AUTONOMOUS VEHICLE TESTING LEGISLATION: A REVIEW OF BEST PRACTICES FROM STATES ON THE CUTTING EDGE

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INTRODUCTION

For several years now, the Mercedes S Class has been capable of cruising on a freeway without any direct input from a human driver—the driver's feet do not need to be on the pedals, and the driver's hands do not need to be on the wheel.[1] "Active Lane Keeping Assist" technology,

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1. The technology is not currently intended to operate without feet and hands, but can do so through a rudimentary hack. *See* Bethany A. Roston, *Mercedes Active Lane Assist Fooled with Soda Can*, SLASHGEAR.COM (Aug. 2, 2014), http://www.slashgear.com/mercedes-active-lane-assist-fooled-with-soda-can-02339580/.

now available in all Mercedes models, uses cameras and radar detectors to sense traffic-lane markings and other vehicles.[2] When used in conjunction with cruise control, the car can automatically adjust the steering wheel and fuel release to remain inside a lane and safely spaced from traffic.[3] Active Lane Keeping Assist is the latest in a long line of similarly impressive autonomous technologies available from a variety of automobile manufacturers.[4] Indeed, most new cars sold today come equipped with semi-autonomous technologies like cruise control, electronic stability control, and anti-lock brakes.[5] And it is increasingly normal for our cars to automatically break in an emergency, sense objects in blind spots, and even park themselves.[6]

As piecemeal advancements in automobile automation have trickled into public use, automakers and tech companies have also aimed to develop vehicles capable of fully autonomous operation.[7] These "driverless cars" can respond to traffic lights, merge in and out of traffic, and even avoid people and other objects unexpectedly crossing their paths.[8] Google's fully autonomous cars have been operating on public roads in California since 2008, and have now logged over 1.7 million miles while only causing one minor accident.[9]

Fully autonomous vehicles are coming. And they have the potential to bring with them enormous changes to society.[10] Forward-thinking lawmakers in a handful of states have recognized that fact and responded with legislation governing the testing of autonomous vehicles on the

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2. *Active Lane Keeping Assist*, MERCEDES-BENZ USA, https://www.mbusa.com/mercedes/technology/videos/detail/title-safety/videoId-e84b9423c67a7410VgnVCM100000ccec1e35RCRD (last visited Dec. 20, 2016).

3. *Id*.

4. *See infra* Part I.

5. In fact, electronic control stability has been mandatory on all light vehicles produced for operation in the United States since May 2011. *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT OF POLICY CONCERNING AUTOMATED VEHICLES (2013), http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf [hereinafter NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT].

6. The 2017 S-Class will reportedly be offered with "active lane change assist," a feature that will allow the driver to change lanes without looking. *See* Peter Gareffa, 2017 *Mercedes-Benz E-Class Gets Upgraded Interior, Active Lange Change*, EDMUNDS.COM (Dec. 10, 2015), http://www.edmunds.com/car-news/2017-mercedes-benz-e-class-gets-upgraded-interior-active-lane-change.html.

7. *See infra* Part I.

8. *Id*.

9. Francis X. Govers III, *Google Reveals Lessons Learned (and Accident Count) from Self-driving Car Program*, NEW ATLAS (Dec. 13, 2013), http://www.gizmag.com/google-reveals-lessons-learned-from-self-driving-car-program/37481/; Chris Ziegler, *A Google Self-Driving Car Caused a Crash for the First Time: A Bad Assumption led to a Minor Fender-Bender*, THE VERGE (Feb. 29, 2016), http://www.theverge.com/2016/2/29/11134344/google-self-driving-car-crash-report.

10. *See infra* Part II.

roads within their borders.[11] The National Highway Traffic Safety Administration (NHTSA)—the federal agency in charge of vehicle safety—has also recently published guidance including a model state policy.[12] Many states, however, have yet to consider the issue.[13]

This Article aims to bring autonomous vehicle testing legislation to the attention of lawmakers who have not yet considered the issue, and to provide encouragement and additional guidance for expansion of legislation at the state level. It does so in three parts. First, the article briefly reviews the history of autonomous vehicles. Second, it discusses some of the ways that autonomous vehicles could impact society, and explains why lawmakers might be interested in facilitating the safe and orderly deployment of the technology. Finally, the article reviews the current state of the existing legislation and offers some best practices for implementation of autonomous vehicle testing legislation based on the laws that have been passed so far.

I. THE HISTORY OF AUTONOMOUS VEHICLES

Autonomous vehicles first entered mass awareness in the 1920s, when Houdina Radio Control cruised a driverless, radio-controlled car up and down New York's Broadway and Fifth Avenue.[14] With the exception of a completely autonomous transatlantic flight by the U.S. Air Force C-53,[15] however, progress toward truly self-sufficient autonomous vehicles did not emerge until shortly before the turn of the century.

In the 1980s and 1990s, universities, militaries, and governments funded a variety of autonomous vehicle development efforts.[16] By that time, the hardware had improved, making vision-guided autonomous vehicles possible.[17] Unlike the earlier "driverless" vehicles running on human brain control via radio waves, the vehicles of the 1980s and 1990s

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11. *See infra* Part III.

12. *See* NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal Automated Vehicles Policy* (2016), https://one.nhtsa.gov/nhtsa/av/pdf/Federal_Automated_Vehicles_Policy.pdf [hereinafter NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*].

13. *See Autonomous Vehicles: Self-driving Vehicles Enacted Legislation*, NAT'L COUNS. ST. LEGISLATURES (Feb. 2, 2017), www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.

14. *Phantom Auto Will Tour City*, MILWAUKEE SENTINEL, Dec. 8, 1926.

15. BRIAN STEVENS & FRANK LEWIS, AIRCRAFT CONTROL AND SIMULATION 197 (1st ed. 1992).

16. JAMES M. ANDERSON ET AL., RAND CORP., AUTONOMOUS VEHICLE TECHNOLOGY: A GUIDE FOR POLICYMAKERS 55-56 (2016), http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf; *see, e.g.*, Richard Wallace et al., *First Results in Robot Road-Following*, ROBOTICS INSTITUTE (1985); TODD JOCHEM ET AL., PANS: A PORTABLE NAVIGATION PLATFORM, ROBOTICS INSTITUTE (1995).

17. ANDERSON ET AL., *supra* note 16, at 56.

began to operate using hardware and software that could mimic a human's ability to operate vehicles.[18]

From 2003 to 2007, the Defense Advanced Research Projects Agency (DARPA)—a division of the United States Department of Defense—funded a series of competitions to create a driverless car.[19] Among those competitions was a challenge with a one million dollar prize for successful autonomous navigation of a 150-mile stretch of road in the Mojave Desert.[20] Not one team finished the inaugural contest.[21] But one year later, in 2005, five autonomous vehicles successfully completed the course.[22]

The first decade of the twenty-first century also saw the first commercial applications of autonomous vehicles in closed environments, where the fledgling technology could be tightly controlled. In 1999, the Netherlands began running the "Park Shuttle," a public, closed-loop autonomous commuter bus.[23] That same year, Rio Tinto began using driverless trucks in its mining operations.[24] Those trucks have since hauled over 100 million metric tons of earth.[25] Indeed, it is now almost a daily occurrence to see industry and popular press releases full of autonomous vehicle technology breakthroughs from auto manufacturers, technology companies, transportation companies, universities, and governments.

Two leading approaches for developing the artificial intelligence algorithms enabling autonomous vehicles are now playing out in the U.S. Google's approach is based on providing the autonomous vehicles with large amounts of data from maps detailed to within centimeters.[26] Google's impressive 1.7 million mile track record using this approach is a major milestone in the development of autonomous vehicles.[27] However, because Google's car carefully plans each route to avoid obstacles, it currently lacks the flexibility to detour off of the familiar routes that Google has previously mapped.[28] Tesla, on the other hand, has

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18. *Id*.
19. *Id*. at 56-57.
20. *Id*. at 57.
21. *Id*. at 57-58.
22. *Id*.
23. INGMAR ANDRÉASSON, INNOVATIVE TRANSIT SYSTEMS SURVEY OF CURRENT DEVELOPMENTS 15 (2001), http://www.vinnova.se/upload/EPiStorePDF/vr-01-03.pdf.
24. Rio Tinto Improves Productivity through the World's Largest Fleet of Owned and Operated Autonomous Trucks, RIOTINTO (June 9, 2014), http://www.riotinto.com/media/media-releases-237_10603.aspx.
25. *Id*.
26. Michael Barnard, *Tesla has the Right Approach to Self-Driving Cars*, CLEAN TECHNICA (Nov. 5, 2015), https://cleantechnica.com/2015/11/05/tesla-right-approach-self-driving-cars/.
27. Govers, *supra* note 9.
28. Barnard, *supra* note 26.

chosen an approach based on a less detailed, learn-by-doing architectural design for the program running their autonomous vehicle.[29] Their drivers have now logged over 130 million miles in "Autopilot" mode.[30]

Both the Google and Tesla approaches are progressing rapidly. The next 5 to 10 years will therefore be a critical test and preparation period for the safe deployment of autonomous vehicles. McKinsey & Company Institute predicts that by 2025, up to 20% of all driving will be accomplished by automated driving features in our vehicles.[31] At the Transportation Research Board's annual conference on the automation of vehicles, five-hundred leading experts were asked at what point they would trust an automated vehicle to take their children to school. More than half of the experts set the date at 2030.[32]

II. THE POTENTIAL IMPACTS OF AUTONOMOUS VEHICLE LEGISLATION

The effects of autonomous vehicles will be felt in all corners of society. Some of the most significant impacts of autonomous vehicle technology are discussed below.

A. *Public Safety Impact*

The public safety improvements associated with autonomous vehicles likely provide the most compelling rationale for encouraging adoption of autonomous vehicle technology. Worldwide, 1.25 million people die every year in car accidents.[33] In the United States, more than 5 million accidents occur annually.[34] Those accidents cause more than 2 million injuries and over 30,000 fatalities.[35] According to the Centers for Disease

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29. *Id*.

30. *Id*. Notably, a Tesla driver recently experienced a fatality while the Autopilot feature was engaged. The car was "autopiloting" 74 mph in a posted 65 mph zone when it passed under a semi-tractor trailer as the car failed to sense the white side of the trailer against the bright sky. Alan Levin & Jeff Plungis, *Driver in Fatal Tesla Crash Using Autopilot Was Speeding*, BLOOMBERG TECH. (July 26, 2016), http://www.bloomberg.com/news/articles/2016-07-26/florida-driver-in-fatal-tesla-crash-using-autopilot-was-speeding.

31. JAMES MANYIKA ET AL., MCKINSEY GLOB. INST., DISRUPTIVE TECHNOLOGIES: ADVANCES THAT WILL TRANSFORM LIFE (May 2013), http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/disruptive-technologies.

32. Lee Gomes, *Urban Jungle a Tough Challenge for Google Autonomous Cars*, MIT TECH. REV. (Aug. 11, 2016), http://www.technologyreview.com/news/529466/urban-jungle-a-tough-challenge-for-googles-autonomous-cars/.

33. WORLD HEALTH ORG., GLOBAL STATUS REPORT ON ROAD SAFETY 2 (2015), http://apps.who.int/iris/bitstream/10665/189242/1/9789241565066_eng.pdf?ua=1.

34. *See* ANDERSON ET AL., *supra* note 16, at xiv.

35. *See id.*

Control, human drivers are one of humanity's leading causes of death by injury, and *the* leading cause of death among children in the United States.[36]

Some insurance industry experts worry that the transition to autonomous vehicles could temporarily increase safety risks as humans adjust to a driverless-car interface.[37] Ultimately, however, experts predict that the technology will reduce driving accidents by up to 90%.[38] It is hard to think of any impact, good or bad, that would outweigh the suffering avoided by such a significant reduction in human-caused driving accidents and fatalities.

B. *Economic Impact*

In addition to the benefits to public safety, the reduction in accidents associated with the deployment of autonomous vehicles holds a significant economic benefit. In 2009, the American Automobile Association studied crash data in the 99 largest urban areas in the United States and estimated the total costs to be $ 299.5 billion in those areas alone.[39] This mostly human-caused economic waste from vehicle accidents could be substantially reduced by autonomous vehicles.

Moreover, autonomous vehicles will allow for the recapture of the waste associated with traffic congestion and travel time by eliminating many of the inefficiencies associated with human drivers. One study from Texas A&M suggests that urban Americans waste a combined annual total of almost 5 billion human hours in traffic congestion—the rough equivalent of 5,700 human lives or 15,200 full-time, thirty-year human careers.[40] Congestion is only part of the consideration since autonomous vehicles have the potential to free human minds from the entire process of driving. With the average American car owner spending 750 hours a year driving, autonomous vehicles could potentially recapture approximately 36% of an average American's work life.[41]

Autonomous vehicles also have the potential to eliminate waste associated with vehicle holding costs by facilitating vehicle sharing. Former Google driverless car developer, Sebastian Thrun, estimates that

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36. CTRS. FOR DISEASE CONTROL & PREVENTION, 10 LEADING CAUSES OF INJURY DEATHS BY AGE GROUP, UNITED STATES – 2013 (2013), https://www.cdc.gov/injury/wisqars/pdf/leading_causes_of_injury_deaths_highlighting_unintentional_injury_2013-a.pdf.

37. CHUNKA MUI & PAUL B. CARROLL, DRIVERLESS CARS: TRILLIONS ARE UP FOR GRABS 821-22 (2013).

38. MANYIKA ET AL., *supra* note 31, at 82.

39. MUI & CARROLL, *supra* note 37, at 53.

40. BILL EISELE ET AL., TEXAS A&M TRANSP. INSTITUTE, CONGESTED CORRIDORS REPORT 18-19 (2011), http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/corridors-report-2011.pdf.

41. *Id.*

about 96% of a car's life is idle–an extremely expensive waste of transportation capital.[42] With current vehicle fleet replacement rates of 6-8% each year,[43] society's transportation needs may quickly shift to a much smaller, shared fleet of autonomous vehicles.[44]

Finally, autonomous vehicles promise to reduce the cost of transportation. These vehicles will break and accelerate more efficiently, and will be capable of safely driving closely behind one another, resulting in a 20 to 25% fuel-efficiency boost.[45] That translates into a worldwide savings of about 2 billion gallons of gas every year.[46] The potential for vehicle size reductions could increase efficiency even further because the size and weight of human-driven vehicles is influenced heavily by crash safety requirements.[47] Because autonomous vehicles will be much less prone to error than vehicles operated by human drivers, many of the vehicle safety requirements may become relatively less desirable. Indeed, some designers have considered the possibility of autonomous vehicles as small, individual-sized transportation "pods."[48]

Autonomous vehicles could even help to facilitate the current trend toward electric cars, as they would be capable of driving themselves to relatively remote charging stations when not in use.[49] A self-shuttling

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42. Sebastian Thrun, *Leave the Driving to the Car, and Reap Benefits in Safety and Mobility*, N.Y. TIMES, Dec. 5, 2011, http://www.nytimes.com/2011/12/06/science/sebastian-thrun-self-driving-cars-can-save-lives-and-parking-spaces.html.

43. Range based on a study limited to Ford Escorts, though the rate is applicable to other vehicle types. *See* DAVID V. SPITZLEY ET AL., CENTER FOR SUSTAINABLE SYSTEMS AT THE UNIVERSITY OF MICHIGAN, AUTOMOTIVE LIFE CYCLE ECONOMICS AND REPLACEMENT INTERVALS 38 (2004), http://www.css.snre.umich.edu/css_doc/CSS04-01.pdf.

44. Current base load demand on vehicles requires only about 6% of U.S. vehicles to provide for transportation. U.S. vehicle owners generally replace their vehicles approximately every 17 years (about 6% per year). With transportation need and annual vehicle replacement approximately equal, it is possible in theory to replace enough human-driven cars to provide for all transportation needs using a shared fleet of autonomous vehicles in one year. While the possibility of a 1-year timeline is unlikely because of constraints in diffusion, capitalization, infrastructure, governance, and regulations of vehicles, the transition to autonomous vehicles could occur more quickly than some expect.

45. ANDERSON ET AL., *supra* note 16, at 29-30, 31.

46. *See* Kevin Bullis, *Will Automated Cars Save Fuel?*, BILL EISELE, MIT TECH. REV. (Apr. 23, 2012), https://www.technologyreview.com/s/427503/will-automated-cars-save-fuel/.

47. MARCIA J. TARBET, NAT'L HIGHWAY & TRANSP. SEC. ADMIN., COST AND WEIGHT ADDED BY THE FEDERAL MOTOR VEHICLE SAFETY STANDARDS FOR MODEL YEARS 1968-2001 IN PASSENGER CARS AND LIGHT TRUCKS, at 142-58 (2004), https://one.nhtsa.gov/cars/rules/regrev/evaluate/pdf/809834Part2.pdf.

48. *See* Chris Bruce, *The Lutz Pathfinder Pod is the UK's First Driverless Car*, AUTO BLOG (2015), http://www.autoblog.com/2015/02/12/the-lutz-pathfinder-pod-uk-first-driverless-car-video/.

49. Autonomous vehicles could facilitate the transition to renewable energy for several reasons. First, AV shared car services could be operated on electricity for half the cost of gasoline, providing a huge profit advantage to car share operators competing against gasoline fleets. *See*

shared fleet of autonomous vehicles would reduce the need for expensive car battery charging infrastructure because the autonomous vehicles could optimize their use of electric fueling or battery swap changes, likely decreasing the infrastructural cost to support a fleet of electricity-powered vehicles.

When applied to the more than one billion cars around the world,[50] mass adoption of autonomous vehicles holds the possibility of bringing about great change and temporarily causing some structural unemployment in transportation and energy-related industries. In fact, because autonomous vehicles will fundamentally change transportation liability, and potentially eliminate accidents that form the basis for a significant percentage of legal disputes, even attorneys would be prudent to consider the potential for autonomous vehicles to eventually shift demand for their work. Still, the positive net economic benefit associated with autonomous cars is clear.

C. *Environmental Impact*

The adoption of autonomous vehicle technology will cause changes in the environment. Among other things, the technology has the potential to: (1) reduce pollution from motor vehicles; and (2) reduce the need to dedicate land to motor-vehicle transportation infrastructure.

The pollution caused by transportation is subject to a multivariable demand function. While fuel efficiency and transportation cost savings could be realized at a consumer level, overall demand for transportation could actually increase as vehicle users, no longer bound to the chore of steering the vehicle, become willing to commute greater distances.[51] In other words, autonomous vehicles might increase consumption of motor-vehicle transportation by allowing commuters to spend their "driving time" as they wish. Further, autonomous vehicles hold the potential to expand the pool of vehicle users. Disabilities, physical limitations, and even age will no longer prevent people from "driving."

On the other hand, while additional consumption of transportation could increase total vehicle miles travelled by some drivers, younger generations have been altogether trending away from driving. For

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Dan Leistikow, *The eGallon: How Much Cheaper is it to Drive on Electricity?*, U.S. DEP'T ENERGY, http://energy.gov/articles/egallon-how-much-cheaper-it-drive-electricity. Second, AV's will not be impeded by lengthy charging times as they could quickly drive themselves to electric charging stations. Third, because AV's can drive themselves to charging stations, fewer, more centralized charging stations will be able to facilitate the charging of more vehicles. Some companies have even begun to develop electric battery-swap stations that could further reduce the time and financial cost of charging electric-powered vehicles.

50. John Sousanis, *World Vehicle Population Tops 1 Billion Units*, WARDS AUTO (Aug. 15, 2011), http://wardsauto.com/news-analysis/world-vehicle-population-tops-1-billion-units.

51. *See* ANDERSON ET AL., *supra* note 16, at 5.

example, researchers at the Frontier Group found that teen driving fell 23% from 2001 to 2010, resulting in an overall decrease in miles travelled per capita in the United States.[52] The Frontier Group suggests a preference toward online entertainment over driving among the young as the primary reason for the recent decrease.[53] There is also a trend away from the work commute, with many employers now offering work-at-home programs. Although these trends are not specifically linked to the emergence of autonomous vehicle technology, they are based on a shared and accelerating expansion of technology generally. That expansion may work to counteract some of the increases in transportation use by current non-consumers or under-consumers of transportation.

It is likely that autonomous vehicles will be used in a variety of industries to alter the way in which services are delivered. Consumers may find new efficiencies in the realm of reducing required driving. For example, some businesses could leverage autonomous vehicles for rapid delivery of home services to efficiently provide needed household goods. For consumers, home delivery of goods and services is already making running out to purchase products unnecessary, and autonomous vehicles will only magnify that trend. Additionally, carpooling to the same events or places could create new efficiencies for parents or groups of people. These and other industry and business models or service delivery transformations may reduce the overall number of miles traveled in motor vehicles, thereby reducing the impact of these vehicles on the environment.

Transportation demand dynamics aside, it is very likely that autonomous vehicles will help facilitate the transition to cleaner transportation energy sources like electricity or hydrogen.[54] The transition to alternative energy sources will be possible, in-part, because autonomous vehicles will allow people using car sharing networks to leverage a few clean cars and still have adequate access to affordable transportation. The cars could themselves move to centrally located charging or alternative fuel stations when not in use.[55] Since autonomous vehicles could shuttle themselves to a fuel station, potentially less infrastructure would be needed in order to fuel them, lowering the costs of implementing alternative vehicle fuels. Even if autonomous vehicles

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52. BENJAMIN DAVIS ET AL., FRONTIER GRP. & U.S. PIRG EDUC. FUND, TRANSPORTATION AND THE NEW GENERATION 20 (2012), http://www.uspirg.org/sites/pirg/files/reports/Transportation%20%26%20the%20New%20Generation%20vUS_0.pdf.

53. *See id.*

54. *See* ANDERSON ET AL., *supra* note 16, at 36**.**

55. The great costs involved with developing a network of hydrogen fueling stations sufficient to service human driven cars could be greatly reduced by autonomous vehicles. The ability of autonomous vehicles to conveniently utilize centralized stations while the vehicles were not in service would enable fleet fueling with far fewer stations.

cause consumption of transportation to increase, they might simultaneously facilitate the transition toward cleaner transportation and still reduce the carbon output of the transportation sector.

Another dramatic environmental impact brought about by autonomous vehicles will be seen in a modified need for transportation infrastructure. The precise operation of autonomous vehicles could allow them to platoon closely together, increasing freeway capacity by 80%.[56] These potential increases in road capacities and decreases in demand for some transportation systems might result in less need for expansion of roadways and less development of some forms of transportation. As a result, real estate now slated for some transportation uses might be allocated to other uses or left in its natural condition. Also, autonomous vehicles can be reallocated or shuttled to standing areas when not in use, decreasing demand on the vast amounts of parking space required by human-driven and human-parked cars.[57]

D. *Societal Impact*

Autonomous vehicles are certain to impact societal structures and artifacts such as culture, laws, tax sources, institutions, and government authorities. However, the particular impact on societal structures will vary from place to place and from jurisdiction to jurisdiction depending primarily on cultural attitudes and norms, as well as the requirements of government and institutional authorities. Restoration of personal freedom to individuals previously incapacitated or forbidden from operating vehicles may be countered by opposition to changes on employment from autonomous vehicles. Still, the timing of states in embracing testing legislation and later follow-on legislation or policies will be an important factor in the speed of diffusion of autonomous vehicles.

Government entities or institutions with systems designed to regulate human driving such as licensure, registration, and private vehicle purchase may experience changes in their operational requirements as autonomous vehicles come into use. This may lead to changes in function and operation for some authorities. For example, if some applications or uses of autonomous vehicles prove disruptive to certain types of transportation, authorities may need to change, scale-back, or even cancel development projects for the disrupted transportation mode. In some

56. Steven Shladover et al., *Impacts of Cooperative Adaptive Cruise Control on Freeway Traffic Flow*, 2324 TRANSP. RES. REC. 63, 66 (2012).

57. *See* ANDERSON ET AL., *supra* note 16, at 19**.** Urban parking occupies 31% of central business districts. If mass adoption of autonomous vehicles occurs, urban zoning ordinances calling for allocation of parking spaces based on proposed building occupancy could reduce the amount of vehicle parking required. This potential change might also allow for redevelopment of some parking spaces or structures into additional buildings or open spaces.

cases, transportation systems made obsolete by autonomous vehicles may need to be dismantled.

Disturbances to funding and tax sources are likely to occur for many government authorities and institutions that are reliant on their funding from fossil fuel taxes. If autonomous vehicles facilitate the transition to alternative energy sources, the entities impacted by this will need to consider alternative revenue generation strategies if the demand for fossil fuels decreases. Similarly, government authorities reliant on revenues from parking fees and driving licensure or registration may need to look for alternate funding sources as autonomous vehicles lessen demand on these facilities and services. The long-term impact of autonomous vehicles on current transportation institutions and authorities will largely depend on how they perceive and prepare for the coming changes.

III. CONSIDERATIONS FOR LEGISLATION GOVERNING THE TESTING OF AUTONOMOUS VEHICLES

Governments have started to acknowledge the potential benefits of autonomous vehicles, and many states have responded with legislation aimed at facilitating the testing of that technology. This trend started in Nevada in 2011, with the enactment of a legislative scheme authorizing the testing of autonomous vehicles on the roads of that state.[58] Florida,[59] California,[60] and Michigan[61] quickly followed with similar statutes. Meanwhile, the District of Columbia passed legislation broadly authorizing the operation of autonomous vehicles on public roads within its jurisdiction.[62] In 2015, Tennessee enacted legislation *preventing* local governments from regulating the use of autonomous technology.[63]

More recently, a few states have enacted legislation directing committees or state agencies to study autonomous vehicles, presumably as a foundation for establishing a legislative framework governing autonomous vehicle testing. For example, in 2015, North Dakota enacted

58. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Nevada A.B. 511). The legislation is now codified as amended at NEV. REV. STAT. §§ 482A.010-.200 (2016).

59. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Florida H.B. 1207). The legislation is now codified at FLA. STAT. §§ 316.003(2) & (20), 316.303, 316.85, 319.145 (2016).

60. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing California S.B. 1298). The legislation is now codified at CAL. VEH. CODE §§ 38750-5 (2016).

61. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Michigan S.B. 169). The legislation is now codified at MICH. COMP. LAWS §§ 257.2b, .35a, .36, .244, .602b(4)(e), .663, .665, .666, .817 (2016).

62. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing D.C. Bill 19-0931). The legislation is now codified at D.C. CODE § 50-2351 (2016).

63. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Tennessee S.B. 676). The legislation is now codified at TENN. CODE ANN. § 55-8-202(a) (2016).

legislation directing that state's legislative management to "consider studying what, if any, current laws need to be changed to accommodate the introduction or testing of automated vehicles in North Dakota, and any automated corridors affecting North Dakota."[64] In 2017, based on the results of that study, the legislature directed the state's Department of Transportation to collaborate with the autonomous vehicle technology industry to undertake additional research.[65] The Department is required to report back at the next legislative assembly.[66] Alabama[67] and Utah[68] have similar legislatively mandated reports pending, but have yet to enact any specific rules governing the testing of autonomous vehicles.

Arkansas,[69] Florida,[70] Michigan,[71] and Utah[72] have started to develop laws for the testing and operation of platoons of so-called connected vehicles. Connected vehicle technology differs from fully autonomous vehicle technologies in that a human driver is still piloting a "lead vehicle," with other vehicles electronically toggled to the lead vehicle.[73] In contrast, an autonomous vehicle is self-piloting, using onboard lasers and computers. Utah's connected vehicle statute, for example, authorizes a connected vehicle technology program that uses networked wireless communication among vehicles, infrastructure, or communication devices.[74]

In 2016, Louisiana enacted a statute that simply defined "autonomous technology,"[75] Virginia[76] and Tennessee[77] passed a laws exempting operators of autonomous vehicles from laws prohibiting the viewing of a

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64. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing North Dakota H.B. 1065).

65. *Id.* (citing North Dakota H.B. 1202).

66. *Id*.

67. *Id.* (citing Alabama S.J.R. 81).

68. *Id.* (citing Utah H.B. 280); UTAH CODE ANN. § 41-26-102 (West 2016).

69. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Arkansas H.B. 1754); ARK. CODE. ANN. §§ 27-51-305-(c) & (d) and 27-51-1408.

70. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Florida H.B. 7061); FLA. STAT. §§ 316.003(20), 316.303(3) (2016).

71. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Michigan S.B. 995); MICH. COMP. LAWS §§ 257.40c, .643(4), .643(a)(2), .665(9), .665(10).

72. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Utah H.B. 373); UTAH CODE ANN. § 41-6a-711-(2)(b) (West 2016).

73. *But see* Dorothy J. Glancy, *Autonomous and Automated and Connected Cars—Oh My! First Generation Autonomous Cars in the Legal Ecosystem*, 16 MINN. J.L. SCI. & TECH. 619, 640-41 (2015), *at* http://scholarship.law.umn.edu/cgi/viewcontent.cgi?article=1013&context=mjlst (discussing the sometimes ambiguous definition of "connected vehicles").

74. UTAH CODE ANN. § 41-6a-711(2)(b) (West 2016)

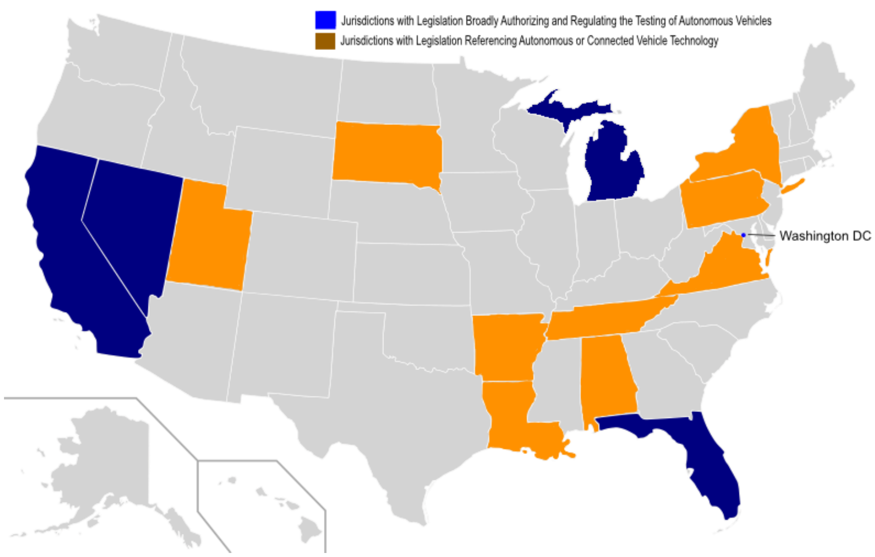
75. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Louisiana H.B. 1143); LA. REV. STAT. ANN. § 32:1(1.2) (2016).

76. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Virginia H.B. 454); VA. CODE. ANN. § 46.2-1077(A)(8).

77. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Tennessee S.B. 1561); TENN. CODE ANN. § 55-9-105(c)(6).

visual display while driving, and Pennsylvania authorized the use of up to $40 million for "intelligent transportation system applications, such as autonomous and connected vehicle-related technology."[78] In 2017, New York enacted legislation authorizing the State Department of Motor Vehicles to approve testing and demonstrations of autonomous vehicles under the supervision of the New York State Police.[79] Many additional bills related to autonomous vehicles are now pending.

Still, only five jurisdictions—Nevada, Florida, California, Michigan, and the District of Columbia—have expressly and broadly authorized the testing of autonomous vehicles within their jurisdictional boundaries.[80] Many states have rejected or otherwise failed to pass bills related to autonomous vehicle technology.[81] More than a dozen states have yet to consider the issue in any way.[82]



In September 2016, the NHTSA published a comprehensive policy that outlined its future plans for regulation of autonomous vehicles, and provided a model state policy to help guide states considering

78. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Pennsylvania S.B. 1267); PA. STAT. ANN. § 9511(e.1).

79. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing New York S.B. 2005).

80. *Id. See supra* notes 58-62.

81. Specifically, Alabama, Arizona, California, Colorado, Connecticut, Georgia, Hawaii, Idaho, Illinois, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Jersey, New Hampshire, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Washington, and Wisconsin.

82. Specifically, Alaska, Delaware, Indiana, Iowa, Kansas, Kentucky, Maine, Mississippi, Montana, New Mexico, Ohio, Vermont, West Virginia, and Wyoming.

autonomous vehicle legislation generally.[83] When coupled with this policy, the existing legislation aimed at testing this autonomous technology provides a good starting point for states that have yet to address the issue. The history behind both successful and failed legislation can help lawmakers avoid pitfalls encountered by early movers. Some best practices derived from the experience of states that have considered the testing of autonomous vehicles follow.

A. *Organization*

When enacting legislation governing the testing of autonomous vehicles, Nevada, California, and the District of Columbia added new sections/chapters to their existing vehicle codes to deal exclusively with autonomous vehicle testing. These sections are self-contained, with unique definitions applicable to the new section only.[84] The legislation in Florida is not as compact. Lawmakers in that state have: (1) added a definition of autonomous vehicles to the general definitions section of the state's vehicle code;[85] (2) created two new sections governing operation, insurance, and liability under a chapter of the code titled "State Uniform Traffic Control;"[86] and (3) created a section with additional operating requirements under a chapter titled "Title Certificates."[87] The procedure used in Michigan was even more complex. Lawmakers in that state have amended almost a dozen existing sections of their state's vehicle code.[88]

Because this new technology is not yet ready for public deployment,[89] and because future public adoption of the technology will almost certainly render parts of existing vehicle codes confusing, redundant, or obsolete,[90] the addition of a self-contained section governing autonomous

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83. *See* NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12.

84. NEV. REV. STAT. § 482A (2016); CAL. VEH. CODE § 38750 (West 2016); D.C. CODE, §§ 50-2351 (2016).

85. FLA. STAT. § 316.003(2) (2016).

86. §§ 316.85-.86.

87. § 319.145.

88. MICH. COMP. LAWS §§ 257.2b, 257.35a, 257.36, 257.244, 257.602b, 257.663, 257.665, 257.666, 257.817 (2016).

89. *See* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5; *see supra* Part One.

90. Many existing motor vehicle operation laws are drafted to address human drivers. While some human drivers will continue operating vehicles, many human-directed laws will not be applicable to autonomous vehicles. For example, laws requiring human hands on the wheel assume a human operator is in control of the vehicle. Other prohibitory laws will also not apply to vehicles driven by autonomous systems, such as laws against following too closely, texting, sleeping, or even use of intoxicants while operating a motor vehicle. A parallel set of laws governing vehicles operated by autonomous vehicles will need to be developed without human-related restrictions or requirements. *See* Bryant Walker Smith, *Automated Vehicles are Probably Legal in the United States*, 1 TEX. A&M L. REV. 411, 463-87 (2014) (discussing how the

vehicles is preferable.

B. *Definition of Autonomous Vehicle*

The definition of "autonomous vehicle" should be precise to avoid unintentional restrictions on existing, semi-autonomous technology. For example, the legislation originally enacted through Nevada's Assembly Bill 511 defined an autonomous vehicle as "a motor vehicle that uses artificial intelligence, sensors, and global positioning system coordinates to drive itself without the active intervention of a human operator."[91] That might seem like a reasonably accurate definition of the technology that the state was seeking to regulate. But lawmakers soon realized that technologies like active cruise control or park assist use "sensors and artificial intelligence to drive without the active intervention of a human operator."[92] Because Nevada had no interest in further regulating semi-autonomous technologies that had been operating safely on public roads for several years, the state ultimately amended the original law.[93] Now, like almost all of the other jurisdictions that have enacted legislation governing the testing of autonomous vehicles, the definition of "autonomous vehicle" found in Nevada's Revised Statutes expressly excludes existing autonomous technologies "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."[94]

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introduction of autonomous vehicle technology: (1) adds confusion to current vehicle code definitions of terms like "driver" and "operator" (463-80); (2) changes policy considerations related to licensing and requiring driver's be present (480-81); and (3) renders laws assuming that drivers are present in a motor vehicle, and in the "driver's seat," confusing or obsolete (481-87)); *see also* MICH. DEP'T OF TRANSP., PUBLIC ACT 231 OF 2013; SECTION 665(3) TESTING AND OPERATION OF AUTOMATED VEHICLES 3 (2013), https://www.michigan.gov/documents/mdot/PA_231_of_2013_Section_6653_AV_legislation_report_512858_7.pdf (discussing how autonomous vehicles may obviate the need for current statues governing driver licensing).

91. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Nevada A.B. 511).

92. *Id*. For a more detailed discussion of distinctions in autonomous vehicle technology, see the "levels of vehicle automation" outlined by the National Highway Safety and Transportation Administration. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5, at 4-5.

93. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Nevada S.B. 140).

94. Specifically, the Nevada law defines "autonomous technology" as "technology which is installed on a motor vehicle and which has the capability to drive the motor vehicle without the active control or monitoring of a human operator. 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." NEV. REV. STAT. § 482A.025 (2016). It then defines "autonomous vehicles" as

In general, the statutes defining autonomous vehicles first independently define the term "autonomous technology." They then define "autonomous vehicle" as a motor vehicle equipped with autonomous technology.[95] Some scholars have recommended breaking the definition of autonomous technology and autonomous vehicle down further, to prepare for potential confusion created by applying current vehicle code terms like driver and operator to autonomous vehicles.[96] These definitions will undoubtedly become important when autonomous technology is made available for general public use. But they are probably not necessary in a statutory scheme focused exclusively on testing.

C. *Prohibitory Law*

All jurisdictions that have successfully enacted legislation authorizing the operation of autonomous vehicles have outlined certain conditions that must be met in order to test an autonomous vehicle on public roads.[97] Although some are clearer than others, these laws have historically prohibited operation on public roads in general. For example, the law in California outlines the requirements for authorized testing,[98] and then expressly prohibits the general operation of autonomous vehicles on public roads until after a manufacturer has successfully applied for permission to release the technology.[99] The Michigan law also makes it absolutely clear that "a person shall not operate an automated motor vehicle upon a highway or street in automatic mode" unless the operation is part of a state-authorized testing program.[100]

"a motor vehicle that is equipped with autonomous technology." § 482A.030; *see also, e.g.*, FLA. STAT. § 316.003(2) (2016); CAL. VEH. CODE § 38750(a)(1)-(2) (West 2016); D.C. CODE § 50-2351(1) (2016); MICH. COMP. LAWS § 257.2b(1) (2016); LA. REV. STAT. ANN. § 32:1(1.2) (2016). *But see* TENN. CODE ANN. § 55-8-202(b) (2016) (continuing to define autonomous technology only as "technology installed on a motor vehicle that has the capability to drive the motor vehicle without the active physical control or monitoring by a human operator").

95. NEV. REV. STAT. §§ 482A.020, .025 (2016); FLA. STAT. § 316.003(2) (2016); CAL. VEH. CODE § 38750(a)(1)-(2) (West 2016); MICH. COMP. LAWS § 257.2b(1) (2016); LA. REV. STAT. ANN. § 32:1(1.2) (2016). *But see* D.C. CODE § 50-2351(1) (2016) (defining the term "autonomous vehicle" without reference to an independent definition of "autonomous technology").

96. Smith, *supra* note 90, at 510-11 (these defined terms include "Automated Operation," "Automated Vehicle," Automation Package," "Automation Period," and "Automation Profile"). The law in Michigan seems to have followed this recommendation to some extent. It contains independent definitions for "automated driving system," "automated motor vehicle," and "automated technology." MICH. VEH. CODE § 257.2b (2016).

97. NEV. REV. STAT. §§ 482A.070-.080 (2016); FLA. STAT. §§ 316.86(1) & 319.145 (2016); CAL. VEH. CODE §§ 38750(b)-(c); D.C. CODE § 50-2352 (2016); MICH. COMP. LAWS § 257.665 (2016); see also CAL. CODE REGS. tit. 13, § 227.00(b) (2017).

98. CAL. VEH. CODE § 38750(b) (West 2016).

99. *Id.* § 38750(c); *see also* CAL. CODE REGS. tit. 13, § 227.02(b) (2017).

100. MICH. COMP. LAWS § 257.663 (2016).

Washington DC is the only jurisdiction that started out with a legislative scheme broadly authorizing the general operation of autonomous vehicles on public roads.[101] But this more permissive statute may represent the start of a trend. Indeed, in recent years, Google has actually opposed bills in Colorado[102] and Texas[103] attempting to authorize autonomous vehicle testing under a limited set of circumstances.[104] Google also withdrew its support from the legislation in Michigan specifically because it included a prohibition on autonomous vehicle operation outside of testing.[105] The 2015 Tennessee law imposes no restrictions on the operation of autonomous vehicles.[106] To the contrary, it prohibits any prohibition on operation.[107] While the initial Florida law effectively limited testing to any "manufactures, accredited educational institutions, or their agents,"[108] more recent amendments do away with that prohibitory language.[109]

Google and other manufacturers of autonomous vehicle technology may have an interest in an unrestricted, permissive regulatory scheme.[110] But while Google and other industry leaders seem to have developed a preference for operating in the legal ambiguity[111] of existing motor vehicle laws, the trend away from regulation seems to be coming to an end.

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101. D.C. CODE § 50-2352 (2016).

102. S.B. 016, 69th Gen. Assemb., Reg. Sess. (Colo. 2013).

103. S.B. 1167, 84th Leg., Reg. Sess. (Tex. 2015).

104. William J. Kohler & Albert Colbert-Taylor, *Current Law and Potential Legal Issues Pertaining to Automated, Autonomous, and Connected Vehicles*, 31 SANTA CLARA HIGH TECH. L.J., 99, 118-19 (2015); Tao Jiang et al., *Self-Driving Cars: Disruptive or Incremental*, 1 APPLIED INNOVATION REV., 3, 15 (2015); Monte Whaley, *Colorado Driverless Car Bill Shelved Until Further Notice*, DENV. POST (Feb. 5, 2013, 11:46 AM), http://www.denverpost.com/_22526956/colorado-driverless-car-bill-shelved-until-further-notice; Jonathan Oosting, *Michigan Gives Green Light to Autonomous Vehicle Testing Despite Concerns from Google*, MLIVE (Dec. 13, 2013, 8:00 AM), http://www.mlive.com/politics/index.ssf/2013/12/michigan_gives_green_light_to.html; Aman Batheja, *Self-Driving Car Bill Stalled by Google, Carmakers*, TEX. TRIBUNE (Apr. 22, 2015), http://www.govtech.com/fs/Self-Driving-Car-Bill-Stalled-by-Google-Carmakers.html.

105. Oosting, *supra* note 104.

106. TENN. CODE ANN. § 55-8-202(a) (2016).

107. *Id.*

108. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing H.B. 1207, 2012 Reg. Sess. (Fl. 2012)).

109. *Id.* (citing H.B. 7027, 2016 Reg. Sess. (Fl. 2016)). The amendments removing prohibitory language are now codified at FLA. STAT. §§ 316.85, 319.145 (2016).

110. Mike Pare, *Tennessee Could Lead in Self-Driving Vehicles, Senator Says*, TIMES FREE PRESS (Jan. 30, 2016), http://www.timesfreepress.com/news/business/story/2016/jan/30/tennessee-could-lead-self-driving-vehicles-se/347484/.

111. Smith, *supra* note 90, at 516 (concluding that international, federal, and state laws prior to the enactment of state regulatory schemes likely did not prohibit the sale and operation of autonomous vehicles).

Indeed, the 2016 NHTSA policy makes it clear that the federal government does not intend to allow the industry to develop autonomous vehicles under a regulatory scheme that does not consider the technology.[112] Regardless, there is an obvious downside to a regulatory scheme statute that does not clearly limit the scope of operation to parties that can prove they are capable of testing autonomous vehicles safely. Indeed, as a recent Tesla Autopilot crash illustrates, there are still dangers associated with the operation of autonomous vehicles.[113] Moreover, the cost to equip a vehicle with autonomous technology is not as high as many might think, and it is falling quickly.[114] Most of us have probably heard about accidents and security concerns associated with hobbyists using commercially available drones.[115] Like over-regulation, allowing recreational tinkering with autonomous vehicles could potentially delay full-scale public deployment of the technology.[116] For the time being, the clear prohibitory language contained in the Michigan statute is preferable.

D. *Scope of Legislation*

For the most part, the existing state legislation focuses on testing only—it does not contemplate autonomous vehicle use by the general public. There are exceptions. For example, the legislation in Nevada, Florida, and Michigan exempts operators of autonomous vehicles from laws making it illegal to send text messages while driving.[117] The

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112. NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12, at 11-36.

113. Bill Vlasic & Neal E. Boudette, *A Tesla Driver Using Autopilot Dies in a Crash*, N.Y. TIMES (July 1, 2016), https://www.nytimes.com/2016/07/01/business/self-driving-tesla-fatal-crash-investigation.html.

114. Alex Davies, *Turns Out the Hardware in Self-Driving Cars is Pretty Cheap*, WIRED (Apr. 22, 2015, 9:00 AM), http:// www.wired.com/2015/04/cost-of-sensors-autonomous-cars/; Matt McFarland, *The $75,000 Problem for Self-Driving Cars is Going Away*, WASH. POST (Dec. 4, 2015), https://www.washingtonpost.com/news/innovations/wp/2015/12/04/the-75000-problem-for-self-driving-cars-is-going-away/; Chris Neiger, *How Much do Driverless Cars Cost?*, MOTLEY FOOL (Aug. 4, 2016), http://www.fool.com/investing/2016/08/04/how-much-do-driverless-cars-cost.aspx.

115. Alex Fitzpatrick, *Here's why so Many Drone Pilots are Getting in Trouble*, TIME (July 8, 2014), http://time.com/2966246/drone-pilots-arrest-fine-law/; Alan Levin, *Drone Operator Fined After Almost Hitting NYC Pedestrian*, Bloomberg.com (May 2, 2014), http://www.bloomberg.com/news/articles/2014-05-02/drone-operator-fined-after-almost-hitting-nyc-pedestrian; Jennifer Calfas, *Drones Impede Wildfire Efforts*, WALL STREET J. (July 6, 2016), http://www.wsj.com/articles/drones-impede-wildfire-efforts-1467762890; Justin Bachman, *Drones are the New Threat to Airline Safety*, BLOOMBERG.COM (Apr. 4, 2016), http://www.bloomberg.com/news/articles/2016-04-04/drones-are-the-new-threat-to-airline-safety.

116. *See, e.g.*, Ashlee Vance, *George Hotz is Taking on Google and Tesla by Himself*, BLOOMBERG BUSINESSWEEK (Dec. 16, 2015), http://www.bloomberg.com/features/2015-george-hotz-self-driving-car/.

117. NEV. REV. STAT. § 484B.165(7) (2016); FLA. STAT. § 322.01(7) (2016); MICH. COMP. LAWS § 257.602b(4)(e) (2016).

regulatory schemes in Nevada and California contemplate the eventual public use of autonomous vehicles.[118]

The 2016 NHTSA policy contemplates both testing and deployment of autonomous technology for public use.[119] Although the emphasis now is clearly on testing, the NHTSA expects regulations governing autonomous vehicles to progress quickly, and plans to publish evolving regulations to set the stage for deployment roughly annually.[120] For now, to facilitate testing and prepare for deployment, the NHTSA has asked state governments implementing autonomous vehicle legislation to: (1) "evaluate their current laws and regulations to address unnecessary impediments to the safe testing, deployment, and operation of HAVs, and update references to a human driver as appropriate;" (2) cooperate with the NHTSA and other states to "avoid a patchwork of inconsistent State laws that could impede innovation and the expeditious and widespread distribution of safety enhancing automated vehicle technologies;" and (3) work with each other to "standardize and maintain road infrastructure including signs, traffic signals and lights, and pavement markings."[121]

E. *Specific Requirements for Operation*

In a 2013 report, the NHTSA outlined the following operational recommendations for autonomous vehicle testing:

> During the testing phase of the development of self-driving vehicles, a driver familiar with the particular vehicle's automated systems is necessary to ensure that a failure of the automated system or the occurrence of conditions in which the automated system is not intended to operate does not put other road users at risk. The driver must be able to quickly and easily retake control

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118. NEV. REV. STAT. § 482A.100 (2016); NEV. ADMIN. CODE § 482A.190 (2016); CAL. VEH. CODE § 38750(c), (e) (West 2015). At the time of this writing, the California Department of Motor Vehicles was still in the process of public hearings and comments as the department develops rules for the testing of autonomous vehicles in California. For more information, visit www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/auto.

119. NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12, at 12, https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf (distinguishing "testing" from "deployment," and defining deployment as autonomous vehicle use "by members of the public who are not the employees or agents of the manufacturer or other testing/production entities").

120. *Id*. at 8; *see also* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5, at 10 (stating "While NHTSA's authority, expertise, and mandate is to establish uniform, national standards needed for vehicle safety, the agency recognizes that premature regulation can run the risk of putting the brakes on the evolution toward increasingly better vehicle safety technologies").

121. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5, at 39.

> of the vehicle from the automated system.
>
> A regulation may require that the driver be able to retake control of the test vehicle by an immediately over-riding, relatively simple, and non-distracting method such as pressing a button located within the driver's reach.
>
> Further, the automated functions of a test vehicle should defer to the driver's input by allowing the driver to retake control by using the breaks, the accelerator pedal, or the steering wheel.
>
> The self-driving vehicle should alert the driver when the driver must take control of the vehicle because the automated system cannot operate due to local road conditions, environmental conditions, a malfunction, or any other condition or circumstance that would require manual driving for safe operation.[122]

To the extent that it addresses operational requirements, all of the existing legislation follows these recommendations by requiring that testing occur only with a licensed driver inside the vehicle and in a position to take control of the vehicle if necessary.[123] Nevada's regulations further implement a requirement for a "system to safely alert the operator of the autonomous vehicle to take control of the autonomous vehicle if a technology failure is detected."[124] However, some lawmakers have declined to follow the NHTSA's 2013 recommendations for system failure alerts and specific methods for transferring control from the automated system to the human operator.[125]

This deviation from the NHTSA's 2013 guidance was arguably wise in this narrow instance. Because the technology is developing rapidly and along an unclear path, [126] efforts to specify how to safely monitor and transition control of an autonomous vehicle may unnecessarily impede

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122. *Id.* at 13.

123. NEV. REV. STAT. §§ 482A.070, .200 (2016); NEV. ADMIN. CODE § 482A.130(2)(a) (2016); FLA. STAT. § 316.85(1) (2016); CAL. VEH. CODE § 38750(b) (West 2016); CAL. CODE REGS. tit. 13, § 227.18 (2017); MICH. COMP. LAWS §§ 257.665(2)(b)–(c) (2016); D.C. CODE §§ 50-2351(2), 50-2352 (2016); *see* NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5, at 13.

124. NEV. ADMIN. CODE § 482A.110(2)(d) (2016).

125. *But see* NEV. ADMIN. CODE § 482A.190(2) (2016) & CAL. VEH. CODE § 38750(c)(1) (West 2016) (outlining requirements almost identical to the NHTSA private testing recommendations, but applied to autonomous vehicles for general use on public roads).

126. NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., PRELIMINARY STATEMENT, *supra* note 5, at 10 (stating "because Level 4 automated systems are not yet in existence and the technical specifications for Level 3 automated systems are still in flux, the agency believes that the regulation of technical performance of automated vehicles is premature at this time").

development of the technology for public use. State legislation that goes beyond the NHTSA's suggested operational requirements is similarly problematic. The law in California, for example, currently directs that an operator of an autonomous vehicle must be "seated in the driver's seat."[127] But again, autonomous vehicle technology will ultimately render the concept of a driver's seat obsolete.[128] In fact, it is already happening. In 2016, California Assembly Member Susan Bonilla successfully ran legislation adding to California's existing statutory scheme by allowing testing of vehicles without steering wheels or pedals, and without a human operator present in the vehicle in certain circumstances.[129] The autonomous vehicles that prompted that legislation do not have "driver's seats," at least in a traditional sense.[130]

Florida's approach appears to adequately protect public safety without sacrificing helpful flexibility. The legislation in that state directs only that "a human operator shall be present in the autonomous vehicle such that he or she has the ability to monitor the vehicle's performance and intervene, if necessary. . . ."[131] It may also be helpful to follow the example of lawmakers in Nevada by specifying that the vehicles must operate safely.[132] Another flexible approach to generally protect public safety—the approach taken in Washington DC—is to simply require that autonomous vehicles used in testing be capable of obeying traffic laws.[133]

That said, the NHTSA's 2016 policy makes it clear that it will now take the lead on operational regulations.[134] It has outlined a number of relatively specific operational requirements.[135] Although states may wish

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127. CAL. VEH. CODE § 38750(b)(2) (West 2016) (noting that the regulations associated with that law do not include this requirement); CAL. CODE REGS. tit. 13, § 227.18 (2017).

128. Jenn U, *The Road to Driverless Cars: 1925-2025*, ENGINEERING.COM, (Jul. 15, 2016), http://www.engineering.com/DesignerEdge/DesignerEdgeArticles/ArticleID/12665/The-Road-to-Driverless-Cars-1925--2025.aspx.

129. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing California A.B. 1592). The legislation is now codified at CAL. VEH. CODE §§ 38755 (2016).

130. *Id*.; *See* Mark Harris, *Sorry, Google: California's Self-Driving Car Bill Would Prioritize Unknown Rival*, GUARDIAN (Jan. 27, 2016), https://www.theguardian.com/technology/2016/jan/27/california-bill-driverless-cars-legal-first-time-america (noting that similar problems exist with the Nevada law, which requires that two drivers be present while testing an autonomous vehicle, and specifies that the transition from human to autonomous control must occur via a "switch"); NEV. ADMIN. CODE §§ 482A.130(1), 482A.110(2)(c) (2016) (considering the evolving state of autonomous vehicle technologies, this level of specificity could potentially interfere with innovation); *see* Brandon Bailey, *Google to Test Cars Without a Driver at Moffett Field*, MERCURY NEWS (Sept. 12, 2014), http://www.mercurynews.com/2014/09/12/google-to-test-cars-without-a-driver-at-moffett-field/.

131. FLA. STAT. § 316.86(1) (2016).

132. NEV. REV. STAT. § 482A.070(2) (2016); NEV. ADMIN. CODE § 482A.110(2)(a) (2016).

133. D.C. CODE § 50-2352(3) (2016).

134. NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12, at 10-11.

135. *Id*. at 27-31.

to work with the NHTSA to simplify these regulations moving forward, laws that conflict with the federal policy will likely be preempted.[136]

F. *Liability and Insurance*

During the testing phase for autonomous vehicles, no unified or consistent approach to liability regimes or insurance requirements has yet emerged. While the NHTSA may later convene a commission to study liability and insurance issues and make recommendations,[137] the 2016 NHTSA policy confirms that states will continue to regulate motor vehicle insurance and liability regimes.[138] Until the NHTSA provides further policy addressing liability and insurance, they suggest that states should include liability and insurance regulator representatives in committees addressing autonomous vehicle regulations.[139]

In the instance of liability regimes, with the exception of California, all of the enacted legislation specifies that car manufacturers are not liable for accidents resulting from vehicles retrofitted with autonomous technology.[140] Limiting the liability of the original manufactures of non-autonomous vehicles would be helpful to clarify current laws that could otherwise unfairly leave the original manufactures on the hook.[141] Also, limiting original manufacturer liability may be a good idea as other states have faced opposition to legislation that leaves open the possibility of increased liability to the original manufactures.[142] Indeed, Nevada did not initially include a provision limiting liability in its legislation governing the testing of autonomous vehicles.[143] Nevada subsequently modified the law[144] in response to manufacturers, lobbyists, and trial lawyers in the State.[145]

When autonomous vehicles are originally manufactured to be autonomous vehicles, a number of complex legal issues arise in relation to traditional products liability and may need to be addressed by an

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136. *Id*. at 38.

137. *Id*. at 47.

138. *Id*. at 7.

139. *Id*. at 40.

140. NEV. REV. STAT. §§ 482A.090, .200 (2016); FLA. STAT. § 316.86 (2016); MICH. COMP. LAWS § 600.2949(b) (2016); D.C. CODE § 50-2353(a) (2016) (noting that the Michigan law also limits the liability of autonomous technology manufacturers when that technology is subsequently modified by a third party); MICH. COMP. LAWS § 257.817 (2016).

141. JOHN VILLASENOR, BROOKINGS INST., PRODUCTS LIABILITY AND DRIVERLESS CARS 16 (2014).

142. *See Minutes of the Senate Committee on Transportation: Hearing on SB 313 before the S. Comm. on Transportation*, 2013 Leg., 77th Sess. (Nev. 2013), https://www.leg.state.nv.us/Session/77th2013/Minutes/Senate/TRN/Final/629.pdf [hereinafter *Hearing on SB 313*].

143. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Nevada A.B. 511).

144. *Id.* (citing Nevada S.B. 140).

145. *See Hearing on SB 313*, *supra* note 142.

alternate products liability regime, such as a no-fault compensation system.[146] In the initial testing phase where many autonomous vehicles are modifications to previously non-autonomous vehicles, however, it is difficult to argue against assigning liability to the testers themselves.

Regarding insurance, Nevada, Florida, and California all require that manufacturers of autonomous technology carry insurance of $5 million to cover potential liability.[147] Michigan simply requires manufacturers to submit proof of insurance to the Secretary of State—there is no minimum dollar amount.[148] Washington DC has no insurance requirement unique to the operation of autonomous vehicles.[149] Congruent with Nevada, Florida, and California state policies, in the NHTSA's 2016 policy suggests that applicants for manufacturing or testing should be required to produce evidence of insurance, a surety bond, or proof of self-insurance for no less than $5 million.[150] Beyond the NHTSA's basic liability and insurance guidelines, primarily deferring decisions to the states, the NHTSA has yet to offer substantive recommendations or policies impacting existing state liability and insurance regimes.[151]

G. *Plan for Implementation*

The states have taken different approaches to implement a scheme governing the testing of autonomous vehicles depending on the state's administrative infrastructure governing transportation. For example, after enacting the general framework noted above, lawmakers in Nevada, where rulemaking for transportation is more centralized in a single

146. *See* Kevin Funkhouser, *Paving the Road Ahead: Autonomous Vehicles, Products Liability, and the Need for a New Approach*, 2013 UTAH L. REV. 437, 458-59 (2013).

147. NEV. REV. STAT. § 482A.060 (2016); FLA. STAT. § 386 (2016); CAL. VEH. CODE § 38750(b)(3) (West 2016).

148. MICH. COMP. LAWS § 257.665(1) (2016).

149. D.C. CODE § 50-2351 (2016).

150. NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12, at 42.

151. However, once testing is concluded and autonomous vehicles transition into mass use, it is possible that the landscape of automobile and transportation related liability regimes and insurance could undergo substantial structural changes somewhat independent of regulations. First, while the initial impact of autonomous vehicles on safety and liability regimes is uncertain, the eventual reduction in human-caused automobile errors could lead to the alteration of insurance mortality tables by reducing the probability of death by automobile. Second, autonomous vehicles could lead to the creation and development of new insurance types for autonomous vehicles in private use and in use for car sharing systems. Because autonomous vehicles will communicate in real-time, it is possible that the cost of transportation insurance could be parsed-out and priced-out differently depending on time of day and location. For example, a trip in an autonomous during heavy congestion or in inclement weather could conceivably be priced differently than a trip in better conditions. With the potential for changes to the traditional models of transportation, many organizations using or providing insurance might consider how their business models could be impacted.

agency, gave rule-making authority to the state's Division of Motor Vehicles.[152] The Nevada legislature directed that state agency to fill in the regulatory framework created by the legislation.[153] The Nevada DMV has now developed an extensive list of regulations clarifying ambiguities and outlining processes for insuring, registering, licensing and operating autonomous vehicles.[154]

On the other hand, the decentralized administrative infrastructure in Florida motivated the legislature in that state to take a different approach in implementing a comprehensive regulatory scheme. Florida lawmakers directed their Department of Highway Safety and Motor Vehicles to prepare a report recommending additional legislative or regulatory action that may be required for the safe testing and operation of motor vehicles equipped with autonomous technology.[155] None of these agencies have a significant history of formal rule making. The legislature plans to act on the report by adding laws governing autonomous vehicles directly to the state Code. The approach taken in Florida may be a more workable option in states with a number of potentially interested agencies.[156]

The 2016 NHTSA policy provides a comprehensive framework for organizing potentially interested lawmakers and agencies into a committee charged with overseeing evolving autonomous vehicle regulation.[157] States should use that framework as a starting point, and evaluate the specific capacities of relevant administrative agencies in developing a plan for implementation.

CONCLUSION

Autonomous vehicle technology is reaching a tipping point and will soon be integrated into all of our lives. The technology will fundamentally change how we own and operate cars, and contribute positively to public safely, the economy, and the environment. State-level legislation governing the testing of autonomous vehicles is a small but necessary step toward the comprehensive legal scheme needed to manage this significant development. The trail has been blazed in other jurisdictions. We hope that this article alerts lawmakers that have yet to consider the issue to that fact, and, in conjunction with the NHTSA's guidance, encourages them to carefully consider how they might

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152. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Nevada A.B. 511).

153. *Id*.

154. NEV. ADMIN. CODE § 482A.

155. NAT'L COUNS. ST. LEGISLATURES, *supra* note 13 (citing Florida H.B. 1207).

156. The legislatures in North Dakota, Alabama, and Utah have now ordered reports/studies as a foundation to autonomous vehicle legislation as well. *Supra* notes 64-68.

157. NAT'L HIGHWAY TRAFFIC TRANSP. SAFETY ADMIN., *Federal*, *supra* note 12, at 40-41.

approach enacting autonomous vehicle testing legislation in their states.