-Driven Liability*, 102 GEO. L.J. 1777, 1797 (2014).

96. *See generally* Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 500–507 (discussing how Nevada, Florida, and California's regulation of automated vehicles and bills pending in other states do not fully solve many of the legal issues posed by automated vehicles).

97. *See generally* Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1; UNIV. OF WASH. TECH. LAW & POLICY CLINIC, AUTONOMOUS VEHICLE LAW REPORT AND RECOMMENDATIONS TO THE ULC, https://www.law.washington.edu/Clinics/technology/Reports/AutonomousVehicle.pdf (last visited Nov. 12, 2016) (suggesting possible uniform regulation language, but recognizing the need for each state to pass specific and more detailed regulations for automated vehicles).

The initial step should therefore be a **legal audit** or legal inventory to identify and analyze every statute and regulation that could apply adversely or ambiguously to automated driving. *Automated Vehicles Are Probably Legal in the United States* identifies many of these provisions, from general requirements of prudent conduct to the specific New York rule that a driver must keep at least one hand on the wheel.[98] Laws that diverge from acceptable driving norms should be particularly suspect. For example, some states prohibit drivers from crossing over a double-yellow line but provide no exception when the driving lane is blocked.[99]

A thorough legal audit will look far beyond the rules of the road to **all relevant law**, particularly in the case of truly driverless systems. These systems may involve different kinds of vehicles, facilities, and business models. Accordingly, governments should evaluate laws regarding particular vehicle types (including low-speed vehicles, neighborhood electric vehicles, golf carts, personal transporters such as the Segway, and electronic toys such as remote-control miniature cars), facility types (including multiuse trails, bike lanes, sidewalks, and quasipublic areas such as parking structures), service types (including ridesharing, carsharing, transportation network companies, and traditional mass transit), and business types (including dealerships, consumer insurance,[100] and reinsurance). Local governments may play a particularly important role in reviewing and crafting these legal regimes.[101]

A legal audit should also analyze **existing legal tools** for regulating automated driving. In enacting "autonomous driving laws" that legislate specifics of vehicle design, some U.S. states have largely ignored legal mechanisms already available to them. Crucially, current state laws typically: (a) prohibit driving recklessly and operating an unsafe vehicle; (b) direct or at least empower departments of motor vehicles to register only safe vehicles and to revoke the registration of unsafe vehicles; (c) require serious crashes to be reported; (d) impose insurance requirements that cast private insurers as indirect regulators of vehicle safety; (e) criminally punish some negligent conduct; and (f) provide civil remedies in tort, product liability, and consumer protection law that can influence vehicle design and operation.[102] A full discussion of regulation is beyond the scope of this Article;[103] the key point is merely that governments already have flexible tools that, when supported by sufficient resources and expertise, provide an attractive alternative to new legislative prescriptions and restrictions.

A key aspect of existing law is **enforcement discretion**. Depending on the particular jurisdiction, freeway speed limits, minimum following distances, centerline restrictions, and general rules about vehicular interactions may be routinely—and in some cases even necessarily—violated without penalty. Understanding this discretion is important to understanding law in practice as well

98. Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 413.

99. *Compare, e.g.*, S.C. CODE ANN. § 56-5-1890 (1993) (providing no such exception), *with* N.J. STAT. ANN. § 39:4-86 (West 1951) (providing such an exception).

100. *See infra* Part V.E (discussing consumer insurance).

101. *See infra* Part V.B (discussing local governments' role in crafting these legal regimes).

102. *See* Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1.

103. *See* Smith, *Risk of Inaction*, *supra* note 1 (discussing regulation).

as in theory.[104] Furthermore, as discussed below,[105] clarifying this discretion at all levels of government can provide greater predictability to developers of automated systems by reducing the potential for selective enforcement by individual officers.

B. Calibrate Existing Law

If a legal audit does identify obstacles, ambiguities, or deficiencies in existing law, the next step may be legal change. Depending on the particular issues and legal structures, this change could occur through legislative act, administrative regulation, executive order, legal interpretation, or policy statement, among other mechanisms. Although the details should largely follow from the legal audit, the following points may be useful.

First, **public-private collaboration** is prudent. Established companies are—or should be—conducting their own legal research and development to complement their technological research and development. If and when these companies want legal change, they can be expected to ask for it.[106] "Broad mandates or basic conditions may be useful in driving or policing innovation, but attempts to closely tailor rules to products that do not yet exist could produce law that is premature and prejudicial."[107]At the same time, governments should remain mindful of market failures that do require intervention.[108]

Second, **uniformity** across jurisdictions may be desirable for mass-produced vehicles, while **tailored regimes** may support pilots, demonstrations, and local deployments. Rather than focusing on developing a uniform automated driving law, governments could cooperate on standardizing or harmonizing more of their underlying legal frameworks—particularly those that govern vehicles, drivers, driving, insurance, dealerships, and commercial vehicle operations. To this end, state governments might collectively reanimate the National Committee on Uniform Traffic Laws and Ordinances (NCUTLO)[109] or else locate similar functions in the American Association of Motor Vehicle Administrators (AAMVA), the American Association of State Highway and Transportation Officials (AASHTO), the Uniform Law Commission (ULC),[110] or another appropriate interstate organization.

Third, SAE International's **levels of automation**, including the supporting definitions, promote uniformity at a foundational level by providing a common

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104. Judges and juries, however, might nonetheless continue to treat the nominal violation of these laws as evidence of negligence or defect in a claim against the developer or operator of an automated system.

105. *See infra*, Part V, F.

106. *See, e.g.*, UTAH CODE ANN. § 41-6a-711(2)(b) (2015) (addressing following-distance restrictions).

107. Smith, *Risk of Inaction*, *supra* note 1, at 600.

108. *See supra* text accompanying note 61.

109. The NCUTLO released the most recent Uniform Vehicle Code in 2000, but "suspended operations about [eight] years ago due to lack in funding." Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 417 n.11 (citing email from NCTULO's former executive director to Bryant Walker Smith).

110. UNIFORM L. COMMISSION, THE NAT'L CONF. OF COMMISSIONERS ON UNIFORM ST. L., http://www.uniformlaws.org (last visited Feb. 1, 2017).

language for discussing (and conceivably regulating) a complex topic.[111] A government contemplating a new regulatory regime, for example, can avoid ensnaring current and imminent advanced driver assistance systems by expressly applying this regime to automation systems at or above SAE level three.[112]

Fourth, **regulatory reciprocity** can also achieve a form of uniformity. If advancements in vehicle technologies ultimately compel novel registration or licensing determinations, treating the favorable determinations of one jurisdiction as conclusive in another could reduce the administrative difficulties that developers might otherwise face.[113] Reciprocity—or even unilateral recognition of another jurisdiction's system approvals—could also benefit smaller jurisdictions that lack the consumer demand to motivate companies to enter the market or the public resources to establish a holistic regulatory regime.

Fifth, and without neglecting the careful legal analysis described above, legislatures could codify **interpretive conventions** to facilitate automation. *Automated Vehicles Are Probably Legal in the United States* offers language that would clarify many potentially relevant provisions common to state vehicle codes.[114] It also provides language to help establish a more reasonable interpretation of a provision in the 1949 Geneva Convention on Road Traffic—which binds the United States and many other countries—that might otherwise be viewed as inconsistent with automated driving.[115]

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111. *See* SAE J3016, *supra* note 4.

112. *Cf.* H.B. 1372, 2016 Leg. Sess. (Va. 2016) ("'Autonomous vehicle' means a vehicle, as defined by levels 4 and 5 of SAE J3016, that utilizes an automated driving system that handles all aspects of the dynamic driving task, and does not require the involvement of a driver at any time for [its] safe operation."). The U.S. states to have specifically regulated automated driving have achieved roughly the same result through less precise language. *See, e.g.*, NEV. REV. STAT. § 482A.025 (2013) ("Autonomous technology" means technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator. The term does not include an active safety system or a system for driver assistance, including, without limitation, a system to provide electronic blind spot detection, crash avoidance, emergency braking, parking assistance, adaptive cruise control, lane keeping assistance, lane departure warning, or traffic jam and queuing assistance, unless any such system, alone or in combination with any other system, enables the vehicle on which the system is installed to be driven without the active control or monitoring of a human operator."); CAL. VEH. CODE § 38750(a)(1) (2015) ("'Autonomous technology' means technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator.").

113. *See* Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 508–17.

114. *Id.*

115. *Compare* Convention on Road Traffic art. 8, Sept. 19, 1949, 3 U.S.T. 3008, 125 U.N.T.S. 3 ("Every vehicle or combination of vehicles proceeding as a unit shall have a driver" and "Drivers shall at all times be able to control their vehicles . . . "), *with* Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 509 ("Geneva Convention. The Legislature hereby finds that automated operation of vehicles under the conditions prescribed herein is consistent with article 8 of the Convention on Road Traffic because (1) such operation has the potential to significantly improve highway safety, one of the objects of the Convention; (2) this State shall make such operation reasonably knowable to the foreign visitors contemplated by the Convention; (3) the Convention implicitly permits indirect control over vehicles and animals; (4) there shall remain a licensed driver of each vehicle who shall be able to specify or accept the parameters of operation; and (5) these parameters shall be consistent with the traffic laws of this State.").

Sixth, establishing a **legal distinction between driver and passenger** would simplify the legal framework for truly driverless systems.[116] In a functional sense, ordinary users of these systems are simply passengers, analogous to riders of taxis, buses, and even elevators. Indeed, a forthcoming version of SAE International's levels of driving automation will likely reach a similar technical conclusion.[117] However, because U.S. states generally take an expansive view of the concept of driver or operator,[118] these users could conceivably be subject to awkward legal qualifications, obligations, and liabilities intended to apply to conventional drivers. To foreclose this possibility, governments could clarify that an individual carried commercially on a vehicle designed to operate at or above SAE level four is a passenger rather than a driver.[119]

Finally, and especially if they retain a broad legal definition of driver, governments could expressly permit the use of otherwise prohibited **electronic devices** in vehicles operating at or above SAE level three. Since these devices are likely to be used anyway,[120] this exemption might merely align law with actual practice.[121] Regardless, it could also enable more effective marketing of advanced driver assistance systems to potential customers and facilitate new (and lawful) business cases in the commercial sector.

More broadly, a government seeking to reconcile an existing legal regime with automated driving technologies and applications might choose among several **drafting approaches**. It could wholly revise an existing regime such as the vehicle code with a view toward addressing both automated and conventional driving. It could expressly restrict the existing regime to conventional driving and develop an entirely new regime to apply to automated driving. Or it could develop a hybridized package that uses definitions, interpretive guidance, clarifications, and other mechanisms to map the existing regime onto automated driving. The choice of approach may depend on the results of the legal audit, the maturity of the relevant technologies, and the priorities of the jurisdiction.

These considerations are far from comprehensive. To reiterate, they are directed at encouraging rather than regulating automated driving. They also largely avoid potential product liability implications of increasing driving automation and connectivity. Announcements over the last several years suggest that, notwithstanding concerns they may have about product liability, major companies are aggressively pursuing automated driving research and development. Although uncertainty about liability could conceivably slow or limit the broad deployment of

116. *See, e.g.*, Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 508–517.

117. *See* SAE J3016, *supra* note 4.

118. Smith, *Automated Vehicles Are Probably Legal*, *supra* note 1, at 433–35.

119. *See id.* at 508–17 (suggesting potential legal language to draw this line).

120. *See generally Distracted Driving*, CTRS. FOR DISEASE CONTROL & PREVENTION (Mar. 7, 2016), http://www.cdc.gov/motorvehiclesafety/distracted_driving/ (stating in the "CDC Research" section that 69 percent of drivers ages 18-64 reported talking on their cell phone while driving and 31 percent of drivers ages 18-64 reported reading or sending text messages while driving in the 30 days preceding the survey).

121. *See* Smith, *Lawyers and Engineers*, *supra* note 45.

these technologies, their developers are in the best position to make and substantiate any such arguments.[122]

C. Enforce Safety Requirements

Enforcing existing laws regarding driver and vehicle safety could amplify the advantages of automated driving in relation to conventional driving. Consider five key examples:

Speed laws. Some (though by no means all) automated driving systems might restrict vehicle speeds to at or below the legal speed limit. If most conventional vehicles are exceeding that limit, this could create the perception that these systems disadvantage their users. Greater enforcement of speed limits, however, could negate that difference. Although automated speed enforcement is controversial, it can be particularly effective.[123]

Distracted driving laws. Some U.S. states have exempted the "drivers" of automated vehicles from prohibitions on texting and using potentially distracting electronic devices[124]—and the previous part suggested that other jurisdictions consider doing so. If aggressive enforcement of these prohibitions discourages drivers of conventional vehicles from engaging in these (demonstrably unsafe[125]) behaviors, then exemptions will provide real and perceived benefits to users of automated vehicles.

Intoxicated driving laws. Drunk driving statistics[126] suggest both an appalling lack of personal responsibility and a dearth of alternatives to driving. Truly driverless systems may provide such an alternative within those communities where they are deployed. At least initially, the limited geographic reach of these systems may reduce their utility to people who either reside in low-density areas or drink far from where they live. Nonetheless, strengthening and more aggressively enforcing intoxicated driving laws could encourage some would-be drunk drivers to rely instead on those systems that are deployed and to create specific demand for systems that have yet to be deployed. Moreover, such enforcement might help to discourage

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122. *See* Bryant Walker Smith, *Uncertain Liability*, CTR. FOR INTERNET & SOC'Y (May 27, 2013, 5:25 PM), http://cyberlaw.stanford.edu/blog/2013/05/uncertain-liability; Smith, *Risk of Inaction*, *supra* note 1, at 599–600; *Proximity-Driven Liability*, *supra* note 95; Bryant Walker Smith, *Automated Driving and Product Liability* (forthcoming 2017), http://newlypossible.org.

123. *See generally* Steven A. Glazer, *Those Speed Cameras Are Everywhere: Automated Speed Monitoring Law, Enforcement, and Physics in Maryland*, 7 J. BUS. & TECH. L. 1, 1–3, 18, 21 (2012) (discussing advantages and disadvantages of automated enforcement).

124. *See* FLA. STAT. § 316.305(3)(b)(7) (2013) (exempting the drivers of automated vehicles from the state's texting ban); NEV. REV. STAT. § 484B.165(7) (2015) (excluding automated vehicles from the definition of 'operating a motor vehicle' for the purposes of the ban on using a wireless communications device while driving).

125. "In 2011, 3,331 people were killed in crashes involving distracted drivers and an estimated additional 387,000 were injured in motor vehicle crashes involving distracted drivers." U.S. DEP'T OF TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., TRAFFIC SAFETY FACTS: DISTRACTED DRIVING 2011 (2013), http://www-nrd.nhtsa.dot.gov/Pubs/811737.pdf.

126. *See* AMY BERNING ET AL., U.S. DEP'T OF TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., TRAFFIC SAFETY FACTS: RESULTS OF THE 2013-14 NATIONAL ROADSIDE SURVEY OF ALCOHOL AND DRUG USE BY DRIVERS (2015), http://www.nhtsa.gov/staticfiles/nti/pdf/812118-Roadside_Survey_2014.pdf.

those who are intoxicated from continuing to drive in the belief that advanced driver assistance systems and emergency intervention systems will compensate for any impairment.

Seatbelt laws. Automated driving systems might encounter situations, like a bicyclist swerving to avoid an opened car door, that require rapid deceleration or other abrupt maneuvers that may imperil vehicle occupants who are not belted. Enforcing seatbelt laws could maximize the safety of the people both inside and outside these vehicles. Governments could also update seatbelt laws that were originally enacted when seatbelt usage was much less common. In many states, for example, statutory or common law rules "restrict whether or for what purpose a defendant automaker can introduce evidence that an injured plaintiff was not wearing her seatbelt."[127] Allowing developers of automated driving systems to assume that people who care about their safety will buckle up may help to ease some of the design challenges that these developers face.[128]

Vehicle laws. Because of their original design, their subsequent modification, or their insufficient maintenance, many vehicles on the road today are dangerous—and not just to their occupants.[129] Whether a pedestrian suffers minor injuries or death, for example, might depend on the stopping distance of the vehicle that strikes her, which in turn depends in part on the weight of that vehicle, the condition of its tires, and the performance of its brakes. Similarly, pollution from motor vehicles kills roughly 50,000 Americans every year,[130] but only 25 percent of vehicles account for 90 percent of this pollution.[131] Many of these vehicles likely

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127. Bryant Walker Smith, *Tesla and Liability*, CTR. FOR INTERNET & SOC'Y (May 20, 2015), http://cyberlaw.stanford.edu/blog/2015/05/tesla-and-liability. *See also, e.g.*, Nabors Well Servs., Ltd. v. Romero, 456 S.W.3d 553, 563 (Tex. 2015) (holding evidence of use or nonuse of seat belts is admissible for apportioning responsibility among parties if plaintiff's conduct was a cause of her damages); N.C. GEN. STAT. § 20-135.2A(d) (2009); MONT. CODE ANN. § 61-13-106 (1987).

128. *See* Federal Motor Vehicle Safety Standards; Occupant Crash Protection, 78 Fed. Reg. 53,386 (Aug. 29, 2013) (denying a petition by BMW "to amend the Federal motor vehicle safety standard on occupant crash protection to permit optional certification using a seat belt interlock for front seat occupants as an alternative to the unbelted crash test requirements"). And yet, interestingly, there are also technological alternatives. Managers in two companies active in the development of automated vehicles have explained to me that their vehicles will not operate, either in automated mode or at all, if the occupants are not belted. *See also Tesla and Liability*, *supra* note 127.

129. *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., THE ECONOMIC AND SOCIETAL IMPACT OF MOTOR VEHICLE CRASHES 2010 (REVISED) (May 2015), http://www-nrd.nhtsa.dot.gov/pubs/812013.pdf [hereinafter ECONOMIC AND SOCIETAL IMPACT].

130. *See* Steven R.H. Barrett et al., *Impact of the Volkswagen Emissions Control Defeat Device on US Public Health: Supplementary Material*, 10 ENVTL. RES. LETTERS 114005 (2015). This is more than the roughly 30,000 Americans who die in motor vehicle crashes every year. *See* U.S. DEP'T OF TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., 2014 CRASH DATA KEY FINDINGS, DOT HS 812 219 (Nov. 2015), http://www-nrd.nhtsa.dot.gov/Pubs/812219.pdf ("In 2014 there were 32,675 people killed in motor vehicle crashes on U.S. roadways."); Press Release, Nat'l Highway Traffic Admin., NHTSA Confirms Traffic Fatalities Increased in 2012 (Nov. 14, 2013), http://www.nhtsa.gov/About+NHTSA/Press+Releases/NHTSA+Data+Confirms+Traffic+Fatalities+Increased+In+2012.

131. Press Release, Univ. of Toronto, Traffic Emission May Pollute 1 in 3 Canadian Homes (Apr. 21, 2015), http://media.utoronto.ca/media-releases/traffic-emissions-may-pollute-1-in-3-canadian-homes/; J.M. Wang et al., *Plume-based Analysis of Vehicle Fleet Air Pollutant Emissions and the Contribution*

violate existing vehicle safety and pollution laws.[132] Removing them from the road could shift some travel demand to automated systems.

These five examples may require some legal changes. In particular, a government may wish to authorize automated speed enforcement, exempt the users of automated vehicles from some distracted driving provisions, mandate alcohol-detecting ignition locks in some situations, update seatbelt laws to reflect contemporary norms, and create or improve a vehicle-testing regime.

D. Internalize the Costs of Driving

Policies that make vehicle owners and operators bear the true cost of driving will indirectly benefit any technologies that produce gains in fuel efficiency or safety. Three key policies actions would help internalize these costs: raising fuel taxes, reducing parking subsidies, and increasing insurance minimums.

Raising fuel taxes at the state and federal levels is the first of these strategies. A recent model (which itself followed many other studies[133]) suggested that driving imposes environmental damages of $3.80 per gallon of gasoline and $4.80 per gallon of diesel.[134] As that analysis recognizes,[135] these costs are difficult to define with precision. Even at the lower end of their ranges, however, they are several times greater than current fuel taxes: On average, these state and federal taxes add less than 50 cents to the cost of a gallon of gasoline and slightly more to the cost of a gallon of diesel.[136]

Taxing fuel at a level that reflects these impacts could make fuel-efficient vehicles more economically attractive to buyers. Automated driving could conceivably increase fuel efficiency by reducing crashes, smoothing speeds and flows, and enabling drag-reducing platoons.[137] Any resulting difference in cost between automated and conventional driving would not be a subsidy to the former or a penalty to the latter; rather, it would reflect the actual difference in pollution-related damages.

This approach could be particularly relevant to truck automation. Fuel is one of the largest single expenses in trucking;[138] a typical combination tractor uses

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from High Emitters, 8 ATMOSPHERIC MEASUREMENT TECHNIQUES 2881, 2894 (2015). These statistics predate revelations about Volkswagen's use of defeat devices.

132. *See.* Wang et al., *supra* note 131.

133. *See* Drew T. Shindell, *The Social Cost of Atmospheric Release*, 130 CLIMATIC CHANGE 313, 314 (2015).

134. *Id.* at 321.

135. *Id.*; *see also, e.g.*, Ian W.H. Perry, *Is Gasoline Undertaxed in the United States?*, 148 RESOURCES 28, 29 (2002), http://www.rff.org/rff/Documents/RFF-Resources-148-gasoline.pdf (explaining that, while economists have tried to calculate the economic damages from carbon emissions, these numbers are speculative at best).

136. For a breakdown of the motor fuel taxes by state, see *State Motor Fuel Taxes*, AM. PETROLEUM INST. (Oct.. 2016), http://www.api.org/~/media/Files/Statistics/StateMotorFuel-OnePagers-Oct-2016.pdf On average, state and federal taxes add 48 cents per gallon to the price of gasoline and 54 cents per gallon to the price of diesel. *Id.*

137. ANDERSON ET AL, *supra* note 1, at 28.

138. W. FORD TORREY, IV & DAN MURRAY, AM. TRANSP. RES. INST., AN ANALYSIS OF THE OPERATIONAL COSTS OF TRUCKING: A 2014 UPDATE (Sept. 2014), http://www.atri-online.org/wp-content/uploads/2014/09/ATRI-Operational-Costs-of-Trucking-2014-FINAL.pdf (explaining that fuel

some $70,000 to $125,000 of diesel annually.[139] This means that reducing a truck's fuel use by ten percent—which automation in combination with platooning might enable[140]—could save nearly $10,000 per year.[141] Doubling total fuel taxes would increase this differential to more than $11,000.[142] In a low-margin business such as trucking,[143] even this small difference could be significant.

Governments could also use taxation more strategically to ensure a price floor for fuel.[144] Automatically raising fuel taxes when pretax prices drop below a particular level could prevent the price dips that might otherwise discourage long-term investment in more fuel-efficient systems, including the technologies needed for automation and platooning.

Although usage taxes can lead to a more efficient allocation of resources,[145] they can also raise equity concerns. In the United States, lower-income households that rely on driving as a primary mode of transportation typically pay more of their total income in fuel taxes than higher-income households.[146] However, these fuel taxes could be directed to support other programs—including public transportation, travel vouchers, and income assistance—that assist the less affluent. This is a crucial

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costs account for 38% of total annual carrier costs). For current diesel prices, see U.S. ENERGY INFO. ADMIN., GASOLINE AND DIESEL FUEL UPDATE, https://www.eia.gov/petroleum/gasdiesel/ (last updated Mar. 14, 2016).

139. U.S. DEP'T OF ENERGY, RESEARCH AND DEVELOPMENT OPPORTUNITIES FOR HEAVY TRUCKS (June 2009), https://www1.eere.energy.gov/vehiclesandfuels/pdfs/truck_efficiency_paper_v2.pdf; *cf. also* WHITE HOUSE, IMPROVING THE FUEL EFFICIENCY OF AMERICAN TRUCKS—BOLSTERING ENERGY SECURITY, CUTTING CARBON POLLUTION, SAVING MONEY AND SUPPORTING MANUFACTURING INNOVATION (Feb. 2014), https://www.whitehouse.gov/sites/default/files/docs/finaltrucksreport.pdf ("[E]very mile per gallon gained in fuel economy is worth thousands of dollars in fuel cost savings per [Class 8] truck per year."); OAK RIDGE NAT'L LAB., 2015 VEHICLE TECHNOLOGIES MARKET REPORT ch. 3 (2015), http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf (truck fuel efficiency); U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., ANNUAL VEHICLE DISTANCE TRAVELED IN MILES AND RELATED DATA—2013 (1) BY HIGHWAY CATEGORY AND VEHICLE TYPE, http://www.fhwa.dot.gov/policyinformation/statistics/2013/vm1.cfm (truck fuel use); TORREY & MURRAY, *supra* note 138 (trucking costs).

140. LAMMERT,, *supra* note 62 (finding that platooning resulted in fuel savings for the trailing truck of up to 9.7%).

141. Ten percent of $70,000 to $125,000 is $7,000 to $12,500. *See* U.S. DEP'T OF ENERGY, *supra* note 139.

142. *See, e.g.*, JORDI BADIA CANAL, FUEL SAVING POTENTIALS OF HDVS THROUGH PLATOONING BASED ON REAL GPS TRACES (XR-EE-RT 2014:008) 33–41 (Mar. 2014) (Master's Degree Project, Stockholm, Sweden), http://upcommons.upc.edu/bitstream/handle/2099.1/22743/Report.pdf?sequence=4 (focusing on the potential benefits in fuel consumption for heavy duty vehicles through platooning and estimating that this could save 10% in fuel costs). *See also* LAMMERT,, *supra* note 62. For current diesel tax rates, see AM. PETROLEUM INST., DIESEL TAX, http://www.api.org/oil-and-natural-gas-overview/industry-economics/fuel-taxes/diesel-tax (last visited Mar. 15, 2016).

143. N.Y.U. STERN SCH. OF BUS., MARGINS BY SECTOR (US) (Jan. 2016), http://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/margin.html.

144. *See* Thomas Merrill & David M. Schizer, *Energy Policy for an Economic Downturn: A Proposed Petroleum Fuel Price Stabilization Plan*, 27 YALE J. ON REG. 1, 5 (2010).

145. *See* Arnold C. Harberger, *Taxation, Resource Allocation, and Welfare*, ROLE OF DIRECT AND INDIRECT TAXES IN FED. RES. SYS. 25 (1964).

146. THOMAS STERNER, FUEL TAXES AND THE POOR: THE DISTRIBUTIONAL EFFECTS OF GASOLINE TAXATION AND THEIR IMPLICATIONS FOR CLIMATE POLICY [PG #] (EDITOR, EDITION 2011).

point: Although the transportation system is far from optimal, transportation itself is essential.

More broadly, efficiency and equity are just two considerations in ongoing debates about raising, indexing, and replacing fuel taxes.[147] Automated driving, however, also belongs in those debates.

Reducing parking subsidies is the second way that governments—particularly local governments—can better align the individual and social costs of motor vehicle travel. More precisely, many cities subsidize private vehicle ownership by providing inexpensive on-street parking (especially in residential areas) and by requiring new buildings to include more parking spots than the market demands.[148] Cheap and plentiful parking encourages both vehicle ownership and vehicle usage.[149] Conversely, making parking more expensive and less convenient could encourage the use of driverless systems that forgo parking altogether or, perhaps, advanced driver assistance systems that automate the driving task in part (such as park assist) or in whole (such as automated valet).

Finally, **raising insurance minimums** may help to translate safety gains from automated driving into financial terms that are obvious to vehicle owners and drivers. The cost of a serious injury crash far exceeds the third-party liability coverage that nearly every state[150] requires vehicle owners and operators to carry. Depending on the methodology used, a single traffic death costs somewhere between $1.5 and $10 million.[151] And yet in most states, the at-fault driver could lawfully have an insurance policy that would pay out no more than $50 *thousand*—a hundredth of this cost.[152] In short, these minimums are far too minimal.[153]

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147. THE TRANSP. RESEARCH BD. OF THE NAT'L ACAD.., THE FUEL TAX AND ALTERNATIVES FOR TRANSPORTATION FUNDING, SPECIAL REP. 285, at 65–66 (2006) http://onlinepubs.trb.org/onlinepubs/sr/sr285.pdf.

148. Victoria Transp. Policy Inst., *Parking Solutions: A Comprehensive Menu of Solutions to Parking Problems*, TDM ENCYCLOPEDIA (last updated Apr. 17, 2015), http://www.vtpi.org/tdm/tdm72.htm.

149. *But see id.*

150. The one exception is New Hampshire. *See* N.H. REV. STAT. ANN. § 264:3 (1989).

151. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN, *supra* note 129, at 1, 44; NAT'L SAFETY COUNCIL, ESTIMATING THE COSTS OF UNINTENTIONAL INJURIES 2013, at 1 (2015), http://www.nsc.org/NSCDocuments_Corporate/estimating-costs-unintentional-injuries-2015.pdf.

152. *See, e.g.,* ALA. CODE § 32-7-6(c) (2008); ARK. CODE ANN. § 27-22-104(b) (2013); COLO. REV. STAT. § 10-4-620 (2003); D.C. CODE § 31-2406(a)(2A)(c) (2009); GA. CODE ANN. § 33-7-11(a)(1)(A)(2009); IDAHO CODE § 49-1229(2) (2009); 625 ILL. COMP. STAT. 5/7-203. (2015); IND. CODE § 9-25-4-5(2) (1991); KAN. STAT. ANN. § 40-3107(e) (1984); KY. REV. STAT. ANN. § 304.39-110(1)(a)(1) (West 1986); MISS. CODE ANN. § 63-15-3(j) (2015); MO. REV. STAT. § 303.190(2)(2) (1999); MONT. CODE ANN. § 61-6-103(1)(b) (2015); NEB. REV. STAT. §60-346 (2005); N.H. REV. STAT. ANN. § 264:20 (1982); N.M. STAT. ANN. § 66-5-208(B) (2012); N.Y. VEH. & TRAF. LAW § 333 (b) (1995); N.D. CENT. CODE § 39-16.1-11(2)(b) (2003); OKLA. STAT. 4509.20(H) (2014); OR. REV. STAT. § 806.070(2)(b) (2010); 31 R.I. GEN. LAWS § 31-34-1(A)(3) (1982); S.C. CODE ANN. § 38-77-140(A)(2) (2006); S.D. CODIFIED LAWS § 32-25-70 (1992); TENN. CODE ANN. § 55-12-102(12)(A)(i)(a)-(b) VT. STAT. ANN. 23 11 § 800(a) (2015); VA. CODE ANN. § 46.2-472(3) (1989) ; WASH. REV. CODE ANN. § 46.29.090(1) (1963); WIS. STAT. § 344.33(2)(b) (2015); WYO. STAT. ANN. § 31-9-103(b)(ii) (1957).

153. In contrast, German law requires at least €1 million in third-party liability coverage for personal injury. Haftpflichtversicherung [Ordinance on the Surveillance Industry], Jan. 1, 1996, Bewachungsverordnung [BewachV] at 362 § 6 (Ger.).; *see also* Pflichtversicherungsgesetz **[**Compulsory Insurance Act**],** Apr. 5, 1965, BGBI I at 213, § 4 (Ger.).

Recent (and distinct) efforts to regulate automated driving and ridesharing suggest the absurdly low level of these minimums. In Nevada and California, developers that wish to test their automated driving systems on public roads must secure or demonstrate the ability to cover $5 million in crash liability.[154] And several states to expressly regulate so-called transportation network companies like Uber and Lyft have imposed insurance requirements several times higher than those imposed on noncommercial drivers.[155]

Raising insurance minimums would likely raise premiums for this insurance, which could in turn raise the cost of owning and operating a vehicle. This could have some undesirable effects: These cost increases could disproportionately impact lower-income households and might also encourage more drivers to unlawfully forgo insurance. It is important to note, however, that as with raising fuel taxes, raising insurance minimums would not raise the cost of driving in universal terms; it would merely shift some costs from those who are actually injured to those who could potentially cause injury.

Automated systems are expected to reduce the frequency and severity of this injury.[156] Indeed, both the National Highway Traffic Safety Administration and the National Transportation Safety Board have recently moved to encourage the deployment of some active safety systems.[157] If these expected safety gains are realized, then the costs of insuring against injuries and deaths related to automated driving may be lower than the corresponding costs for conventional driving. Ensuring that insurance minimums more fully reflect these costs could increase the potential cost difference in a way that would be favorable (and fair) to the owners and users of automated driving systems.

Raising these minimums could also help address one of the product liability concerns associated with increasing automation. The growing prevalence of advanced driver assistance systems and automated emergency intervention systems means that a greater share of crashes may be linked, however minimally or implausibly, to some aspect of vehicle design or performance.[158] As a result, even in a crash caused primarily by a human driver's negligence, the companies that designed, manufactured, or sold the vehicle or its relevant components could face litigation.[159] These automotive manufacturers are often more attractive defendants

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154. *See* NEV. REV. STAT. § 482A.060 (2013); CAL. VEHICLE CODE § 38750(b)(3) (2015).

155. CAL. PUB. UTIL. CODE § 5433(b)(2) (West 2015) (requiring "transportation network companies" to provide at least $1,000,000 of uninsured and underinsured motorist coverage from the moment a passenger enters a vehicle to the moment the passenger exits the vehicle).

156. Press Release, Nat'l Highway Traffic Safety Admin., U.S. Department of Transportation Releases Policy on Automated Vehicle Development NHTSA 14-13 (May 30, 2013), http://www.nhtsa.gov/About+NHTSA/Press+Releases/U.S.+Department+of+Transportation+Releases+Policy+on+Automated+Vehicle+Development.

157. *See* NAT'L TRANSP. SAFETY BOARD, SPECIAL INVESTIGATION REP.: THE USE OF FORWARD COLLISION AVOIDANCE SYSTEMS TO PREVENT AND MITIGATE REAR-END CRASHES 37-38 (May 19, 2015), http://www.ntsb.gov/safety/safety-studies/Documents/SIR1501.pdf.

158. *See, e.g.*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., NHTSA'S 2014 AUTOMATIC EMERGENCY BRAKING TEST TRACK EVALUATIONS DOT HS 812 166 (June 2015), http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2015/812166-2014AutomaticEmergencyBrakingTestTrackEval.pdf.

159. This depends on the particular U.S. state.

than individual owners in part because they may be able to pay plaintiffs much more than an individual's third-party liability insurance would cover.

Requiring vehicle owners and operators to carry insurance in the millions rather than the thousands of dollars would lessen this discrepancy. For a variety of reasons, manufacturers would still face litigation: Their products may in fact be defective, they may be less sympathetic than individual drivers, multiple defendants may increase a plaintiff's chance of recovery, or the negligent driver and the injured plaintiff may be one and the same. At the same time, however, proving that a driver was negligent may be easier than proving that a product was defective.[160] More broadly, ensuring that individuals can pay for the harms they inflict may reduce the extent to which developers of automated systems need to pay as well.

In short, raising insurance minimums can help consistently internalize the costs of crashes, which in turn can help automated driving compete fairly with conventional driving.[161] Rationalizing insurance—a strategy discussed in the next part—can enhance both the accuracy and the precision of this effort.

E. Rationalize Insurance

Insurance companies will play a key role in establishing the safety and desirability of automated driving. "[B]etter tailor[ing] their products to reflect the actual risk posed by particular drivers in particular vehicles in particular conditions" could "advantage those automated vehicles that actually represent a safety improvement."[162] Governments can assist by facilitating access to key data and by providing flexibility to insurers as well as to the insured.

States tend to closely regulate automotive insurance.[163] Vehicle owners are generally required to carry at least third-party liability insurance (or show the means to insure themselves).[164] Providers of this insurance are subject to a wide range of requirements, including restrictions on the rates they may charge.[165] In general, these insurers must be able to demonstrate to regulators that their proposed or actual rates are not "excessive, inadequate, or unfairly discriminatory."[166] These arguments can turn on concrete data, which may be lacking for new applications such as automated

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160. This may be counterintuitive, particularly since products liability is often described as "strict." *See* David P. Griffith, Note, *Products Liability—Negligence Presumed: An Evolution*, 67 TEX. L. REV. 851, 853 (1989). In many jurisdictions, however, a plaintiff claiming a design defect must point to a particular design change that, if adopted, would have prevented or reduced the particular injury without diminishing the product's overall safety. This can be a difficult hurdle. *See, e.g.*, Branham v. Ford Motor Co., 390 S.C. 203, 220–25, 701 S.E.2d 5, 14-17 (2010) ("This presentation of an alternative design must include consideration of the costs, safety and functionality associated with the alternative design."), *superseded by statute*, S.C. CODE ANN. § 15–38–15 (2014).

161. This is also the goal of a more dramatic proposal to embrace enterprise liability. *See* Smith, *Risk of Inaction*, *supra* note 1, at 606–07. That proposal, however, is beyond the scope of the instant Article.

162. Smith, *Risk of Inaction*, *supra* note 1, at 598.

163. *See, e.g.*, S.C. CODE ANN. § 38-77-10 (1997).

164. Peterson, *supra* note 19, at 111–13; *see also supra* (discussing these minimums).

165. *See* Peterson, *supra* note 19, at 1343–44.

166. *Id.*

driving[167] and usage-based insurance.[168] A dearth of these data could frustrate insurers seeking either to satisfy regulatory requirements or merely to accurately price their own risks.[169]

A state conducting a legal audit[170] should consider whether existing law obscures the data or distorts the economics of automated driving. Relevant provisions may require actuarial data that are not practically available,[171] limit the collection of driving data,[172] or restrict the use of those data in setting rates.[173] California, for example, prohibits usage-based insurance[174] and mandates specific insurance rating factors, some of which may be less relevant at higher levels of driving automation.[175] The key here, as in the next part, is to provide flexibility commensurate with both the risks and the opportunities of automated driving.

F. Embrace Flexibility

No legislature, agency, or developer will be able to anticipate every legal complication that might arise in the case of particular automated driving technologies or applications. For this reason, governments should consider how best to provide interpretations and clarifications of existing law and, as necessary, to grant appropriate exceptions to and exemptions from that law.

Governments should consider whether and how they might use a **variety of legal mechanisms**, including legislative acts, administrative regulations, executive orders, legal interpretations, and policy statements, to address any obstacles or uncertainties suggested by existing law. In some instances, formally amending a statute may be the only way to clearly and correctly accommodate a particular automated driving application. In other instances, however, less formal means may be as effective. For example, depending on the state, the legislature, the department

167. *Id.* at 1345 ("Rating a new technology with an unproven track record may include a considerable amount of guesswork.").

168. *See* NAT'L ASS'N INS. COMM'RS (NAIC), CTR. FOR INS. POL'Y & RES., USAGE-BASED INSURANCE AND TELEMATICS, http://www.naic.org/cipr_topics/topic_usage_based_insurance.htm (last updated June 6, 2016).

169. *See* Peterson, *supra* note 19, at 1345.

170. *See supra.*

171. *Cf.* Randall Guensler et al., *Current State Regulatory Support for Pay-As-You Drive Automobile Insurance Options* (unpublished manuscript), http://transportation.ce.gatech.edu/sites/default/files/files/current_state_regulatory_sup port_for_pay-as-you-drive_automobile_insurance_options.pdf (last visited Oct. 29, 2016).

172. *Cf.* Event Data Recorders, 49 C.F.R. § 563 (2015); The Elec. Privacy Info. Ctr., *Federal Motor Vehicle Safety Standards; Event Data Recorders* 4 (Feb. 11, 2013), https://epic.org/privacy/edrs/EPIC-Coal-NHTSA-EDR-Cmts.pdf (discussing state limits on insurer access to in-vehicle event data recorders); Nat'l Conference of State Legis., *Privacy of Data from Event Data Recorders: State Statutes*, http://www.ncsl.org/research/telecommunications-and-information-technology/privacy-of-data-from-event-data-recorders.aspx (last updated Jan. 4, 2016) (discussing federal and state laws restricting access to recorded event data).

173. DIMITRIS KARAPIPERIS ET AL., CIPR STUDY: USAGE-BASED INSURANCE AND VEHICLE TELEMATICS: INSURANCE MARKET AND REGULATORY IMPACTS 20 (Mar. 2015).

174. *Id.* at 5, 73, 76.

175. Because of a ballot initiative, California requires insurers to use an insured's driving safety record, annual miles driven, and years of driving experience as the top three factors for setting a rate. CAL. INS. CODE § 1861.02 (West 2016).

of motor vehicles, the highway patrol, or the attorney general may play a role in defining the "driver" of an automated vehicle for the purpose of a particular legal regime.

The **enforcement discretion** already employed by government agencies and agents is an informal means of providing flexibility—as well as a potential source of significant uncertainty. For example, two state vehicle inspectors may disagree on whether a particular vehicle is "safe" for the purposes of vehicle registration, and two local police chiefs may disagree on whether a motorist should be stopped or cited under any of the traffic code provisions with a potentially unclear application to automated driving.[176] Governments can manage this discretion by clarifying enforcement priorities, practices, and parameters. Especially when linked with the public network of support described below,[177] this policy guidance can highlight jurisdictions that are especially receptive in practical terms to automated driving.

Recognizing and even formalizing a robust statutory or regulatory **exemption authority** may also provide developers with prospective certainty without reducing the flexibility available to them. This could be particularly important for limited deployments of truly driverless vehicles in particular communities. These deployments may reveal unanticipated legal hurdles that could be addressed at least initially through waivers rather than wholescale reform.[178] In turn, the legal and practical lessons from these deployments can inform whatever broader reforms eventually do occur.

Some federal agencies already have explicit if limited authority to create exceptions to generally applicable law. The U.S. Department of Transportation, for example, "may exempt, on a temporary basis, motor vehicles from a motor vehicle safety standard . . . on terms the Secretary considers appropriate."[179] Indeed, the Department's January 2016 announcement on automated and connected vehicle technologies specifically "encouraged manufacturers to submit requests for use of the agency's exemption authority."[180] European governments have also relied heavily on exemptions to facilitate the research-and-development testing of automated driving.[181] Expanding explicit exemption authority can provide more flexibility.

176. Smith, *supra* note 1, at 494–97, 498–500.

177. *See infra*.

178. Smith, *supra* note 2.

179. 49 U.S.C. § 30113; *see also* 49 U.S.C. § 30114.

180. Press Release, U.S. Dep't of Transp., Secretary Foxx Unveils President Obama's FY17 Budget Proposal of Nearly $4 Billion for Automated Vehicles and Announces DOT Initiatives to Accelerate Vehicle Safety Innovations (Jan. 14, 2016), https://www.transportation.gov/briefing-room/secretary-foxx-unveils-president-obama%E2%80%99s-fy17-budget-proposal-nearly-4-billion; *see also* U.S. Dep't of Transp. & Nat'l Highway Traffic Safety Admin., "DOT/NHTSA Policy Statement Concerning Automated Vehicles" 2016 Update To "Preliminary Statement Of Policy Concerning Automated Vehicles," http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Autonomous-Vehicles-Policy-Update-2016.pdf (last visited Oct. 29, 2016).

181. *See, e.g.*, Dep't of Transp. (London), *The Pathway to Driverless Cars: Summary Report and Action Plan* (Feb. 2015), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401562/pathway-driverless-cars-summary.pdf; GOV'T OF THE

This authority can also be implicit. "Unless a statute or regulation employs 'extraordinarily rigid' language, courts recognize an administrative law principle that allows agencies to create unwritten exceptions to a statute or rule for '*de minimis*' matters."[182] Significant statutory deviations for substantial undertakings, however, may fall outside this principle. "The ability to create a de minimis exemption 'is not an ability to depart from the statute, but rather a tool to be used in implementing the legislative design.'"[183]

Finally, **public safety cases** might be part of a more formal process for granting significant exceptions to statutory or regulatory regimes.[184] In short, a government might require a developer seeking a specific legal exemption to "publicly make and defend arguments about how well its system should perform and how well its system actually performs."[185] Such a process could encourage the sharing of information, the informal development of fluid best practices, and the technical education of regulators as well as the general public.

VI. COMMUNITY STRATEGIES

A. Identify Local Needs and Opportunities

A community that wants to attract or implement a truly driverless system should demonstrate that it is a strong candidate for such a system. For example, "low-speed, low-mass, geographically restricted, and centrally supervised" systems "could be particularly well suited for airports, city centers, business clusters, university campuses, convention centers, military bases, retirement communities, amusement parks, and last-mile transit applications. Small robotic trucklets could similarly facilitate on-demand and last-mile freight delivery" in dense environments.[186] Even more specifically, a community should be able to articulate how an automated system would solve entrenched problems or create new possibilities.

To a lesser extent, the community might also document how its conditions could advance the state of the technologies themselves. For example, extreme

NETHERLANDS, MOBILITY, PUBLIC TRANSPORT AND ROAD SAFETY: SELF-DRIVING VEHICLES https://www.government.nl/topics/mobility-public-transport-and-road-safety/contents/self-driving-vehicles (last visited Oct. 29, 2016); *see also, e.g.*, NAT'L TRANSP. COMM'N (Australia), CURRENT PROJECTS/PREPARING FOR MORE AUTOMATED ROAD AND RAIL VEHICLES, http://www.ntc.gov.au/current-projects/preparing-for-more-automated-road-and-rail-vehicles (last visited Oct. 29, 2016).

182. Kentucky Waterways Alliance v. Johnson, 540 F.3d 466, 491 (6th Cir. 2008) (quoting Greenbaum v. EPA, 370 F.3d 527, 534 (6th Cir. 2004)); *see also* AARP v. EEOC, 390 F. Supp. 2d 437 (E.D. Pa. 2005); Envtl. Def. Fund, Inc. v. EPA, 82 F.3d 451, 466 (D.C. Cir. 1996).

183. *Envtl. Def. Fund*, 82 F.3d at 466 (quoting Ala. Power Co. v. Costle, 636 F.2d 323, 360 (D.C. Cir. 1979)).

184. *See* Smith, *Risk of Inaction*, *supra* note 1, at 600-602; *see also* Smith, *New Years Resolutions*, *supra* note 3.

185. Smith, *Risk of Inaction*, *supra* note 1, at 601; *see also* Bryant Walker Smith, Third Annual Conference on Governance of Emerging Technologies, Developing Danger, at 5 (May 2015), http://conferences.asucollegeoflaw.com/get2015/files/2014/06/Walker-Smith-Developing-Danger.pdf; Bryant Walker Smith, Regulating Automated Driving, TRB-AUVSI Automated Vehicles Symposium, at 12 (July 2015), http://newlypossible.org/files/presentations/2015-07-21_TRB-AUVSI_Regulation.pdf.

186. Smith, *Three Misconceptions*, *supra* note 2, at 2-3.

weather, atypical road users, and unusual infrastructure will all challenge automated systems (and their designers). However, a community that carefully analyzes automated driving in the context of its local transportation needs will be far more interesting to developers than a community that merely announces—to the surprise of no one—that it has snow.

A thoughtful local plan could inform subsequent proposals to or even stimulate interest from a variety of public and private actors. Federal and state agencies—including the U.S. Departments of Transportation, Housing and Urban Development, Energy, and Defense—may have relevant grants focused on transit, technology, urban renewal, and energy efficiency.[187] An enthusiastic Congress (or state legislatures) might fund fifty "Smart Cities" rather than just one.[188] Private real estate developers may embrace driverless systems as centerpieces for new mixed-use projects. Institutional investors familiar with parking and toll facilities may look to expand their investment portfolios. Developers of automated systems, including startups and universities, may seek new environments in which to test their systems.

Most significantly, the companies that ultimately launch these systems are likely to target select communities before expanding incrementally to others. Indeed, companies like Google, Uber, and Amazon have embraced this geographic strategy.[189] Just as Google ran a competition to select its Fiber cities,[190] a company launching a driverless system might invite communities to compete to become a showcase for its system.

A community that brings together local stakeholders to preemptively develop such a proposal could also discover compelling business cases that may not require external support. When vendors begin seriously marketing mature driverless shuttle systems, some of these stakeholders may become early customers.

B. Identify Allies and Constituencies

A government that wants to signal its support for automated driving should identify both public and private networks of support.

The public network should document a chain of support from the governor to the legislature to the department of motor vehicles to the local chief of police. A credible statement of uniform policy down and across the entire hierarchy of relevant government will reassure developers that, for example, an enthusiastic municipal

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187. *See Smart City Challenge*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/smartcity (last updated Feb. 12, 2016); U.S. DEP'T OF TRANSP., FED. TRANSIT ADMIN., CAPITAL INVESTMENT PROGRAM , https://www.transit.dot.gov/funding/grant-programs/capital-investments/about-program (last visited Mar. 15, 2016) (outlining New Starts grant); *TIGER Discretionary Grants*, U.S. DEP'T OF TRANSP., https://www.transportation.gov/tiger (last updated Mar. 8, 2016); *Dwight David Eisenhower Transportation Fellowship Program*, U.S. DEP'T OF TRANSP., FED. HIGHWAY ADMIN., https://www.fhwa.dot.gov/tpp/ddetfp.htm (last modified Mar. 4, 2016).

188. *See Smart City Challenge*, *supra* note 187.

189. *See, e.g.*, EXPANSION PLANS, *supra* note 13 (discussing the cities Google Fiber is available in and how Google decides what cities to expand to next); Martin Bryant, *Hitting the Ground: What it Takes to Launch Uber, Hailo and Citymapper in a New City*, TNW NEWS (July 28, 2014, 7:25 pm), http://thenextweb.com/entrepreneur/2014/07/28/hitting-ground-takes-launch-uber-hailo-citymapper-new-city/ (explaining how Uber decides to expand to a new city).

190. *See Think Big with a Gig: Our Experimental Fiber Network*, GOOGLE (Feb. 10, 2010), https://googleblog.blogspot.com/2010/02/think-big-with-gig-our-experimental.html.

position will not be preempted by a protectionist legislature or skeptical sheriff. The Arizona governor's executive order on automated driving exemplifies a top-down approach,[191] while the proclamations of several local governments in Iowa reflect a bottom-up approach.[192] A comprehensive approach should encompass these levels plus everything in between.

The private network should involve key interest groups, companies, and even individuals who could advocate for, and possibly collaborate with, developers of automated driving systems. Disability-rights groups and downtown business associations may help to educate and excite the community about driverless systems. Universities, military bases, and planned real-estate developments may provide attractive sites for initial deployment. Hospitals and other major employers that routinely face issues related to parking and congestion may also contribute financially, whether directly or indirectly, to such a deployment. And locally prominent insurance companies may be able to allay some concerns about physical or financial risk. This network would serve both a substantive role (by generating support) and a symbolic one (by evidencing that support).

C. Prepare Society

Governments should begin to anticipate and manage the broader implications of automation and connectivity. This requires stepping back and thinking ahead rather than merely chasing each particular technology as it develops. Indeed, even though automated vehicles are likely to be a particularly prominent symbol of the next technological revolution, they will be far from the only one. Basic social science research can help governments and their constituents understand the policy choices that these technologies will present. Robust structures for managing unemployment and underemployment can help ease economic transitions for individuals and industries. Informed discussion of these technologies can help to appropriately manage public expectations.[193]

Planning of this kind is one of the most important contributions that governments can make to automated driving in the long term. The status quo is far from perfect. Automated driving may address some of today's problems while exacerbating others. Similarly, automated driving may be advantaged by some of those problems but disadvantaged by others. Understanding these issues—which may not necessarily be a priority for the companies developing and deploying relevant technologies—will help governments determine the role that automated driving can play in advancing larger public policy goals.

191. Exec. Order No. 2015-09, Self-Driving Vehicle Testing and Piloting in the State of Arizona; Self-Driving Vehicle Oversight Commission [M15-241], 22 Ariz. Admin. Reg. 87 (Jan. 15, 2016), http://apps.azsos.gov/public_services/register/2016/3/26_governor_EO.pdf.

192. *See* Jack O'Leary & Marco Santana, *Iowa County Says Yes to Driverless Cars*, USA TODAY (July 25, 2014, 2:10 pm), http://www.usatoday.com/story/money/cars/2014/07/25/iowa-driverless-cars/13159845/.

193. *See generally* Smith, *Three Misconceptions*, *supra* note 2.

D. Be Public

Governments should share the steps they are taking to promote (as well as to anticipate and regulate) automated driving. In other words, they should say what they are doing.

Some states have worked to publicize their automated driving efforts. The Nevada and California departments of motor vehicles, for example, both maintain websites for their relevant regulatory activities.[194] Florida's Department of Transportation conducts an annual symposium on this topic.[195] The state of Michigan has invested heavily in a new partnership among government, academia, and industry devoted, in part, to automated and connected vehicles.[196] The American Association of Motor Vehicle Administrators maintains a useful repository of information on relevant law.[197]

At the same time, governments can do much more. States can and should identify the point person recommended above.[198] Official websites should meaningfully engage key audiences—not only the public at large but also established developers, startups, insurers, local governments, advocacy organizations, and would-be buyers, partners, and users. Governments should emphasize what they are doing as well as how others can contribute to or benefit from these efforts.

This communication is important for at least four reasons specific to automated driving.[199] First, it enhances the broader dialogue about what governments are and should be doing. Second, it assists companies that are considering where to develop or deploy technologies relevant to automated driving—a category that is far broader than just vehicles. Third, it builds institutional credibility, which will be particularly important in the event of a crash or other setback. Finally, this communication helps to appropriately manage public expectations about these technologies and applications.[200]

VII. CONCLUSION

This Article has briefly introduced a number of administrative, legal, and community strategies for encouraging automated driving. These strategies start from a careful understanding of emerging technologies and applications, of existing legal constraints and tools, and of local needs and opportunities. This understanding is

194. *See Autonomous Vehicles*, NEVADA DMV, http://www.dmvnv.com/autonomous.htm (last visited Mar. 15, 2016); *Autonomous Vehicles in California*, *supra* note 23.

195. *See Florida Automated Vehicles*, FLORIDA DEP'T OF TRANSP., http://www.automatedfl.com/2016summit/ (last visited Mar. 15, 2016).

196. *See Mobility Transformation Center*, UNIVERSITY OF MICHIGAN, http://www.mtc.umich.edu/ (last visited Mar. 15, 2016).

197. *Current Legislation*, AM. ASS'N OF MOTOR VEHICLES ADM'RS, http://capwiz.com/aamva/issues/(last visited Mar. 15, 2016).

198. *See supra* Administrative strategies (recommending such a person).

199. Government transparency is important generally as well.

200. *See* Eva Kaplan-Leiserson, *Driving the Future*, PE MAG. (Jan./Feb. 2016), http://www.nspe.org/resources/pe-magazine/january-2016/driving-the-future (National Society of Professional Engineers).

necessary to optimize the physical, digital, legal, and social infrastructures on which automated driving will depend.

An important perspective on safety should guide the implementation of these strategies: Governments should appreciate the risks of both automated and conventional motor vehicle travel. Contrary to some assertions, automated vehicles are not yet demonstrably better than human drivers across a full range of driving conditions.[201] Suggesting (without demonstrating) otherwise risks raising public expectations unrealistically high. At the same time, the considerable dangers of conventional driving[202] are not sufficiently appreciated by the public or addressed by policymakers. In short, the public should be concerned about automated driving but terrified about human driving.

For this reason, governments should expect more from all motor vehicles and their drivers rather than uniquely burdening automated systems. Policymakers concerned about the potential malfunction of automated vehicles should expend at least as much energy on the actual misbehavior of conventional drivers. And policymakers eager to promote automated driving should address subtle subsidies for the ownership and operation of conventional vehicles that could disadvantage new products and services. In other words, governments should encourage automated driving by raising the bar for all forms of driving.

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201. *See* Myra Blanco et al., *Automated Vehicle Crash Rate Comparison Using Naturalistic Data Final Report* at iii-iv, VA. TECH. TRANSP. INST. (Jan. 2016), http://www.vtti.vt.edu/PDFs/Automated%20Vehicle%20Crash%20Rate%20Comparison%20Using%20 Naturalistic%20Data_Final%20Report_20160107.pdf (comparing automated driving *with safety drivers* to conventional driving); Bryant Walker Smith, *Driving at Perfection*, CTR. FOR INTERNET & SOC'Y (Mar. 11, 2012, 3:20 pm), https://cyberlaw.stanford.edu/blog/2012/03/driving-perfection; *See generally* CALIFORNIA DMV, AUTONOMOUS VEHICLE DISENGAGEMENT REPORTS(2011), https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/disengagement_report (link to list of separate reports describing incidents)

202. *See, e.g.*, CTR. FOR DISEASE CONTROL, NAT'L CTR. FOR INJURY PREVENTION & CONTROL, 10 LEADING CAUSES OF DEATH BY AGE GROUP, UNITED STATES—2013, http://www.cdc.gov/injury/images/lc-charts/leading_causes_of_death_by_age_group_2013-a.gif (last visited Mar. 15, 2016); CTR. FOR DISEASE CONTROL, NAT'L CTR. FOR INJURY PREVENTION & CONTROL, 10 LEADING CAUSES OF DEATH BY AGE GROUP HIGHLIGHTING UNINTENTIONAL INJURY DEATHS, UNITED STATES—2013, http://www.cdc.gov/injury/images/lc-charts/leading _causes_of_injury_deaths_highlighting_unintentional_injury_2013-a.gif (last visited Mar. 15, 2016); Bryant Walker Smith, *Human Error as a Cause of Vehicle Crashes*, CTR. FOR INTERNET & SOC'Y (Dec. 18, 2013, 3:15 pm), http://cyberlaw.stanford.edu/blog/2013/12/human-error-cause-vehicle-crashes.

VIII. STRATEGY CHECKLIST

Administrative strategies	
Prepare government	
Identify a point person	
Understand automated driving	
Cultivate broader expertise	
Review planning processes	
Develop break-the-glass plans	
Provide resources	
Prepare infrastructure	
Maintain roadways	
Review design policies	
Implement design policies	
Train roadway personnel	
Standardize data	
Update registration databases	
Cooperate on DSRC	
Improve wireless networks	
Manage congestion	
Calm neighborhood traffic	
Plan infrastructure	
Leverage procurement	
Advocate for AEIS mandates	
Legal strategies	
Analyze existing law	
Conduct a legal audit	
Consider all relevant law	
Consider existing legal tools	
Review enforcement discretion	
Calibrate existing law	
Collaborate with private actors	
Facilitate uniformity	
Reference levels of automation	
Extend regulatory reciprocity	
Codify interpretive conventions	
Distinguish passengers from drivers	
Permit the use of electronic devices	
Enforce safety requirements	
Enforce speed laws	
Enforce distracted driving laws	
Enforce intoxicated driving laws	
Enforce (and update) seatbelt laws	
Enforce vehicle laws	
Internalize the costs of driving	
Raise fuel taxes	
Reduce parking subsidies	
Raise insurance minimums	
Rationalize insurance	
Embrace flexibility	
Tailor legal mechanisms	
Clarify enforcement discretion	
Formalize exemption authority	
Encourage public safety cases	
Community strategies	
Identify local needs and opportunities	
Identify allies and constituencies	
Prepare society	
Be public	
General strategies	
Anticipate a surprising future	
Appreciate the risks of driving generally	
Expect more from all vehicles and drivers	