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WHAT GOVERNMENTS ACROSS THE GLOBE ARE DOING TO SEIZE THE BENEFITS OF AUTONOMOUS VEHICLES

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This policy paper introduces some of the main policy and regulatory actions that are being undertaken in the international arena in relation to automated vehicles (AVs) We cover initiatives from the G7 international meetings, the United States, the European Union, Singapore, Japan, South Korea, China, and New Zealand. This primer is not intended to serve as comprehensive analysis of the governing regimes established within these jurisdictions, but rather to provide a broad overview of noteworthy developments that have taken place within a sample of jurisdictions.

From this collection, we identify trends in public policy and regulatory strategies on AVs. These trends may include the motivations driving governments toward adopting certain policies or specific actions being taken to deploy AVs, such as harmonizing regulatory frameworks, coordinating actions with stakeholders, analyzing socio-economic and ethical impacts, or supporting research and development of the technology. We revisit these trends in the concluding remarks section of this paper.

Learning from one another's experiences can inspire creative actions and facilitate improved AV policies. However, the impact of the initiatives will depend on the legal, social, and economic environment in which they are developed and implemented. To be successful, each initiative will need to be adapted to the specific context of its region.

Automated vehicles (AVs) are vehicles with driving functions or tasks that do not require human intervention. There are different degrees of automation, depending on the number of automated tasks embedded in the vehicle and how machines and humans share the driving responsibilities.

AVs are classified according to their **level of automation**. There are many existing taxonomies of AVs, but the most widely adopted at an international level is the one produced by the *Society of Automotive Engineers-SAE (International Standard J3016-2014)*.[1] The SAE taxonomy includes six levels of automation, ranging from manual vehicles to fully automated ones. In the **0 level**, the vehicle is fully controlled by the human. In **levels 1-3**, the vehicle's autonomous mode is only available in certain traffic situations or places—like highways—and the human is expected to be ready to take over control of the vehicle if the system requires it. In **levels 4 and 5**, the artificial intelligence system is fully responsible for driving the vehicle. The vehicle can ask for human intervention—allowing the human to take over the vehicle whenever he or she chooses—but cannot rely on receiving it.

Level 0 and 1 vehicles are widely distributed, and several Level 2 vehicles are already being offered. A KPMG report[2] estimates the deployment of Level 3, 4, and 5 vehicles by end of 2020-2025; 2025-2030; and beyond 2030, respectively.

1 The SAE J3016 has been adopted by the U.S. Department of Transportation in September 2016; it has been adopted by the OECD in 2015; and the European Union has referred to it in its strategy of AV deployment.

2 *See* KPMG, *Impact of Autonomous Vehicles on Public Transport Sector* (2017); https://assets.kpmg.com/content/dam/kpmg/ie/pdf/2017/07/ie-impact-av-vehicles-public-transport-2017.pdf (page 6)

1 INTERNATIONAL OVERVIEW

On a political level, it is worth mentioning the increasing prevalence of AV dialogues on the intergovernmental agendas. For instance, the **G7**[3] is adding AV discussions to its program, focusing on the technical, legal, societal, and ethical implications of the technology. In September 2015, the Transport Ministers of the G7 and the European Commissioner for Transport signed a **Declaration on Automated and Connected Driving**, stressing the need to harmonize the regulatory framework around this technology.[4] The signatories agreed on working together to coordinate their research, adapt technology regulations, and improve data protection and cybersecurity.[5]

In 2016, the G7 Transport Ministers established the Karuizawa working group to study issues including the "**human-machine interface, infrastructure, and social acceptance" of AVs** and to use these results to guide the development of harmonized regulations.[6]

And, in 2017, the Ministers reinforced the need to **strengthen international regulatory cooperation** in topics such as the allocation of liability and **ethical implications**, specifically "the ethical choices that autonomous vehicles ought to make in emergency situations."[7]

On a technical level, one of the most prominent international endeavors regarding AVs is the **adaptation of two treaties, the UN Vienna (1968, 75 parties)** [8] **and Geneva (1949, 97 parties)**[9] **Convention on Road Traffic**, to legalize AV operation.[10] The work is being led by the Inland Transport Committee of the United Nations Economic Commission for Europe (UNECE).[11]

3 The Group of Seven includes Canada, France, Germany, Italy, Japan, UK, and the US; the largest advanced economies.

4 *See* Declaration on Automated and Connected Driving, Group of Seven (September 17, 2015) (available at https://ec.europa.eu/commission/commissioners/2014-2019/bulc/announcements/g7-declaration-automated-and-connected-driving_en).

5 *See id.*

6 G7 Transport Ministers Meeting, Meeting Declaration: Development and Widespread Utilization of Advanced Technology for Vehicles and Roads at 2 (September 24, 2016) (available at http://www.mlit.go.jp/common/001146631.pdf).

7 G7 Transport Ministers Meeting, Declaration of the Ministers at 3 (June 23, 2017) (http://www.g7italy.it/sites/default/files/documents/Final%20Declaration.pdf).

8 Vienna Convention on Road Traffic, Nov. 8, 1968, 1042 U.N.T.S. 17.

9 Geneva Convention on Road Traffic, Sep. 19, 1949, 125 U.N.T.S. 3.

10 European Parliament *Research for TRAN Committee – Self-piloted cars: the future of road transport? (2016)*; http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573902/EPRS_BRI(2016)573902_EN.pdf (page 7) where it says "[...] a further amendment process [of the Conventions] would be necessary to permit driverless vehicles." *See* also UNECE Inland Transport Committee, *AUTOMATED DRIVING*, (2017); https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-2017-Informal-2e.pdf (paragraphs 19 and 20 at page 4)

11 *See* European Parliament *Briefing in Automated vehicles in the European Union (2016)*: http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/573902/EPRS_BRI(2016)573902_EN.pdf (page 6). *See also* UNECE Inland Transport Committee, *AUTOMATED DRIVING*, (2017), https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-2017-Informal-2e.pdf (paragraphs 19 and 20 at page 4); *see* also Government of the Netherlands Official Webpage, *On our way towards connected and automated driving in Europe* https://www.government.nl/documents/leaflets/2017/05/18/on-our-way-towards-connected-and-automated-driving-in-europe (page 7)

The Vienna Convention on Road Traffic was created in pursuit of the "desir[e] to facilitate international road traffic and to increase road safety through the adoption of uniform traffic rules,"[12] similar to the aim of the Geneva Convention on Road Traffic.[13] For more than a decade, the **World Forum for the Harmonization of Vehicle Regulations (WP29)** has been developing technical regulations for Advanced Driver Assistance Systems (ADAS);[14] and the **Road Safety Forum (WP1)** has been adapting the conventions to legally allow the use of those ADAS systems.[15]

However, fully AVs may require deeper changes to the Treaties that update and clarify concepts such as the nature of the "driver" and what it means to be "in control" of the vehicle. In 2016, UNECE amended the Vienna Convention to allow certain automated functions in vehicles, although not enough for highly automated vehicles as they still require the presence of a driver who should be able to regain control of the vehicle at all times.[16]

Currently, the WP1 is studying how to adapt the conventions to allow for the use of automated driving functions and, eventually, fully autonomous vehicles.[17] The three possibilities being considered include: **developing guidance on interpretation** of problematic concepts for AVs, such as the nature of control, role of driver, and nature of driver; **amending** the conventions; and creating a **new convention** for AVs.[18]

A 2-step approach is also being considered, which involves (1) issuing a protocol or amendment—a complex and time-consuming exercise—and (2), in the meantime, releasing guidance on how to interpret the conventions regarding AVs.[19]

12 Vienna Convention on Road Traffic at 18.

13 *See* Geneva Convention on Road Traffic at 71.

14 UNECE Inland Transport Committee, *Consolidated Resolution on the Construction of Vehicles (R.E.3) Revision 6*, (July 11, 2017), https://www.unece.org/fileadmin/DAM/trans/main/wp29/wp29resolutions/ECE-TRANS-WP.29-78r6e.pdf, 100.

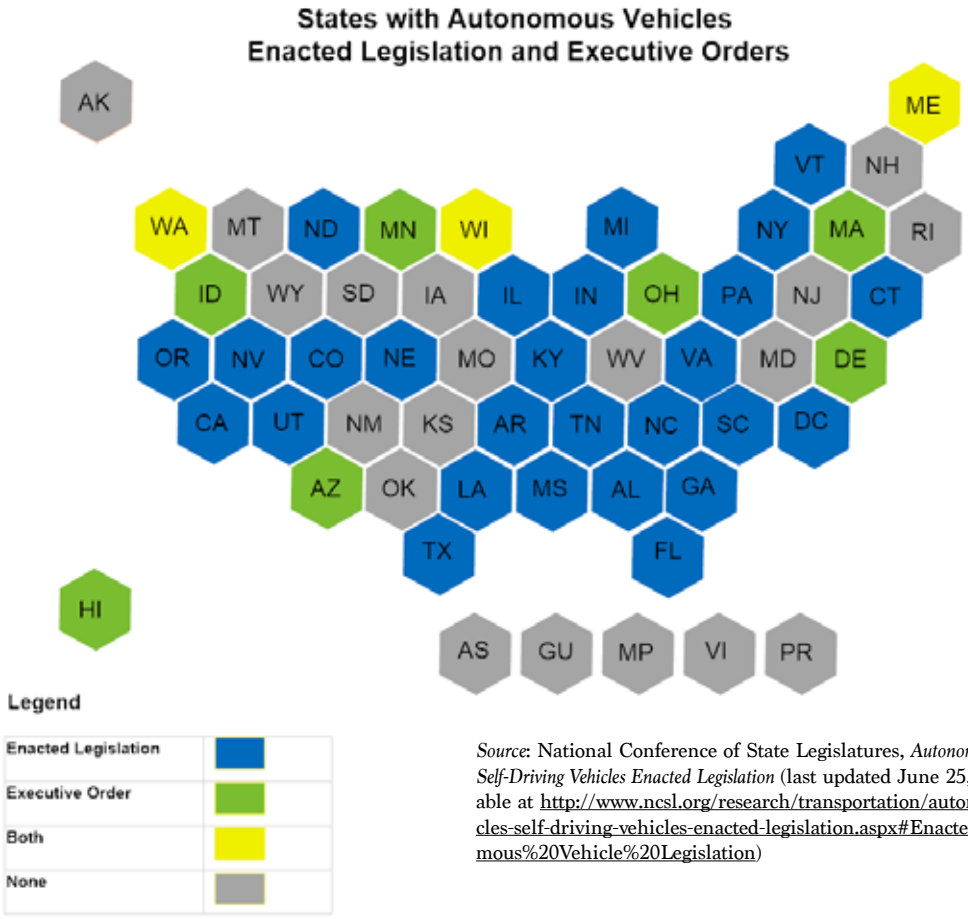
15 UNECE Inland Transport Committee, *AUTOMATED DRIVING*, (2017), https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-2017-Informal-2e.pdf (paragraph 20 at page 4)

16 European Parliament, *Self-piloted cars: the future of road transport?* (2016); http://www.europarl.europa.eu/RegData/etudes/STUD/2016/573434/IPOL_STU(2016)573434_EN.pdf (page 54-55)

17 *See UNECE Inland Trans*port Committee, AUTOMATED DRIVING, (2017), https://www.unece.org/fileadmin/DAM/trans/doc/2017/wp1/ECE-TRANS-WP1-2017-Informal-2e.pdf (section D at pages 7-8)

18 *Id.*

19 *Id.*



Source: National Conference of State Legislatures, *Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation* (last updated June 25, 2018) (available at http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx#Enacted%20Autonomous%20Vehicle%20Legislation)

2 UNITED STATES

In the **US**, **states have been very active in promulgating AV regulations** in recent years. In 2011, Nevada became the first state to enact legislation authorizing the use of autonomous vehicles.[20] In 2012, legislation regarding AVs was introduced in six other states[21]. The momentum continued in the years that followed, and "[s]ince 2012, at least 41 states and D.C. have considered legislation related to autonomous vehicles."[22] While not all of the proposals were successful, AV legislation has been enacted in twenty-nine states,[23] and the governors of ten states—including those of several states which also adopted legislative proposals—have issued AV executive orders.[24]

State laws regulate different aspects of AVs, including definitions, insurance and liability, privacy of collected data, cybersecurity, licensing and registration, operation requirements, and platooning, among others.[25] These **regulations vary from state to state.**[26] For example, while "California, Florida, and Nevada require drivers to submit an insurance instrument, surety bond,

20 *See Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation*, National Conference of State Legislatures (last updated June 25, 2018) (available at http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx).

21 *Introduced 2012 Autonomous Vehicles Legislation*, National Conference of State Legislatures (accessed on July 2, 2018) (available at http://www.ncsl.org/Portals/1/Documents/transportation/Introduced2012AutonVehLeg.pdf).

22 *Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation*, *supra* note 20.

23 *See id.*

24 *Id.*

25 *See generally Autonomous Vehicles | Self-Driving Vehicles Enacted Legislation*, *supra* note 20.

26 *See generally id.*

or proof of self-insurance. . . . Nevada has taken a further step and crafted a licensing framework that requires operators of self-driving cars to obtain a certificate for the vehicle and a driver's license with an endorsement from Nevada's DMV."[27]

At the **federal level**, the National Highway and Transportation Safety Administration (NHTSA) issued **guidelines for states and industry for the deployment of AV** in September 2016.[28] The guidelines introduced a model state policy to "help avoid a patchwork of inconsistent laws and regulations,"[29] adopted the proposed SAE classification of AVs,[30] and discussed the respective roles of federal and state governments in the regulation of AVs.[31] In the United States, the "DOT and the Federal Government are responsible for regulating motor vehicles and motor vehicle equipment, and States are responsible for regulating the human driver and most other aspects of motor vehicle operation."[32]

In September 2017, the new administration updated these guidelines in **"Automated Driving Systems 2.0:** *A Vision for Safety,"* which focuses specifically on Automation Levels 3 through 5 (conditional automation to full automation).[33]With the old guidelines, AV companies were encouraged to submit a 15-point safety assessment to the NHTSA, which would be published after it was reviewed in a process that could take more than 6 months.[34] The new guidelines still encourage public disclosure of voluntary safety assessments (of 12 items) but specify that no federal approval is required.[35]. Also, the model state policy from old guidelines has been replaced by best practices from states.[36]

Currently, the Department of Transportation is **planning to release the 3.0 guidance update** in 2018,[37] as part of its strategy to maintain an evolving policy framework that adapts with technological developments.[38]

At the same time, the **U.S. House of Representatives and the Senate Commerce, Science, and Transportation Committee is also considering** legislation related to AVs. The **SELF DRIVE Act** passed the House in September

27 Brian A. Browne, *Self-Driving Cars: On The Road To A New Regulatory Era,* 8 Case W. Res. J.L. Tech. & Internet Article 3, 12 (2017) (available at https://scholarlycommons.law.case.edu/jolti/vol8/iss1/4/).

28 National Highway Traffic Safety Administration, *Federal Automated Vehicles Policy* (Sep. 2016).

29 *Id.* at 37 (Sep. 2016).

30 *Id.* at 9.

31 *Id.* at 38.

32 *Id.*

33 National Highway Traffic Safety Administration, *Automated Riving Systems 2.0: A Vision for Safety* at 2 (Sept. 2017).

34 National Highway Traffic Safety Administration, *Federal Automated Vehicles Policy* (Sep. 2016); https://www.hsdl.org/?view&did=795644 (page 62)

35 *See Automated Driving Systems 2.0: A Vision for Safety* at 16.

36 *Id.* at 22.

37 *See* Tanya Snyder & Lauren Gardner, POLITICO, *DOT Gets Driverless Guidance 3.0 in Gear* (Jan. 11, 2018) (available at https://www.politico.com/newsletters/morning-transportation/2018/01/11/dot-gets-driverless-guidance-30-in-gear-071076).

38 National Highway Traffic Safety Administration, *U.S. DOT Releases New Automated Driving Systems Guidance* (Sep. 12, 2017) (available at https://www.nhtsa.gov/press-releases/us-dot-releases-new-automated-driving-systems-guidance).

2017,[39] and the **AV START Act** passed the Senate Committee on Commerce, Science, and Transportation in October 2017.[40] Neither have received consideration from the full Senate.[41] Both pieces of legislation provide a regulatory regime for testing and operating AVs to **preempt any inconsistent patchwork of state regulations and avoid unnecessary burdens** on the development of AVs.[42] They both **set a cap on the number of AVs (25,000-50,000) for testing on public roads during the first year of the bills' enactment.**[43] Although the bills have many similarities, there are considerable distinctions in their original form; for example, in contrast with the SELF DRIVE ACT, the AV START Act did not apply to trucks [44] and did not specifically address privacy.[45]

The objective of these bills is mainly to facilitate the large-scale deployment of AVs for testing in a real-world environment.[46] If either of these bills become law in their current formulations, the NHTSA would be required to issue safety regulations within 2 years.[47]

The United States is also the **country with most test-beds (23 locations).**[48] One of the most prominent testing locations is known as **Mcity**, created by the **University of Michigan**, which is striving towards "**the implementation of a working system of connected and automated vehicles in Ann Arbor by 2021.**"[49]

Mcity
the University of Michigan's AV test-bed

Mcity is a public-private partnership created to research and develop AVs.[50] It includes 60 industry partners, faculty and students from University of Michigan, and federal and local governments.[51] The facility boasts a 1,500 connected vehicle environment, 40 funded research projects, and $20 million invested in R&D.[52] Mcity's research "goes beyond technology" and "consider[s] all aspects of the future of transportation and mobility, such as the impact on business, infrastructure, and society."[53] Mcity takes an interdisciplinary approach to "address social, economic, regulatory, and policy issues key to the implementation of a mobility system."[54]

50 Mcity, *Our Vision* (last visited Jun. 29, 2018), available at https://mcity.umich.edu/our-vision/.

51 *Id.*

52 *Id.*

53 *Id.*

54 *Id.*

39 *See* 163 Cong. Rec. H6677 (daily ed. Sep. 6, 2017).

40 S. Rep. No. 115-187, at 4 (Nov. 28, 2017).

41 See U.S. Congress, Leg. Actions for H.R. 3388 - SELF DRIVE Act: https://www.congress.gov/bill/115th-congress/house-bill/3388/all-actions; U.S. Congress, Leg. Actions for S. 1885 - AV START Act: https://www.congress.gov/bill/115th-congress/senate-bill/1885/all-actions?overview=-closed#tabs

42 SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf (pages 2-4) and AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (pages 44-45)

43 AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (page 54, lines 1-6) and SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf (page 16, lines 5-9). At the time of writing this paper, the number of AVs considered for testing on both bills have been reduced to 15,000 (AV START Act) and 25,000 (SELF DRIVE Act).

44 *See* definition of highly automated vehicle at AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (at page 44, lines 14-20) that establishes the limit of 10,000 pounds and SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf (at page 3, lines 1-9) that does not establish this weight limit, and thus including trucks in the regulation.

45 SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf (page 29-32) and *see* the new addition of privacy in AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (page 93-95).

46 *See* AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (page 54, lines 1-6) and SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf, (page 16, lines 5-9) where it establishes the amount of vehicles that will be exempted from the regime, preparing for a large scale deployment of AVs.

47 SELF DRIVE Act, https://www.congress.gov/115/bills/hr3388/BILLS-115hr3388rfs.pdf ("§ 30129. Updated or new motor vehicle safety standards for highly automated vehicles 3 "(a) SAFETY ASSESSMENT CERTIFICATION.— 4 "(1) FINAL RULE at page 4) and *see* AV START Act, https://www.congress.gov/115/bills/s1885/BILLS-115s1885rs.pdf (section 21)

48 KPMG International; *Autonomous Vehicles Readiness Index: Assessing countries' openness and preparedness for autonomous vehicles* (2018); https://assets.kpmg.com/content/dam/kpmg/nl/pdf/2018/sector/automotive/autonomous-vehicles-readiness-index.pdf (page 17)

49 Mcity, *Our Vision* (last visited Jun. 29, 2018), available at https://mcity.umich.edu/our-vision/

3 EUROPEAN UNION

Within the **European Commission** of the European Union, the responsibilities on AV policy are shared mainly among **5 directorate generals: DG GROW** (in charge of vehicle legislation, competitiveness of automotive sector, product liability, intellectual property, GNSS-Galileo system, etc.), **DG CONNECT** (looking for synergies with the telecommunication sector), **DG MOVE** (responsible for traffic management and road safety), **DG RTD** (facilitating research into AVs and funding) and **CLIMA** (promoting sustainability).[55]

In April 2016, 28 Member States of the **European Union** signed the **Amsterdam Declaration** with an objective of "work[ing] towards a coherent European framework for the deployment of interoperable connected and automated driving, which should be available, if possible, by 2019."[56] With this objective in mind, member states urged the European Commission to develop a European strategy on AVs.[57]

The European Commission then issued a Communication on "Cooperative Intelligent Transport Systems,"[58] which the group described as "an important milestone in creating a European strategy for the deployment of cooperative, connected and automated vehicles, as called for in the Declaration of Amsterdam."[59] The strategy aims at "ensur[ing] synergies and coherence between ongoing and future initiatives" regarding AV deployment.[60] This strategy builds on the EU's past efforts, including funding that it has provided and over 15 years of research on Intelligent Transport Systems.[61] The **H2020** fund and the Trans-European Transport Network strategy (with its financial instrument, Connecting Europe Facility) will continue supporting AV research and development.[62]

55 *Automated Driving Roadmaps Overview*, http://brk.mn/1em, 3.

56 Declaration of Amsterdam: Cooperation in the Field of Connected and Automated Driving at I(a) (Apr. 14-15, 2016) (available at https://www.regjeringen.no/contentassets/ba7ab6e2a0e14e39baa77f5b76f59d14/2016-04-08-declaration-of-amsterdam---final1400661.pdf).

57 *Id.* at IV(a).

58 European Commission, *A European Strategy on Cooperative Intelligent Transport Systems* (Nov. 30, 2016) (available at https://ec.europa.eu/transport/sites/transport/files/com20160766_en.pdf).

59 *Id.* at 12.

60 *Id.*

61 *Id.* at 4.

62 European Commission, *On the road to automated mobility: An EU strategy for mobility of the future* (2018) https://ec.europa.eu/transport/sites/transport/files/3rd-mobility-pack/com20180283_en.pdf (page 6) and Innovation and Network Executive Agency, https://ec.europa.eu/inea/en/horizon-2020/automated-road-transport

Member states are also working to harmonize internal market regulations to accommodate AVs.[63] In addition, they seek to update the United Nation's **Vienna** and **Geneva Conventions on Road Traffic** that currently require a human driver to sit behind the wheel.[64]

At the **public policy level**, the European Parliament has asked the European Commission to prioritize the deployment of AVs.[65] Per the 2017 **Commission Work Program, "the Commission will continue working on the regulatory environment, ecosystem-building, resource efficiency, and standardization to facilitate the market introduction of increasingly efficient cooperative, connected and automated vehicles."**[66] In addition, **GEAR 2030, "a High Level Group set up [in] October 2015 to look at the future of the automotive sector,"** brings together member states, industry stakeholders, and members of the European Commission with a goal of developing AV policy recommendations.[67]

Through the **European Council**, the different Presidencies are helping to coordinate AV policy among member states within this European strategy. For example, during the last half of 2017, the Estonian Presidency worked on Council Conclusions on the digitalization of EU transport sector to improve its efficiency.[68] Also, a series of **High-Level Dialogues on Connected and Automated Driving** are taking place, during which member states, the European Commission, industry, and other stakeholders share their views, concerns, and objectives for advancing the deployment of these technologies and develop common action plans.[69]

These dialogues facilitate the exchange of member states' experiences with their specific initiatives. For instance, in June 2017, **Germany** issued a regulatory framework for self-driving cars that allows AV testing on public roads (to be reviewed in 2 years), as well as a report that provided "[e]thical rules for automated and connected vehicular traffic."[70] In 2013, Germany's Federal Ministry

63 European Commission, *Connected and automated mobility in Europe*; https://ec.europa.eu/digital-single-market/en/connected-and-automated-mobility-europe

64 European Parliament, *Self-piloted cars: the future of road transport?* (2016); http://www.europarl.europa.eu/RegData/etudes/STUD/2016/573434/IPOL_STU(2016)573434_EN.pdf (page 55) and Government of the Netherlands Official Webpage, *On our way towards connected and automated driving in Europe,* https://www.government.nl/documents/leaflets/2017/05/18/on-our-way-towards-connected-and-automated-driving-in-europe (page 3)

65 European Parliament, *A common EU approach to liability rules and insurance for connected and autonomous vehicles*, (2018), http://www.europarl.europa.eu/RegData/etudes/STUD/2018/615635/EPRS_STU(2018)615635_EN.pdf.

66 *A European Strategy on Cooperative Intelligent Transport Systems* at 4-5.

67 *Id.* at 4.

68 Council of the European Union, *Council conclusions on the digitalization of transport* (December 5th, 2017); http://data.consilium.europa.eu/doc/document/ST-15431-2017-INIT/en/pdf

69 See, e.g., High Level Structural Dialogue, *Action Plan of Connected and Automated Driving* (2017); https://www.bmvi.de/SharedDocs/EN/Documents/DG/action-plan-automated-and-connected-driving.pdf?__blob=publicationFile

70 German Federal Ministry of Transport and Digital Infrastructure Ethics Commission, *Report: Automated and Connected Driving* (June 2017) (available at https://www.bmvi.de/SharedDocs/EN/Documents/G/ethic-commission-report.pdf?__blob=publicationFile).

of Transport also created "the 'Automated Driving' Round Table, an advisory body that enables a close exchange of ideas and experiences among stakeholders from industry, academia, associations and public administration and pools the required know-how in such a way that a broad-based social consensus can be achieved" on issued related to autonomous vehicles.[71]

The **UK's Department of Transport** has "determined that it is legal for driverless cars to operate on any public roads without permits or extra insurance."[72] Additionally, the UK has also created a "Center for Connected and Automated Vehicles"[73] and issued a guidance document on "[t]he key principles of vehicle cyber security for connected and automated vehicles."[74]The UK government aims to have "driverless cars on British roads by 2021 and plans to make further changes to regulations to support this."[75]

Latvia is also reviewing legislation that would allow test vehicle research and public road testing in a public-private partnership.[76]

71 German Federal Ministry of Transport and Digital Infrastructure, *Automated and Connected Driving* (accessed July 3, 2018) (available at https://www.bmvi.de/EN/Topics/Digital-Matters/Automated-Connected-Driving/automated-and-connected-driving.html).

72 KPMG, *Autonomous Vehicles Readiness Index* at 21 (2018) (available at https://home.kpmg.com/xx/en/home/insights/2018/01/2018-autonomous-vehicles-readiness-index.html).

73 *Id.*

74 UK Department of Transport, *Guidance: The Key Principles of Vehicle Cyber Security for Connected and Automated Vehicles* (Aug. 6, 2017) (available at https://www.gov.uk/government/publications/principles-of-cyber-security-for-connected-and-automated-vehicles/the-key-principles-of-vehicle-cyber-security-for-connected-and-automated-vehicles).

75 KPMG, *supra* note 72, at 21.

76 *Latvia is staking its place as a hub for autonomous car testing in Europe*, http://tech.eu/features/15574/latvia-autonomous-car-europe/

German Ethics Commission's Report on Automated and Connected Driving

In **June 2017**, the German Federal Ministry of Transport and Digital Infrastructure released the **world's first report on ethical rules for automated and connected driving**, focusing on levels 4 and 5 of automation.[77] The **Ethics Commission on Automated and Connected Driving**, which prepared the report, started its work in September 2016, and includes experts on philosophy, law, sociology, technology, and the automotive industry.[78]

The report states **20 ethical rules.**[79] For example, in the case of an unavoidable accident with a "trolley dilemma", **human life is protected above all other interests**, such as animals or property.[80] The rules also **prohibit selecting humans** based on their personal features (e.g. age, gender, physical or mental state) and comparing victims to each other, but it may allow programming to minimize the number of injuries, following the general principle of damage minimization.[81] In addition, the rules establish the principle of **not sacrificing those who are not involved** in the risky activity (i.e. activating an AV),[82] although it does not mandate subordinating the principle of self-protection to the protection of innocent parties.[83]

Other ethical rules refer to the primary objectives of AV systems: improving safety for all users,[84] increasing mobility opportunities,[85] respecting personal autonomy,[86] being transparent about the deployment and programming of AVs,[87] and educating society on the proper handling of AVs.[88]

Beyond ethical rules, the Commission's report reflects on and raises **other important issues.** For example, should the use of fully autonomous vehicles should be mandatory, as they increase road safety?[89] In conditionally automated driving (level 4), should the freedom of the driver to retake control of the AVs be ruled out in favor of safety, despite reducing human autonomy?[90] Is a total connectivity of infrastructure appropriate and ethically justifiable, when it means centralizing all traffic management, and maybe leading to a total surveillance state of all road users?[91]

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77 Federal Ministry of Transport and Digital Infrastructure, *ETHICS COMMISSION ON AUTOMATED AND CONNECTED DRIVING*, (June 2017); https://www.bmvi.de/SharedDocs/EN/publications/report-ethics-commission.pdf?__blob=publicationFile, 14.

78 *Id.* at 7

79 *See* German Federal Ministry of Transport and Digital Infrastructure Ethics Commission, *supra* note 77.

80 *Id.* at 7 (rule 7).

81 *Id.* (rule 9).

82 *Id.*

83 *Id.* at 19

84 German Federal Ministry of Transport and Digital Infrastructure Ethics Commission, *supra* note 77, at 1 (rule 1).

85 *Id.*

86 *Id.*

87 *Id.* at 8 (rule 12).

88 *Id.* at 9 (rule 20).

89 *See id.* at 5; *see also id.* at 7 (rule 6).

90 *See id.* at 7 (rule 6).

91 *Id.* at 8 (rule 13).

4 SINGAPORE

Singapore stands out for the high priority that its government placed on the deployment of AVs in its **"Smart Nation" strategy**. Singapore is facing increasing travel demands, land constraints that complicate the expansion of road infrastructure, an aging population, and a shortage of bus drivers.[92] The Singapore Strategy seeks to **promote public transportation, on-demand transportation services, and car-sharing schemes**, using AVs to optimize road capacity and increase safety.[93]

As part of Singapore's AV strategy, the government has created the **Singapore AV Initiative (SAVI)**—a partnership between the Land Transport Authority and A*STAR (Agency for Science, Technology, and Research), the top agency for R&D in Singapore—"to provide a technology platform . . . to oversee and manage research and development and test-bedding of AV technology, applications and solutions for industry partners and stakeholders.[94] In 2014, the government formed the Committee on Autonomous Road Transport for Singapore[95] to **"holistically chart the strategic direction for AV-enabled land mobility concepts in Singapore."**[96] In 2017, an amendment nation's Road Traffic Act empowered the Land Transport Authority to establish rules for testing AVs and grant exemptions that would **allow AV testing on public roads.**[97]

The *Autonomous Vehicles Readiness Index* report noted "the entire city-state of Singapore is effectively a test area for AVs, meaning all residents may see the technology in development," and "research suggests they are more open to the technology than many other countries."[98]

92 Alan Quek, *Singapore Autonomous Vehicle Initiative (SAVI)* (presentation) at slide 4, Singapore Land Transport Authority (2017) (available at https://www.itu.int/en/ITU-T/extcoop/cits/Documents/Workshop-201707-Singapore/010%20-%20Alan-Quek-Singapore%20Autonomous%20Vehicle%20Initiative%20%28SAVI%29.pdf).

93 *Id.* at slides 5-6

94 Press Release, A SAVI Step Towards Autonomous Transport, Singapore Land Transport Authority & Singapore Agency for Science, Technology and Research (Aug. 27, 2017) (available at https://www.a-star.edu.sg/News-and-Events/News/Press-Releases/ID/3235).

95 Quek, *supra* note 92, at slide 7

96 *A SAVI Step Towards Autonomous Transport, supra* note 94.

97 *See Regulations in Place to Ramp up Driverless Vehicle Trials in Singapore, Channel News Asia (Feb. 7, 2017) (available at https://www.channelnewsasia.com/news/singapore/regulations-in-place-to-ramp-up-driverless-vehicle-trials-in-sin-7622038).*

98 KPMG, *supra* note 72, at 15.

5 JAPAN

Japan had in **more patents on AV technology per capita than any other country considered by KPMG in their** *Autonomous Vehicles Readiness Index* **report.**[99] Additionally, the country has received "high ratings for its road infrastructure" and boasts "4G network availability second only to South Korea."[100] Although some expect AVs to help Japan's elderly population by reducing the increased number of car accidents in which they are involved,[101] "its consumers are among the most cynical regarding AV technology and very few live-in test cities, contributing to its bottom-five ranking for consumer acceptance."[102]

To boost the development of the technology, the government is working to pass the **necessary AV legislation by 2019.**[103]In addition, the Japanese Prime Minister listed artificial intelligence and AVs as **key innovations for economic growth.**[104]

Japan is aiming to have self-driving taxis on the road for the **Olympics in 2020.**[105]

In pursuit of these goals, the Japanese government has partnered with Dynamic Map Planning to create **3D maps of the nation's roadways,** and build the digital infrastructure needed for AVs to circulate in Tokyo.[106] The high-definition 3D maps will include road signs, traffic lights, and pedestrian crossings, which, combined with information from the vehicle's sensors,—will enable vehicles to operate with greater precision,[107] and could help in cases where, for example, a sign happens to be blocked by a tree or a pedestrian. The initial **3D-mapping effort will cover 300 km of expressways.**[108]

99 *See id.* at 27.

100 *Id.*

101 *See id.*

102 *Id.*

103 *A Global Race for Autonomous Vehicles: Views From The United States, Europe, And Asia,* FTI Consulting (June 2, 2017) (available at http://fticommunications.com/2017/06/global-race-autonomous-vehicles-views-united-states-europe-asia/).

104 *Id.*

105 *Id.*

106 Janet Burns, *Japan's Leaders Want To Make Tokyo A Self-Driving City For 2020 Olympics,* Forbes (Sep. 8, 2016) (available at https://www.forbes.com/sites/janetwburns/2016/09/08/japanese-leaders-aim-to-make-tokyo-a-self-driving-city-for-2020-olympics).

107 *Japan to Develop 3-D Maps for Self-Driving Cars,* Nikkei Asian Review (Sep. 5, 2016) (available at https://asia.nikkei.com/Business/Biotechnology/Japan-to-develop-3-D-maps-for-self-driving-cars).

108 *Id.*

6 SOUTH KOREA

The South Korean government's strategy involves **investing in infrastructure for AVs.** In KPMG's *Autonomous Vehicles Readiness Index* report, South Korea was rated as having the best 4G network coverage of the countries considered.[109] Additionally, the South Korean government has opened more than 300 kilometers of the country's roads to research-licensed companies for AV testing.[110] In 2017, South Korea's Ministry of Land, Infrastructure, and Transport devoted $24.5 million to building AV infrastructure.[111] Furthermore, South Korea is developing **"K-City," one of the largest test beds for AVs,** which will try to simulate real-world conditions on its 3.45 million square feet.[112] The K-City complex is "slightly smaller than Vatican City" and "nearly three times the size of its U.S. equivalent," the University of Michigan's Mcity.[113]

The complex recently opened a four-lane highway section, which will be followed by "downtown areas, city outskirts, and communal environments" with potholes, construction areas, and toll gates.[114]The **full facility is expected to be operational by end of 2018.**[115] A Korean telecommunications company has built a high-speed 5G network and control center, that reportedly "exchanges data with test vehicles in 0.001 seconds," to serve in K-City.[116] The K-City project was launched in support of the government's goal of commercializing **Level 3 AVs by 2020.**[117] K-City is located 20 miles away from Seoul[118] and has cost around $10 million USD.[119]

The government also used the **2018 Winter Olympics** as an opportunity to boost public acceptance of AVs by employing autonomous shuttle services around the stadium.[120]

109 *See* KPMG, *supra* note 72, at 26.

110 Jie Ma & David Welch, *Self-Driving Cars Find Clearer Paths in Europe*, Bloomberg (May 14, 2018) (available at https://www.bloomberg.com/news/articles/2018-05-14/california-arizona-may-get-lapped-by-asia-in-self-driving-race); KPMG, *supra* note 72, at 26.

111 Elaine Ramirez, *How South Korea Plans To Put Driverless Cars On The Road By 2020,* Forbes (Feb. 7, 2017) (available at https://www.forbes.com/sites/elaineramirez/2017/02/07/how-south-korea-plans-to-put-driverless-cars-on-the-road-by-2020/)

112 Trevor Mogg, *Driverless Cars Are Now Tootling Around Their Own 'City' in South Korea,* Digital Trends (Nov. 7, 2017) (available at https://www.digitaltrends.com/cars/driverless-cars-k-city-south-korea/).

113 Will Sabel Courtney, *South Korea Building an Entire Town for Testing Self-Driving Cars*, The Drive (May 9, 2017) (available at http://www.thedrive.com/tech/10106/south-korea-building-an-entire-town-for-testing-self-driving-cars).

114 Mogg, *supra* note 112.

115 *See id.*

116 Michael Herh, *World's First 5g Autonomous Driving Test Bed Created*, Business Korea (Dec. 29, 2017) (available at http://www.businesskorea.co.kr/news/articleView.html?idxno=20198)

117 *South Korea to Open Test Center for Autonomous Cars Next Year*, Korea Herald (May 21, 2017) (available at http://www.koreaherald.com/view.php?ud=20170521000156).

118 Mogg, *supra* note 112.

119 *Korea Partially Opens Test Bed Road for Autonomous Vehicles*, Korea Herald (Nov. 6, 2017) (available at http://www.koreaherald.com/view.php?ud=20170521000156).

120 *See* Pietro Decristofaro & Youkyung Lee, Associated Press, *Pyeongchang Olympics Showcases Korean Self-Driving Vehicles*, Chicago Tribune (Feb. 19, 2018) (available at http://www.chicagotribune.com/business/sns-bc-as--skorea-olympics-autonomous-driving-20180215-story.html); KPMG, *supra* note 72, at 26.

7 CHINA

China has ambitious plans regarding AV deployment, hoping that **10% of the cars sold will be fully autonomous by 2030**.[121] "Recent work has included a rapid development of sensor technology, optimized chips for AV, artificial intelligence in computer vision, voice recognition and routes planning, and vehicle-to-everything (V2X) communications." [122] It is also developing strong industry partnerships.[123] However, it still can improve its roads and technology infrastructure, which have received poor ratings.[124]

The Chinese government is also starting to introduce **modifications to existing regulations**, which currently limit AV deployment.[125] For instance, Chinese regulations required maps to be less precise than 50 meters, prohibited AV testing on public roads, and required both of a driver's hands to be on the steering wheel.[126]

As Chinese companies are developing open platforms for AV deployments (e.g. Baidu's Apollo Initiative) and academies for research (Alibaba's DAMO academy), the government is seriously considering regulatory changes.[127] As an example, in April 2018, the Chinese Government established the first guidelines to for AV testing.[128] These would increase Chinese companies' competitiveness in the global market.

121 Michael J. Dunne, *China Aims to Be No. 1 Globally in EVs, Autonomous Cars By 2030*, Forbes (Dec. 14, 2016) (available at https://www.forbes.com/sites/michaeldunne/2016/12/14/chinas-automotive-2030-blueprint-no-1-globally-in-evs-autonomous-cars/).

122 KPMG, *supra* note 72, at 32.

123 *See id.*

124 *See id.*

125 Twinnie Siu, Reuters, China issues first licenses to road test driverless vehicles (March 1st, 2018) https://www.reuters.com/article/us-china-autos-selfdriving/china-issues-first-licenses-to-road-test-driverless-vehicles-idUSKCN1GD5AW

126 KPMG, *supra* note 72, at 32.

127 Yue Wang, Forbes (Nov 22nd, 2017) https://www.forbes.com/sites/ywang/2017/11/22/why-chinas-baidu-could-beat-google-in-the-race-for-self-driving-cars/#6719bbf35f98

128 Adam Jourdan, Reuters (April 13th, 2018) https://www.reuters.com/article/us-autos-selfdriving-china/china-lays-out-self-driving-rules-in-global-race-china-daily-idUSKBN1HK04J

Apollo 2.0 open-source autonomous vehicle platform

Baidu's Apollo was "designated as the **national self-driving platform by China's government.**"[129] Apollo is an **open platform that allows "its partners to develop their own autonomous driving systems** through on-vehicle and hardware platforms."[130] It provides high-definition map service, "the only open Autonomous Driving simulation engine," and a deep learning algorithm.[131] The open platform "accelerates the development, testing, and deployment of Autonomous Vehicles" and evolves faster than closed systems—"[a]s participation grows, more accumulated data becomes available."[132]

Apollo was created in April 2017.[133] In January 2018, it had its first update: **Apollo 2.0.**[134] "The newly updated system boasts added security and more robust positioning, control and cloud simulation capabilities... Apollo 2.0 is no capable of autonomously guiding a vehicle through basic urban environments, even at night."[135] The company future plans include to "gradually introducing fully autonomous driving capabilities on highways and open city roads by 2020."[136] The initiative engages more than 90 partners,[137] including Bosch, Ford, Microsoft, Nvidia, Tomtom, and Hyundai.[138]

Baidu has partnered with Chinese bus manufacturer Kim Long "to begin mass-producing driverless buses" (level 4) with Apollo software by August 2018.[139] Baidu is also collaborating with car manufacturers to develop autonomous vehicles (level 3) with Apollo software by 2020.[140]

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129 Alan Ohnsman, *What I Learned About Self-Driving Cars at CES*, Forbes (Jan. 10, 2018) (available at https://www.forbes.com/sites/alanohnsman/2018/01/10/what-i-learned-about-self-driving-cars-at-ces-psst-theyre-almost-here/).

130 Apollo open platform project, Official Website, http://apollo.auto/ (last accessed July 3, 2018).

131 *Id.*

132 *Id.*

133 Emma Lee, *Baidu Launches Open Platform Project Apollo to Speed Up Self-Driving Car Development*, TechNode (Apr. 19, 2017) (available at https://technode.com/2017/04/19/baidu-launches-open-platform-project-apollo-to-speed-up-self-driving-car-development).

134 Nicole Jao, *Baidu Unveils Apollo 2.0 at CES 2018*, TechNode (Jan. 9, 2018) (available at https://technode.com/2018/01/09/baidu-unveils-apollo-2-0-at-ces-2018-more-mapping-more-test-drives-and-udacity-partnership/).

135 Andrew Tarantola, *Baidu Debuts its Apollo 2.0 Autonomous Driving Platform*, Engadget (Jan. 8, 2018) (available at https://www.engadget.com/2018/01/08/baidu-apollo-2-autonomous-driving-platform/).

136 *Baidu to launch self-driving car technology in July*, Reuters (Apr. 18, 2017) (available at https://www.reuters.com/article/us-baidu-autonomous-idUSKBN17L05K).

137 Tarantola, *supra* note 135.

138 Apollo open platform project, Official Website, http://apollo.auto (last accessed July 3, 2018).

139 Tarantola, *supra* note 135.

140 *Id.*

8 NEW ZEALAND

New Zealand is starting to be considered a testing-site of new technologies.[141] In its 2014 **Intelligent Transport Systems Technology Action Plan**, the government specifically refers to AVs and commits to reviewing existing transportation regulations related to AVs.[142]

The New Zealand Transport Agency is **supporting companies' AV testing** and making the process as easy to follow as possible.[143] It has put in place a **6-step testing process**: 1) contact the Transport Agency for a support manager, 2) determine the AV requirements and certification steps, 3) determine the license class for the operator, 4) submit a safety plan for on-road testing activities, 5) apply for trade plates, and 6) start testing.[144] The government has not limited the areas where AV testing can take place.[145] Still, those testing AVs on public roads are responsible for preserving safety of society and not interfere with traffic flow.[146]

In addition, New Zealand's current **regulatory framework presents "no obvious legal barriers** to deploying autonomous vehicles for testing as there are no existing NZ provisions that require a vehicle to have a driver."[147] Also, New Zealand offers different road conditions and a **wide range of climate** that make the country suitable for testing.[148]

Trials on AV electric shuttles have already started on the private roads of Christchurch International Airport, Sydney's Olympic Park, and Melbourne's La Trobe University.[149] The university trial is testing "the use of an autonomous vehicle as a 'Last Mile' solution, transferring students and University staff around the campus, between bus and tram transport hubs and campus sites."[150]

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141 Intelligent Transport Systems Technology Action Plan 2014-18 at 10, New Zealand Ministry of Transport (May 2014); KPMG, *supra* note 72, at 25.

142 *See* Intelligent Transport Systems Technology Action Plan 2014-18 at 10, New Zealand Ministry of Transport (May 2014)

143 *Testing Autonomous Vehicles in New Zealand*, NZ Transport Agency website (last accessed Jul. 5, 2018) (available at https://nzta.govt.nz/vehicles/vehicle-types/automated-and-autonomous-vehicles/testing-autonomous-vehicles-in-new-zealand/)

144 *Id.*

145 *Id.*

146 *Id.*

147 Autonomous including driverless vehicles, NZ Ministry of *Transport (Jul. 10, 2016) (available at* https://www.transport.govt.nz/multi-modal/technology/specific-transport-technologies/road-vehicle/autonomous-vehicles/).

148 *Testing Autonomous Vehicles in New Zealand*, *supra* note 143.

149 *HMI Technologies Automated Vehicle Trials and Deployment*, HMI Technologies, Official Website (accessed Jul. 5, 2018) (available at https://www.hmi.co.nz/en/automated-vehicles).

150 *Id.*

CONCLUSION

Autonomous vehicles are gaining the attention of industry, governments, academia, and civil society. While the technology has the potential to produce many benefits for society, it also poses challenges that regulators and policymakers should consider.

Learning from one another's experiences and strategies can help governments to accelerate the design of better AV policies.

In this paper we explored some of the AV strategies and initiatives that governments are taking to navigate the challenges of AVs and reach their full potential. These initiatives reveal some of the trends within public policy and regulatory efforts of AVs, such as:

Aiming to solve a wide range of problems. Governmental efforts to adopt AVs are driven by a range of motivations, for example, a lack of taxi and bus drivers; the challenges to mobility faced by an increasingly aging population; and road safety.

Harmonizing and clarifying AVs legal frameworks. Governments aim to harmonize the legal patchwork that exists among local, regional, national, and international level regulations that could hamper the development of AVs.

Coordinating processes and actions with stakeholders. Governments' efforts also look at coordinating their actions with different stakeholders. This often includes establishing public-private partnerships, collaborating with different states/regions, or creating a specialized body to coordinate governmental actions.

Promoting the development of the technology. Some governments specifically support the testing and developing of technology for AVs by, for instance, promoting test beds, 3D mapping activities, and open software for AVs.

Producing knowledge about the impact of the technology. Governments also are creating specific centers of research on AVs and their impacts on society, the economy, and norms.

Caring about ethical aspects of the technology. Governments are also becoming more concerned about the ethical challenges that autonomous systems are generating, and they are working on developing rules and standards that could serve as ethical guidelines when deploying these technologies.

ABOUT THIS POLICY PRIMER

Regulators and policymakers are increasingly involved in making decisions about policies and regulations related to automated vehicles (AVs). AVs, however, are a complex technology, and their impacts go further than the first apparent safety and security issues. They have the potential to affect privacy, accessibility, the environment, and land management, among other areas.

Governments should work quickly and proactively to develop an understanding of the potential impacts of AV technology, as this will allow them to design policies that seize the benefits of this technology while avoiding unintended and undesired consequences.

However, when working proactively—before a problem becomes apparent—governments face the challenge of deciding which policy action should be taken to avoid a problem that may not yet exist; this task is particularly difficult when dealing with complex technologies like AVs. Learning from one another's experiences can help with this problem. The sharing of knowledge among governments about the successes and failures of various approaches can accelerate the development of better AV policies. It can also shorten the timeline of the technology's deployment because it avoids the use of isolated trial-and-error techniques that require a lot of time and effort.

This policy brief explores some of the AV strategies and initiatives that governments are taking to navigate the challenges of AVs and while attempting to harness their full potential. This document aims to inform policymakers on a number of initiatives and international trends in AV policy and regulation so that they can select and investigate further the specific experiences they may be interested in. It intends to bridge the information asymmetries that exist between policymakers and technologists. It also aims to help policymakers create more effective policies and regulations by expanding their governance toolbox

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ADDITIONAL READINGS

For further information about AVs and their technical issues, threats and opportunities, and potential tools to address their regulatory challenges, regulators and policymakers can access the following complementary policy papers of the series:

Five Technological Factors Regulators and Policymakers Need to Know, which presents the basics of the technology and current policy discussions.

A Smart Move? Twenty-Four Essentials of a SWOT Analysis Policymakers Need to Consider, which analyzes some of the governments' most relevant strengths, weaknesses, opportunities, and threats (SWOT analysis) in relation to AVs that could help them design better fitted and more comprehensive public policies.

Three Practical Tools to Help Regulators Develop Better Laws and Policies, which analyzes some of the types of AV regulatory challenges and provides three practical tools that policymakers and regulators can use to develop better AV policies and expand their set of instruments to govern the technology: Legal Interfaces, Law Labs, and structured dialogues.