WHERE THE RUBBER MEETS THE ROAD: A FRAMEWORK FOR THE RESPONSIBLE DEVELOPMENT OF NONCOMPLIANT AUTONOMOUS VEHICLE BEHAVIORS

Casey G. Watkins*

No comprehensive federal laws or regulations currently govern the use and deployment of autonomous vehicles (AVs). For over a decade, proponents of federal legislation have emphasized the need to prevent a "patchwork quilt" of conflicting state requirements, arguing it is essential for the widespread rollout of autonomous vehicles and the industry's growth.[1] While the National Highway Traffic Safety Administration (NHTSA) has initiated some preliminary programs,[2] the agency has largely adopted a wait-and-see approach to autonomous vehicle technology. That approach has consisted largely of monitoring standing general order (SGO) crash reports,[3] and on a few occasions, engaging in discussions with developers that resulted in recalls.[4] Federal legislation has

*Casey G. Watkins is Counsel at Ballard Spahr LLP, where he advises clients in the automotive, autonomous vehicle, mobility, and consumer products sectors on regulatory compliance and litigation. His practice includes class actions, commercial litigation, and product liability claims. He brings extensive experience in autonomous vehicle law, motor vehicle safety, and advanced driver assistance systems, leveraging his background as a Senior Attorney for Product and Vehicle Safety at Argo AI. He earned his J.D., cum laude, from Rutgers Law School, where he served on the *Rutgers Law Review*.

1. *See, e.g.*, Richard T. Baker & Jason Wagner, *Policy Pathways to Vehicle Automation: Industry Perspectives on the Role of Public Policy in Autonomous Vehicle Development*, *in* 2013 INTERNATIONAL CONFERENCE ON CONNECTED VEHICLES AND EXPO (ICCVE) 431, 436 (2013); ALL. FOR AUTO. INNOVATION, READY TO LAUNCH: AUTONOMOUS VEHICLES IN THE U.S.: TRACKING THE CURRENT (AND FUTURE) AV LANDSCAPE 1 (2022).

2. *See, e.g.*, Press Release, Nat'l Highway Traffic Safety Admin., NHTSA Proposes National Program for Vehicles with Automated Driving Systems (Dec. 20, 2024), https://www.nhtsa.gov/press-releases/nhtsa-proposes-national-program-vehicles-automated-driving-systems [https://perma.cc/P4XP-AA2Z]; Press Release, Nat'l Highway Traffic Safety Admin., U.S. Department of Transportation Announces Expansion of AV TEST Initiative (Jan. 11, 2021), https://www.nhtsa.gov/press-releases/us-department-transportation-announces-expansion-av-test-initiative [https://perma.cc/WUD3-PED5].

3. *See, e.g.*, U.S. DEP'T TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., IN RE: SECOND AMENDED STANDING GENERAL ORDER 2021-01, INCIDENT REPORTING FOR AUTOMATED DRIVING SYSTEMS (ADS) AND LEVEL 2 ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) (2023), https://www.nhtsa.gov/sites/nhtsa.gov/files/2023-04/Second-Amended-SGO-2021-01_2023-04-05_2.pdf [https://perma.cc/H2UX-BYB7].

4. *See, e.g.*, U.S. DEP'T TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., 22E-016, PART 573 SAFETY RECALL REPORT (2022), https://static.nhtsa.gov/odi/rcl/2022/RCLRPT-22E016-6814.PDF [https://perma.cc/9HW5-LGLE] (recalling AV after minor collision with road sign and after issue had been resolved by the developer, Pony.ai).

been unsuccessfully introduced several times.[5] However, the immediate outlook for sweeping federal action with preemptive effect is uncertain.[6]

In response to this federal legislative vacuum and the score of AV developers seeking to deploy fleets, states have acted on their own. A significant number of states have enacted legislation addressing autonomous vehicles.[7] While these laws tend to be similar and are often based on the model legislation published by the Autonomous Vehicle Industry Association (AVIA),[8] there are also a number of important differences among each state's laws. Indeed, the much-feared patchwork of state and local laws is not only taking shape but is being stitched into an increasingly intricate and varied fabric.

What is often overlooked, however, is that a patchwork of state and local laws has long existed regarding the rules of the road and how drivers (and by extension autonomous vehicles) are expected to behave. Each state has adopted its own vehicle code. These laws are not uniform and have varied significantly over time, with different states adopting and enforcing their own unique set of rules. Some states have adopted various versions of the Uniform Vehicle Code (UVC)[9]—which has not been updated since 2000—while others have made sweeping changes to that text or created their own codes from scratch.[10] In some states, vehicle codes preempt local ordinances,[11] while in others, municipalities retain authority to enforce their own traffic rules.[12] This is where the rubber

5. *See, e.g.*, SELF DRIVE Act, H.R. 3711, 117th Cong. (2021).

6. NHTSA's latest proposed program, AV STEP, explicitly does not preempt state or local law. Nat'l Highway Traffic Safety Admin., ADS-Equipped Vehicle Safety, Transparency, and Evaluation Program, 90 Fed. Reg. 4130, 4176 (proposed Jan. 15, 2025) (to be codified at 49 C.F.R. pts. 595 & 597).

7. For a comprehensive, yet somewhat dated, overview of state actions related to autonomous vehicles, see *Autonomous Vehicles: Self-Driving Vehicles Enacted Legislation*, NAT'L CONF. STATE LEGISLATURES (Feb. 18, 2020), https://www.ncsl.org/transportation/autonomous-vehicles [https://web.archive.org/web/20250720122451/https://www.ncsl.org/transportation/autonomous-vehicles].

8. *See* SELF-DRIVING COALITION FOR SAFER STREETS 2022 MODEL BILL (AUTONOMOUS VEHICLE INDUS. ASS'N 2022), https://archive.legmt.gov/content/Committees/Interim/2021-2022/Transportation/21_Jan/SDC%20Model%20Bill%202022%20%28003%29.pdf [https://perma.cc/G8PH-S4JA]. While the National Conference of Commissioners on Uniform State Laws (NCCUSL) (more commonly known as the Uniform Law Commission) has adopted a uniform autonomous vehicles law, that model legislation, UNIF. AUTOMATED OPERATION OF VEHICLES ACT (UNIF. L. COMM'N 2019), has not been adopted by any state. *See Automated Operation of Vehicles Act*, UNIF. L. COMM'N, https://www.uniformlaws.org/committees/community-home?communitykey=4e70cf8e-a3f4-4c55-9d27-fb3e2ab241d6#LegBillTrackingAnchor [https://perma.cc/33YZ-9HQN] (last visited Oct. 29, 2025). Its model has not received the backing of the industry, is more onerous than the laws adopted by permissive states, and does not follow the permit or authorization path adopted by states seeking to regulate AV deployment more closely.

9. UNIF. VEHICLE CODE (Nat'l Comm. on Unif. Traffic L. & Ordinances 2000).

10. *See, e.g.*, MASS. GEN. LAWS ch. 89, §§ 1–12 (statutes governing the "law of the road" not based on the UVC).

11. *See, e.g.*, FLA. STAT. ANN. § 316.007 (West, Westlaw through 2025 1st Reg. Sess.).

12. *See, e.g.*, TEX. TRANSP. CODE tit. 7 (2025), https://statutes.capitol.texas.gov/docs/tn/htm/tn.545.htm [https://perma.cc/6R25-CTC4]; AUS., TEX., CODE OF ORDINANCES tit. 12 (2025), https://library.municode.com/tx/austin/codes/code_of_ordinances?nodeId=TIT12TRRE [https://perma.cc/Y6UA-MLVQ] (modifying state law regarding the regulation of pedestrian and motor traffic).

meets the road, and understanding this patchwork is crucial for successful AV development and deployment.

I. THE PATCHWORK OF STATE AND LOCAL ROAD RULES

Many lawyers and much of the public are unaware of the wide variations in road rules across the country. There is generally no requirement to retake a driving exam when moving to a new state, and local nuances in road rules are rarely tested.

For example, in Washington, D.C., right-on-red turns have been effectively eliminated, while in most other jurisdictions, both right-on-red and even left-on-red turns are permitted.[13] Some states require drivers approaching an active emergency vehicle on the shoulder to slow down by twenty miles per hour (mph) or change lanes.[14] Others mandate only a ten mph reduction, regardless of whether the vehicle moves over.[15] Still others simply require the approaching driver to slow down to a "reasonable" speed.[16] The list of differences extends to, among other things, varying restrictions on standing or stopping for alighting or disembarking passengers,[17] different minimum distances to maintain when

13. *See* Safer Streets Amendment Act of 2022, D.C. Law 24-214, § 2(c), 69 D.C. Reg. 3 (Dec. 21, 2022), https://lims.dccouncil.gov/downloads/LIMS/48835/Signed_Act/B24-0673-Signed_Act.pdf [https://web.archive.org/web/20250506072449/https://lims.dccouncil.gov/downloads/LIMS/48835/Signed_Act/B24-0673-Signed_Act.pdf] ("Beginning January 1, 2025, a motor vehicle operator shall not make a turn when facing a steady red traffic control signal . . . ."). *But see* Rachel Weiner & Joe Heim, *The D.C. Council Banned Turning Right on Red Citywide. It Won't Be Enforced.*, WASH. POST (Nov. 25, 2024), https://www.washingtonpost.com/dc-md-va/2024/11/25/dc-right-on-red-ban-dispute/ [https://perma.cc/2RXC-22A8] (noting funding shortfall delayed implementation of full ban on right-on-red turns).

14. *See, e.g.*, FLA. STAT. ANN. § 316.126(1)(b)(2) (West, Westlaw through 2025 1st Reg. Sess.).

15. MICH. COMP. LAWS ANN. § 257.653a(1)(a) (West, Westlaw through 2025 Reg. Sess., 103rd Leg.).

16. ARIZ. REV. STAT. § 28-775(E)(2) (West, Westlaw through 2025 1st Reg. Sess., 57th Leg.; GA. CODE ANN. § 40-6-16(b) (West, Westlaw through Legis. passed at the 2025 Reg. Sess., Ga. Gen. Assemb.). The frequent use of ill-defined terms like "reasonable" in traffic laws poses a challenge to AV developers in itself. People are much more understanding of human error and willing to give drivers the benefit of the doubt in edge cases than they are with AVs. The tendency to hold automotive electronics to a higher standard applies broadly, not just in the context of AVs. *See* Neal Walters & Casey Watkins, *Good Deeds Punished: Consumer Response to Advancing Technology in Auto Class Actions,* LEGAL INTELLIGENCER (Jan. 20, 2021, at 10:59 MT), https://www.law.com/thelegalintelligencer/2021/01/20/good-deeds-punished-consumer-response-to-advancing-technology-in-auto-class-actions/?slreturn=20250403152111 [https://web.archive.org/web/20210226221415/https://www.law.com/thelegalintelligencer/2021/01/20/good-deeds-punished-consumer-response-to-advancing-technology-in-auto-class-actions/].

17. D.C. MUN. REGS. tit. 18, § 2409 (West, Westlaw through D.C. Reg., vol. 72, no. 38, dated Sept. 19, 2025); FLA. STAT. ANN. § 316.194 (West, Westlaw through 2025 1st Reg. Sess.); MICH. ADMIN. CODE r. 28.1818 (West, Westlaw through amends. in the Mich. Reg., iss. no. 18-2025, Oct. 15, 2025.).

passing a cyclist,[18] requirements for yielding to pedestrians in crosswalks, and mundane things, like hazard light usage.[19]

In many states, municipalities have enacted ordinances that modify state vehicle codes and separately govern key behaviors, such as parking, stopping, and standing.[20] Even more confounding are local customs, such as the "Pittsburgh Left," which are not codified in any formal rules.[21] There is not simply a patchwork of fifty state-specific sets of road rules that must be considered—there are thousands.

II. AUTONOMOUS DRIVING SYSTEMS AND ADVANCED DRIVER ASSISTANCE SYSTEMS

What is popularly referred to as "autonomous" vehicle technology spans a continuum from advanced driver assistance systems (ADAS) to fully autonomous driving systems (ADS). Although public discourse often conflates ADS and ADAS,[22] they embody distinct operational paradigms that have important legal and practical implications.

ADAS—typically classified as SAE Levels 0–2—are designed to support human drivers by managing portions of the dynamic driving task (DDT),[23] which includes vehicle control functions, such as steering, acceleration, braking, and environmental monitoring.[24] In ADAS-equipped vehicles, functions like adaptive cruise control, lane-keeping assistance, and collision avoidance reduce the driver's workload, but ultimate responsibility for the vehicle's operation re-

18. 75 PA. STAT. AND CONS. STAT. § 3303(a)(3) (West, Westlaw through Act 44 of the 2025 Reg. Sess.) (4 feet); CONN. GEN. STAT. ANN. § 14-232(a) (West, Westlaw through the 2025 Reg. Sess.) (3 feet); N.C. GEN STAT. ANN. §§ 20-149(a) (West, Westlaw through Sess. L. 2025-70, Sess. L. 2025-72 to Sess. L. 2025-75, & Sess. L. 2025-77 to Sess. L. 2025-89, of the 2025 Reg. Sess. of the Gen. Assemb.) (2 feet); WASH REV. CODE ANN. § 46.61.110(2)(a)(i) (West, Westlaw through 2025 Reg. Sess. of the Wash. Leg.) (change lanes if possible).

19. FLA. STAT. ANN. § 316.2397(7)(a) (West, Westlaw through 2025 1st Reg. Sess.).

20. CAL. VEH. CODE § 22507(a) (West, Westlaw through ch. 764 of the 2025 Reg. Sess., & Governor's 2025 Reorganization Plan No. 1) (allowing local authorities to set additional restrictions or designate specific areas for loading and unloading passengers); AUS., TEX., CODE OF ORDINANCES §§ 12-1-35(A)(4), (B), (C)(2) (2025), https://library.municode.com/tx/austin/codes/code_of_ordinances?nodeId=TIT12TRRE_CH12-1TRREAD_ART3TRRE_S12-1-35VUROUS [https://perma.cc/AEF6-KG8B] (requiring trucks to maintain six-foot distance from cyclists).

21. The "Pittsburgh Left" is an informal and unsanctioned driving practice where a driver quickly turns left at an intersection just as the light turns green, before oncoming traffic moves forward. This custom requires the knowing cooperation of the oncoming drivers to avoid collisions and near misses.

22. Memorandum from the All. for Auto. Innovation to Interested Parties, Dig Deeper: NHTSA's Standing General Order on Crash Data 2 (June 7, 2022), https://www.autosinnovate.org/resources/press/Auto%20Innovators%20Memo%20on%20NHTSA%20SGO%206JUNE2022.pdf [https://perma.cc/X2Y5-MU64].

23. The DDT, as defined by SAE J3016, is the collection of tasks required to safely operate a vehicle on public roads. *See* TAXONOMY AND DEFINITIONS FOR TERMS RELATED TO DRIVING AUTOMATION SYSTEMS FOR ON-ROAD MOTOR VEHICLES, J3016_201806 (SAE Int'l 2018) [hereinafter J3016_201806], https://www.sae.org/standards/content/j3016_201806/ (available for free download by creating an account).

24. *Automated Vehicles for Safety*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/vehicle-safety/automated-vehicles-safety#the-topic-road-to-full-automation [https://perma.cc/8VAB-AY6M] (last visited Apr. 1, 2025).

mains with the human operator. That is, the driver must remain attentive when using ADAS features.[25] In contrast, ADS, which include SAE Levels 3–5, are intended to execute the DDT either partially (Level 3) or entirely (Levels 4 and 5) without human intervention.[26]

Regardless of the level of automation, all ADAS or ADS-equipped vehicles must navigate the patchwork of state and local road rules described in Part I to an extent. For that reason, along with the general conflation of the technologies, public opinion and the views of regulators regarding popular ADAS features are relevant for developers of ADS technology.[27]

III. THE NEED FOR REASONABLE NONCOMPLIANT BEHAVIORS

Developers of AVs face unique challenges when planning nationwide deployments. Human drivers often navigate the variations in local rules of the road without much thought. This is largely because most people drive within the same area daily.[28] Yet, these differences matter for AV developers. Every variation in state or local road rules potentially requires a different firmware version specific to that location. It is easy to give the burden and expense associated with that prospect short shrift—but it can be substantial, if not prohibitive. Each firmware version requires development, testing, and validation throughout the cycle.[29] It is not as simple as changing a few lines of code for every jurisdiction.

This multiplicity creates a strong practical and business need for uniform AV behaviors that can be applied fleet-wide. These behaviors can often be developed by comparing the various rules of the road for the jurisdictions in which the AV developer plans to operate and identifying the behavior that is compliant in all jurisdictions (i.e., the "most compliant" behavior), even if it is overly conservative in many.

For example, a developer might choose to program AVs to avoid left-on-red turns from one one-way street to another. That behavior is allowed in most jurisdictions, and included in the UVC, but not permitted in a handful of states,

25. TAXONOMY AND DEFINITIONS FOR TERMS RELATED TO DRIVING AUTOMATION SYSTEMS FOR ON-ROAD MOTOR VEHICLES, J3016_202104, at 4–6, 26 (SAE Int'l 2021), https://www.sae.org/standards/content/j3016_202104/ (available for free download by creating an account).

26. *See* J3016_201806, *supra* note 23.

27. *See* discussion of Telsa's FSD beta's "assertive" mode *infra* Part III.

28. *See National Household Travel Survey Daily Travel Quick Facts*, BUREAU TRANSP. STATS. (May 31, 2017), https://www.bts.gov/statistical-products/surveys/national-household-travel-survey-daily-travel-quick-facts#:~:text=,miles%20per%20person%20per%20day [https://perma.cc/VH7X-XKBB]; Barbara Haas et al., *Close to Home: An Analysis of the Relationship Between Location of Residence and Location of Injury*, 78 J. TRAUMA ACUTE CARE SURGERY 860, 862 (2015).

29. *See Paving the Way for Self-Driving Vehicles: Hearing before the S. Comm. on Com., Sci., & Transp.*, 115th Cong. 22 (2017) (statement of John M. Maddox, President & Chief Exec. Officer, Am. Ctr. for Mobility), https://www.congress.gov/115/chrg/CHRG-115shrg30767/CHRG-115shrg30767.pdf [https://perma.cc/7YRQ-SK4D].

including New Jersey, Connecticut, and North Carolina.[30] Or, if an AV developer is not planning to operate in those states, it may decide to adopt a behavior that will make left-on-red turns from a one-way street but not from a two-way street. Five states allow such turns from a two-way street,[31] but the benefit of this behavior likely is outweighed by the costs associated with developing a fragmented set of firmware. Such a behavior may not maximize the options available under each jurisdiction's road rules, but it is compliant with all of them.

But what if the rules of the road in the jurisdictions under consideration conflict in a way such that there is no universally compliant behavior? Or, what if the behavior specified by the vehicle code does not align with how human drivers behave? The consideration of noncompliant behaviors to address those situations is one of the most difficult policy, legal, and engineering issues facing AV developers.

Competing schools of thought exist regarding AV adherence to traffic laws. One camp insists that all ADAS and ADS features must strictly comply with all traffic laws. Under this view, a deviation from traffic laws is considered a defect. This view, endorsed by figures like Senator Richard Blumenthal (D-Connecticut) and Senator Ed Markey (D-Massachusetts),[32] as well as many industry pundits, gained prominence following the controversy surrounding Tesla's introduction of an "assertive" driving mode in its Full Self-Driving (FSD) beta software.[33] That mode, which featured "rolling stops"—violating the UVC and most states' laws—also allowed for a shorter following distance, more frequent lane changes, and persistent use of the passing lane. These features collectively pushed the boundaries of conventional road rule adherence. NHTSA raised con-

30. *Compare* UNIF. VEHICLE CODE § 11-202(c)(3) (Nat'l Comm. on Unif. Traffic L. & Ordinances 2000) (permitting left-on-red turns on a one-way street after stopping) *with* N.J. STAT. ANN. § 39:4-115 (West, Westlaw through Pub. L. 2025) *and* CONN. GEN. STAT. § 14-299 (West, Westlaw through 2025 Reg. Sess.) (omitting left-on-red turns from acceptable actions allowed on a steady red signal), N.C. GEN. STAT. ANN. § 20-158 (West, Westlaw through Sess. L. 2025-70, Sess. L. 2025-72 to Sess. L. 2025-75, & Sess. L. 2025-77 to Sess. L. 2025-89, of the 2025 Reg. Sess. of the Gen. Assemb.) (describing permissible turns at intersections).

31. ALASKA ADMIN. CODE tit. 13, § 02.010 (LEXIS through Reg. 255); IDAHO CODE ANN. § 49-802(3)(b) (West, Westlaw through 1st Reg. Sess. of the 68th Idaho Legis.); MICH. COMP. LAWS ANN. § 257.612(1)(c)(ii) (West, Westlaw through P.A.2025, No. 13, of the 2025 Reg. Sess., 103d Leg.); OR. REV. STAT. ANN. § 811.360(1)(b) (West, Westlaw 2025 Reg. Sess. of the 83d Legis. Assemb.); WASH. REV. CODE § 46.61.055(3)(a) (West, Westlaw through 2025 Reg. Sess. of the Wash. Leg.).

32. *See* Press Release, U.S. Sen. Edward J. Markey, Markey & Blumenthal Demand Tesla's Advanced Driver Assistance & Automated Driving Systems Follow the Law & Prioritize Safety (Feb. 8, 2022), https://www.markey.senate.gov/news/press-releases/markey-and-blumenthal-demand-teslas-advanced-driver-assistance_automated-driving-systems-follow-the-law--prioritize-safety [https://perma.cc/REC2-B8A6].

33. U.S. DEP'T TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., 23V-085, PART 573 SAFETY RECALL REPORT 2 (2023), https://static.nhtsa.gov/odi/rcl/2023/RCLRPT-23V085-3451.PDF [https://perma.cc/9L64-7HLJ] (Tesla's "FSD Beta is an SAE Level 2 driver support feature that can provide steering and braking/acceleration support to the driver under certain operating limitations."). Although this example involved ADAS, the responses from policymakers and regulators are equally applicable to ADS developers.

cerns about the feature and prompted Tesla to voluntarily recall 53,822 vehicles equipped with this version of the FSD beta.[34]

Proponents of the strict compliance approach argue that literal rule following can maximize safety, a view also reflected in recent regulatory proposals that mandate absolute compliance as a safeguard for public safety.[35] Yet, such an approach faces inherent trade-offs among safety, legal adherence, and operational efficiency because codifying human judgment into rigid rules is profoundly challenging.[36]

A second camp holds the view that AVs should have the authority to bend the rules to comply with local norms and the expectations of human drivers. Proponents of this view believe that the ultimate goal is for the AV to behave exactly as the "average" human driver. The ultimate achievement under this philosophy would be for the AV to seamlessly blend into currently existing traffic flows and patterns, and to be indistinguishable from other road users—aside from the sensor stack.

Both of those views leave something to be desired. The strict compliance route can lead to somewhat absurd results. For instance, an AV that strictly adheres to a state's cyclist safe passing law, without exceptions for narrow lanes or oncoming traffic, may unnecessarily back up traffic in a situation where even the most cautious human driver would have simply passed at a reduced speed with as much margin as possible. That may seem like a trivial concern, but AV companies routinely face public criticism for these types of ultraconservative behaviors and even for completely unobstructive but atypical behaviors.[37]

However, programming AV behavior to mimic the "average" driver's habits is also problematic. The average driver, often insufficiently informed about traffic laws or prone to distraction, does not provide the best model for safe driving. For example, twenty percent of drivers are unaware of whether their state has a law requiring vehicles to change lanes or slow down when passing an active emergency vehicle on the shoulder.[38] As the NHTSA notes, "In 2023, there were 3,275 people killed and nearly 325,000 people injured in traffic

34. U.S. DEP'T TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., 22V-037, PART 573 SAFETY RECALL REPORT (2022), https://static.nhtsa.gov/odi/rcl/2022/RCLRPT-22V037-4462.PDF [https://perma.cc/CD6S-7QPM].

35. Amitai Y. Bin-Nun et al., *How Should Autonomous Vehicles Drive? Policy, Methodological, and Social Considerations for Designing a Driver*, HUMANS. & SOC. SCIS. COMMC'NS, Aug. 30, 2022, art. no. 299, at 1; Xiaohan Ma et al., *Legal Decision-Making for Highway Automated Driving*, 9 IEEE TRANSACTIONS ON INTELLIGENT VEHICLES 5284, 5284 (2023) ("The results indicate that the proposed method increases the vehicle's overall compliance rate from 13.85% to 84.46%, reduces the proportion of active violations to 0%, and only slightly decreases the vehicle's traffic efficiency by 2.7%, demonstrating its effectiveness.").

36. Bin-Nun et al., *supra* note 35, at 2.

37. *See, e.g.*, *Waymo's Self-Driving Cars Keep Ending Up on a Dead-End San Francisco Street*, CBS NEWS (Oct. 14, 2021, at 18:12 EDT), https://www.cbsnews.com/news/waymo-self-driving-cars-san-francisco-dead-end-street/ [https://perma.cc/N3H5-BJG6].

38. AM. AUTO. ASS'N FOUND. FOR TRAFFIC SAFETY, AMERICAN DRIVERS' SELF-REPORTED PERCEPTIONS AND ATTITUDES REGARDING MOVE OVER LAWS 3 tbl.4 (2021), https://publicaffairsresources.aaa.biz/download/18733/ [https://web.archive.org/web/20231113122448/https://publicaffairsresources.aaa.biz/download/18733/].

crashes involving distracted drivers."[39] Moreover, a 2020 study by the Insurance Institute for Highway Safety (IIHS) casts doubt on the effectiveness of programming AVs to emulate average human driving.[40] The IIHS estimated that AVs programmed to emulate average human driving might only prevent about one-third of crashes currently caused by human error.[41] The study highlights that forty percent of human-caused crashes involve errors, such as speeding and executing illegal maneuvers, indicating that replicating average human driving behavior could perpetuate these risks rather than mitigate them.[42]

A much more nuanced approach should be deployed. The goal should be to adopt AV behaviors that comport with how the *best* human drivers behave. The best human drivers are capable of exercising judgment about when to violate the letter of the law to avoid unnecessary delays to themselves and other road users while maintaining a high level of safety. For example, a cautious human driver might cross double yellow lines, after appropriately verifying there is no risk of a collision from oncoming traffic, to pass a slow-moving sanitation truck making frequent stops to collect waste. That is so, despite the fact that courts have held that a sanitation truck engaged in its expected behavior of trash collection is not an "obstruction" permitting a driver to cross a double yellow line.[43]

Indeed, a growing body of scholarship supports the notion that a degree of constrained rule bending based on logical criteria is not only acceptable but necessary. Minor deviations to avoid the obstruction of traffic can be essential to maintaining smooth traffic flow.[44]

If developers take this approach, the key question becomes: How can noncompliant behaviors be responsibly developed?

IV. POTENTIAL FRAMEWORKS FOR NAVIGATING NONCOMPLIANCE

Developing responsible noncompliant AV behaviors is challenging, and several groups have proposed approaches for addressing these issues. This section briefly introduces some key frameworks currently influencing discussions around AV behaviors.

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39. *Put the Phone Away or Pay*, NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., https://www.nhtsa.gov/risky-driving/distracted-driving [https://web.archive.org/web/20250718052938/https://www.nhtsa.gov/campaign/distracted-driving] (last visited July 18, 2025).

40. Alexandra S. Mueller et al., *What Humanlike Errors Do Autonomous Vehicles Need to Avoid to Maximize Safety?*, 75 J. SAFETY RSCH. 310 (2020).

41. *Id.* at 313.

42. *Id.* at 312–13.

43. *See* Parker v. State, 622 S.E.2d 403, 405 (Ga. Ct. App. 2005) (upholding trial court's finding in bench trial that a garbage truck was not an obstruction).

44. *See* Chris Tennant et al., *Code, Culture, and Concrete: Self-Driving Vehicles and the Rules of the Road*, FRONTIERS SUSTAINABLE CITIES, Nov. 18, 2021, art. no. 710478, at 1; Xiaohan Ma et al., *Law Compliance Decision Making for Autonomous Vehicles on Highways*, ACCIDENT ANALYSIS & PREVENTION, Sept. 2024, art. no. 107620, at 1, 2–3; Nick Reed et al., *Ethics of Automated Vehicles: Breaking Traffic Rules for Road Safety*, 23 ETHICS & INFO. TECH. 777, 783 (2021).

A. Formalized Rule-Based Approaches and IEEE 2846

Many early efforts to codify appropriate driving behavior aimed to translate traffic laws and unwritten road norms into mathematical "rules." For instance, models, such as Nvidia's Safety Force Field (SFF) and Intel Mobileye's Responsibility-Sensitive Safety (RSS) framework, seek to define "safe states" by establishing quantitative thresholds for acceptable behavior.[45] However, such rule-based systems risk "flattening" the inherently multi-layered nature of rules of the road by reducing flexible, context-sensitive norms to rigid formulas.[46]

Recent developments in industry standards, exemplified by IEEE Standard 2846, further refine this approach by explicitly defining a set of assumptions regarding the "reasonably foreseeable" behaviors of other road users.[47] Rather than presupposing perfect adherence to traffic laws, IEEE 2846 acknowledges that human drivers frequently deviate from strict compliance—for example, by occasionally exceeding speed limits or braking abruptly.[48] By delineating a safety envelope within which an AV must operate, the standard permits some noncompliance when necessary to avert collisions. This construct aligns with proposals advanced by some scholars who favor a framework for decision-making that emphasizes hierarchical processing of static and dynamic traffic laws.[49]

B. Functional Safety: ISO 26262 and SOTIF

While the aforementioned frameworks address the tactical decisions involved in driving, international standards governing functional safety—namely ISO 26262 and its companion ISO 21448 (Safety of the Intended Functionality (SOTIF))—focus on ensuring that an AV's hardware and software operate reliably under expected conditions.[50] Although indispensable for certifying system safety, these standards do not provide guidance on the real-time behavioral decisions required when an AV encounters scenarios that necessitate a deviation from traffic laws. This gap reinforces the need for an integrated, process-based framework that explicitly considers both legal liability and operational needs.

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45. *See, e.g.*, DAVID NISTÉR ET AL., THE SAFETY FORCE FIELD 13–14 (2019), https://www.nvidia.com/content/dam/en-zz/Solutions/self-driving-cars/safety-force-field/the-safety-force-field.pdf [https://perma.cc/89LJ-BPGT]; Shai Shalev-Shwartz et al., Mobileye, *On a Formal Model of Safe and Scalable Self-Driving Cars*, arXiv 6 (2017), https://arxiv.org/pdf/1708.06374v6 [https://perma.cc/D2YY-2423].

46. Tennant et al., *supra* note 44, at 7.

47. INTEL. TRANSP. SYS. COMM., IEEE VEHICULAR TECH. SOC'Y, IEEE STD 2846™-2022, IEEE STANDARD FOR ASSUMPTIONS IN SAFETY-RELATED MODELS FOR AUTOMATED DRIVING SYSTEMS 13 (2022).

48. *Id*. at 18.

49. Ma et al., *supra* note 44, at 3.

50. *See 26262-1:2018, Road Vehicles—Functional Safety*, INT'L ORG. FOR STANDARDIZATION (2018), https://www.iso.org/standard/68383.html (standard available for purchase); *21448:2022, Safety of the Intended Functionality*, INT'L ORG. FOR STANDARDIZATION (2022), https://www.iso.org/standard/77490.html (standard available for purchase).

C. International Regulatory Perspectives: UNECE ALKS and Emerging FRAV Guidelines

At the regulatory level, international initiatives further highlight the tension between strict legal compliance and necessary flexibility. The United Nations Economic Commission for Europe (UNECE) Automated Lane Keeping Systems (ALKS) regulation for Level 3 automation, for example, imposes stringent adherence to traffic laws under clearly defined operational assumptions—such as specified deceleration limits of lead vehicles.[51] In contrast, emerging guidelines from UNECE's Functional Requirements for Automated Vehicles (FRAV) group recognize that in emergencies, an AV may need to execute evasive maneuvers even if these temporarily violate traffic laws.[52] This evolving regulatory perspective acknowledges the practical realities that the integration of AVs into existing transportation systems may require reevaluating the balance between traffic law compliance and road safety.[53]

D. Toward a Process-Based Framework for Noncompliant Behaviors

Taken together, the technical standards and regulatory approaches discussed above address largely the "what" and "why" of AV behavior—defining safe operating envelopes and establishing the rationale for controlled deviation. They provide less practical guidance, however, on "how" an AV developer should navigate the immediate legal, practical, and risk-management challenges of drafting product requirements, developing the products, and then deploying them.

The process proposed in the following section can help AV developers balance the legal liability considerations, technical risk assessments, and evolving regulatory requirements when considering noncompliant behaviors. It will also help them to develop a defensible methodology for evaluating behaviors.

V. A FRAMEWORK FOR EVALUATING NONCOMPLIANT BEHAVIORS

Addressing the need for the practical, process-based methodology identified above, this section proposes a framework designed to guide AV developers

51. *See* U.N. Economic Commission for Europe World Forum for Harmonization of Vehicle Regulations, Proposal for a New UN Regulation on Uniform Provisions Concerning the Approval of Vehicles with Regards to Automated Lane Keeping System, § 5.2.5.1, U.N. Doc. ECE/TRANS/WP.29/2020/81 (Apr. 6, 2020).

52. *See* Informal Working Group on Functional Requirements for Automated Vehicles, U.N. Econ. Comm'n for Eur., FRAV Status Report on Functional Performance Requirements for Automated Driving Systems and ADS-Equipped Vehicles § 3.1.7, at 6 (stating "driving entails the prioritization of competing demands (e.g., compliance with traffic laws versus risk to human life)"), § 3.3.2, at 10 (stating an automated vehicle "should comply with traffic laws . . . except in cases where such compliance would . . . introduce unreasonable risks"), U.N. Doc. No. GRVA-05-40 (Feb. 2020), https://unece.org/DAM/trans/doc/2020/wp29grva/GRVA-05-40e.pdf [https://perma.cc/6MCD-H3LX].

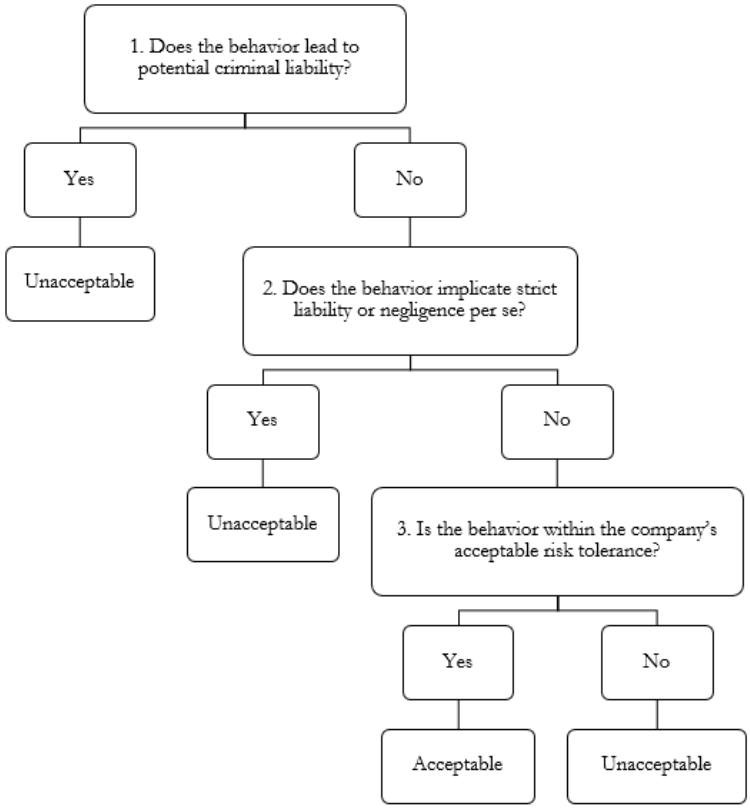
53. Bin-Nun et al., *supra* note 35, at 3.

through the evaluation of potentially noncompliant behaviors. This structured approach integrates considerations of legal liability, safety validation, and organizational risk tolerance, offering a starting point for responsible decision-making when strict rule adherence is insufficient or infeasible.

This proposed framework consists of several gating questions that can be answered by the AV developer's legal, policy, and safety teams. While there may be a desire to develop an algorithmic solution to make this type of evaluation, at the moment, the best way to make the process as defensible as possible in a product liability suit is to have decision-makers on those teams involved in the analysis. As noted above,[54] a jury is much more likely to credit the efforts of those professionals as fulfilling the company's duty of care than it is if the analysis is conducted with a formula alone.[55]

The overall structure of the framework is shown in Figure 1 below.

Figure 1. Proposed Framework with Gating Questions



54. *See* Walters & Watkins *supra* note 16.

55. This is a potential drawback for defense counsel attempting to build a defense around a formulaic proposal like RSS.

A. Does the Proposed Behavior Subject an Operator or the Developer to Potential Criminal Liability?

A violation of most traffic laws is punishable as a noncriminal infraction. However, some vehicle code provisions carry heightened penalties, and violations may be punishable as misdemeanor or felony criminal offenses. Examples include violations of move-over or slow-down laws that result in injury to a first responder.[56]

If the answer to this question is "yes," the proposed behavior likely poses too significant a risk to justify implementation. Very few companies will have a risk tolerance for AV behaviors that can subject their leadership, employees, or the company itself to criminal penalties.

If the answer is "no," the proposed behavior may pose an acceptable risk, but additional civil liability risks must be considered.

B. Does the Proposed Behavior Implicate Strict Liability or Negligence Per Se?

If no criminal liability attaches to a violation of the road rule in question, the next step is to consider whether the proposed behavior could result in the AV developer being held strictly liable or liable under principles of negligence per se. In most jurisdictions, the doctrine of negligence per se applies when a criminal or regulatory statute imposes a specific duty for the protection or benefit of others, and the defendant neglects to perform that duty.[57] Under this doctrine, the defendant is liable to anyone in the class of individuals the statute was designed to protect and for harms the statute intended to prevent. Such a violation establishes either negligence as a matter of law or creates a rebuttable presumption of negligence. Similarly, strict liability could apply in situations where a noncompliant behavior is deemed a "defect."[58] A plaintiff may recover under strict products liability if the product was defective at the time of sale, left the manufacturer's control in that condition, and the defect caused the plaintiff's injuries during reasonably foreseeable use.[59]

If the answer to either of the above questions is "yes," the proposed behavior likely poses too significant a risk to justify implementation. If the answer to both of the above questions is "no," the proposed behavior may pose an acceptable risk and be permissible. But, there are additional considerations.

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56. 75 PA. STAT. AND CONS. STAT. § 3327 (West, Westlaw through Act 44 of the 2025 Reg. Sess.); 625 ILL. COMP. STAT. 5/11-907(c) (LEXIS, through Pub. Act 104-96 of the 2025 Reg. Sess, 104th Gen. Assemb.).

57. RESTATEMENT (SECOND) OF TORTS § 286 (A.L.I. 1965).

58. Several courts have treated a recall or NHTSA defect finding as relevant and persuasive evidence that a product was defective under § 402A, though usually not conclusive by itself. *See, e.g.*, Carey v. Gen. Motors Corp., 387 N.E.2d 583, 587–88 (Mass. 1979).

59. *See* RESTATEMENT (SECOND) OF TORTS § 402A (A.L.I. 1965).

C. Does the Proposed Behavior Fall within the Developer's Risk Tolerance?

The next step is to evaluate whether the proposed behavior is likely to result in a crash or exceed the company's risk tolerance. A common approach regarding such determinations involves the creation of a risk matrix. A risk matrix provides a visual representation of the probability and impact of the outcome of adopting a given AV behavior. This tool is generally accepted in the automotive industry, and NHTSA's Office of Defect Investigation uses a risk matrix when evaluating whether to open a formal investigation into a potential vehicle defect. While NHTSA's component-specific matrices consider multiple factors like detectability and injury consequence, a more universal 5 × 5 risk matrix can be used as a starting point for most AV behaviors.

A sample 5 × 5 risk matrix would look like Table 1 as shown below. By applying a color-coding scheme, the matrix can be used to enhance understanding and decision-making by legal, safety, and engineering teams when assessing a proposed AV behavior. To a large extent, it is up to each developer to decide how to draw the lines and what level of risk is acceptable. A developer may decide to reject any proposed noncompliant AV behavior with a score higher than 4. Others may choose to take a more conservative approach and reject behaviors with a score higher than 2.

There is a point at which no reasonable developer would consider a noncompliant behavior acceptable. While that line is not readily defined, it is clear noncompliant behaviors that could have severe or major consequences are much more likely to be considered defects by NHTSA, regardless of frequency. For context, NHTSA has opened preliminary evaluation (PE) inquiries for issues posing potential major or severe risks even when the risk of occurrence is very small.[60] Generally, proposed behaviors that fall outside of the lower left quadrant of the matrix should be rejected. Note also that the monetary value of any penalty for violating a traffic law should not receive undue weight in the severity analysis. Relying too heavily on a cost calculation opens the door unnecessarily to a dangerous "profits over people" theme by a plaintiff's counsel.

60. In January 2025, NHTSA opened a PE into roughly 878,000 GM trucks after 39 complaints of engines seizing and causing power loss (~0.004% of vehicle population). NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., PE25001, ODI RESUME: LOSS OF MOTIVE POWER DUE TO ENGINE FAILURE 1 (2025), https://static.nhtsa.gov/odi/inv/2025/INOA-PE25001-10002.pdf [https://web.archive.org/web/20250727103728/https://static.nhtsa.gov/odi/inv/2025/INOA-PE25001-10002.pdf]. In another recent case, ODI opened an investigation in March 2025 into 1.3 million Ford F-150 trucks after receiving 138 consumer complaints about sudden downshifts causing rapid deceleration (0.01% of vehicle population). NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., PE25002, ODI RESUME: UNINTENDED TRANSMISSION DOWNSHIFT AND REAR WHEEL LOCK-UP 1 (2025), https://static.nhtsa.gov/odi/inv/2025/INOA-PE25002-10022.pdf [https://web.archive.org/web/20250512085903/https://static.nhtsa.gov/odi/inv/2025/INOA-PE25002-10022.pdf].

Table 1. Sample 5 × 5 Risk Matrix

	Severity Factors	**Frequency Level**				
Severity Level	**Consequence**	**Rare (1)**	**Unlikely (2)**	**Occasional (3)**	**Likely (4)**	**Frequent (5)**
Severe (5)	Severe or fatal injury; Extreme fines or civil liability; Felony criminal consequences	5	10	15	20	25
Major (4)	Moderate injury; large fines or civil liability; misdemeanor criminal consequences	4	8	12	16	20
Significant (3)	Minor injury; moderate fines or civil liability; significant financial or reputational damage	3	6	9	12	15
Minor (2)	Negligible injury; small fines or civil liability; minor financial or reputational damage	2	4	6	8	10
Insignificant (1)	No injury; negligible fines or civil liability; minimal financial or reputational impact	1	2	3	4	5

D. Application of the Proposed Framework.

1. *Hazard Light Usage for Passenger Pickup and Drop Off*

By way of example, consider a proposed AV behavior that activates the AV's hazard lights as the AV begins to slow and pull over to the roadside to pick up a waiting passenger. That proposed behavior would violate Florida's prohibition on flashing lights to indicate anything other than a turn, lane change, or "to indicate that the vehicle is lawfully stopped or disabled upon the high-

way."[61] Yet, this noncompliant behavior is not only commonplace, but it is typically expected by the waiting passenger and other motorists.

Applying the analysis above, this behavior does not present a foreseeable risk of collision and constitutes only "a noncriminal traffic infraction, punishable as a nonmoving violation."[62] And, because no protected class of person is implicated in the relevant vehicle provision, there is no concern of an automatic presumption of liability.

Moving on to the risk analysis, the noncompliant behavior of activating the AV's hazard lights to signal to other drivers that the vehicle is engaging in a passenger pickup would score a 1 or a 2 in the above risk matrix and could be a justifiable noncompliant behavior. Enforcement of that provision could be considered rare or unlikely. Indeed, the Florida Highway Patrol has issued approximately 150 such citations per year for improperly using flashing lights, the majority apparently directed at motorists attempting to alert other motorists to the presence of the patrol car.[63] And, even if a citation was issued, the small one-hundred dollar fine does not pose a significant risk to the company's operations.

Note that this risk profile can change over time if the regulatory environment within the state changes. Florida does not impose a permitting requirement or actively exercise oversight over AV fleets. However, if the state were to adopt a style of regulation similar to California, where a permit is required to operate at various stages of deployment, even a minor violation of the vehicle code could place the developer's permit to operate in jeopardy. This would increase the risk category assigned to the behavior.

2. *"Rolling" Stops*

In contrast, a "rolling stop" behavior like the one previously discussed in Section III would involve allowing an AV approaching an all-way-stop intersection to proceed without fully stopping, provided certain conditions are met (e.g., low speed, clear intersection visibility, and absence of detected road users).[64] While human drivers commonly perform rolling stops,[65] this practice presents significant liability risks for AV developers.

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61. FLA. STAT. ANN. § 316.2397(7)(a) (West, Westlaw through 2025 1st Reg. Sess.).

62. *Id.* § 316.2397(10)(b) (Westlaw).

63. Veronica Crespo, *Miami Drivers Rejoice: Flashing Hazard Lights Could Soon Be Legal*, LOC. 10 NEWS (May 28, 2021, at 13:39 EDT), https://www.local10.com/news/florida/2021/05/28/miami-drivers-rejoice-flashing-hazard-lights-could-soon-be-legal/ [https://web.archive.org/web/20230323052653/https://www.local10.com/news/florida/2021/05/28/miami-drivers-rejoice-flashing-hazard-lights-could-soon-be-legal/].

64. U.S. DEP'T TRANSP., *supra* note 34, at 2–3.

65. N.J. BICYCLE & PEDESTRIAN RES. CTR. OF THE ALAN M. VOORHEES TRANSP. CTR. (VTC), RUTGERS, THE STATE UNIV. OF N.J., EVALUATING THE EFFECTIVENESS OF PORTABLE STOP SIGNS 9–12 (2022), https://njbikeped.org/wp-content/uploads/2022/09/Stop-Signs-Report-Updated.pdf [https://web.archive.org/web/20251006012116/https://njbikeped.org/wp-content/uploads/2022/09/Stop-Signs-Report-Updated.pdf]; Geoffrey S. Corn, *"Light Him Up": Addressing the Dangerous Intersection of Traffic Stops and Consent*, 20 GEO. J.L. & PUB. POL'Y 617, 621 (2022).

In most jurisdictions, failing to come to a complete stop is typically a noncriminal infraction absent aggravating circumstances.[66] Thus, under normal operating conditions, the rolling-stop behavior does not inherently expose AV operators or developers to criminal liability. Accordingly, the answer to the first gating question is likely "no," suggesting that further civil liability concerns must be assessed.

Because stop-sign laws explicitly aim to protect intersection users, a rolling stop potentially implicates negligence per se, increasing civil liability exposure.[67] Therefore, under the second gating question, the behavior should be rejected.

While the second gating question indicates the behavior should not be implemented, further analysis under the risk matrix for completeness demonstrates additional risks. On the severity axis, a rolling stop could lead to a collision at an intersection—particularly a side-impact crash, potentially involving serious injuries or fatalities. Such scenarios could plausibly fall within the "Major (4)" severity category.

Regarding frequency, while the carefully defined operational conditions (low speed, absence of detected hazards) may initially suggest lower frequency of incidents, there is inherent uncertainty in sensor performance and environment perception. Even rare sensor errors or unexpected behaviors by other road users could result in "Occasional (3)" incident frequencies. Using moderate assumptions results in a risk score of 12. Thus, even if negligence per se concerns were not dispositive, the rolling stop's risk profile likely places it well beyond what any developer would deem acceptable. This analysis demonstrates how the proposed framework can systematically provide AV developers with a way to make legally defensible decisions regarding noncompliant behaviors.

Developing noncompliant autonomous vehicle behaviors that minimize risks to passengers, other road users, and developers requires balancing legal compliance with practical functionality. The variances in state and local traffic laws pose unique challenges for AV developers, compelling them to devise behaviors that are not only technically feasible but also legally defensible and socially acceptable. The proposed framework, combining legal analysis with a risk assessment matrix, provides a structured method for evaluating noncompliant behaviors. This approach helps developers prioritize safety and compliance while addressing the practical realities of driving. As autonomous vehicle regulations evolve, so must development strategies. Success will depend on the industry's ability to navigate complex regulations and public expectations, ensuring that AVs are safe, reliable, and seamlessly integrated into roadways.

66. *See, e.g.*, FLA. STAT. ANN. § 316.074(6) (West, Westlaw through 2025 1st Reg. Sess.); CAL. VEH. CODE § 22450 (West, Westlaw through ch. 764 of the 2025 Reg. Sess., & Governor's 2025 Reorganization Plan No. 1).

67. *See, e.g.*, Williams v. Calhoun, 333 S.E.2d 408 (1985); Bumbarger v. Kaminsky, 457 A.2d 552, 554 (1983) ("The law of this Commonwealth is clear that the failure to obey a stop sign is negligence per se . . . .").