# Autonomous Vehicles Primer

As the voice of the electric car driver, Plug In America views the advancing autonomous vehicle (AV) market as one part of the future of transportation, in addition to electric vehicles and shared mobility options and programs. AVs are a growing technology that consumers, policymakers and regulators should be aware of as a viable transportation option as the market develops. This primer is intended to provide more information on AVs and to highlight the Plug In America principle that **all AVs should be electric vehicles (EVs)**.

What is an autonomous vehicle?

An AV has advanced technology that allows the vehicle to drive without human control. Through the use of Light Detection and Ranging (LiDAR), cameras and digital mapping, the technology can create a safer and more efficient form of transportation. The National Highway Traffic Safety Administration (NHTSA) separates the technology into 6 different levels of autonomy, varying from level 0, where the human driver has full control of the vehicle's functions, to level 5, where the vehicle can drive itself without a human.[1,2]
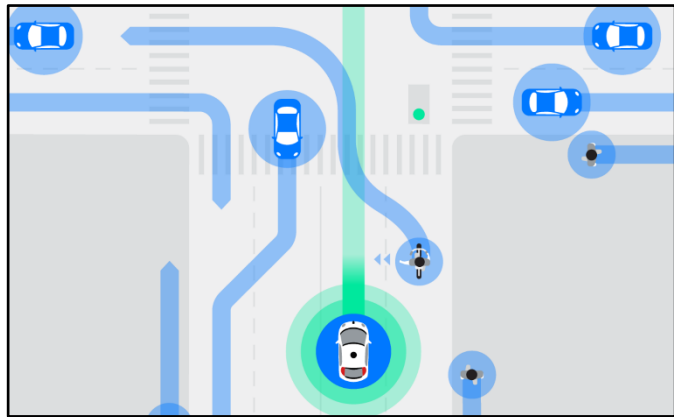
A graphic depicting the Google Waymo AV technology. Graphic credit: Waymo.com.

How are AVs refueled?

To be fully autonomous and have no human interference, wireless electric vehicle charging is the only available option for refueling AVs. Some AVs on the road today are powered by gasoline and some are battery EVs that are charged via human help connecting the vehicle plug to the electricity source. However, the Society of Automotive Engineers International is developing the J2954 standard for wireless charging to allow easy charging of AVs at various levels of EV charging stations without complications or incompatibilities.[3]

What does AV technology have to do with EV technology?

As noted above, **to be fully autonomous with no human interference, AVs must be EVs**. As both technologies develop further and experience widespread consumer adoption, the two technologies are likely to converge. Consumer adoption of EVs is accelerating due to battery costs declining, consumer education and awareness, and also supportive policies in many states. Therefore, since AVs are a few years behind EVs, when AVs are ready to be mass marketed the EV technology will be the best technology to choose and will already be widely accepted by consumers.[4] In addition, the convergence of AVs, EVs and transportation service providers will together likely create a disruptive synergy that will transform the transportation sector.[5]

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[1] http://www.rand.org/content/dam/rand/pubs/research_reports/RR400/RR443-2/RAND_RR443-2.pdf
[2] https://one.nhtsa.gov/nhtsa/av/av-policy.html
[3] http://insideevs.com/wireless-charging-autonomous-electric-cars/
[4] http://blog.luxresearchinc.com/blog/2016/09/six-reasons-why-electric-vehicles-and-autonomous-vehicles-will-inevitably-merge/
[5] http://www.slate.com/articles/technology/future_tense/2016/06/driverless_electric_shared_cars_will_revolutionize_our_transportation_system.html
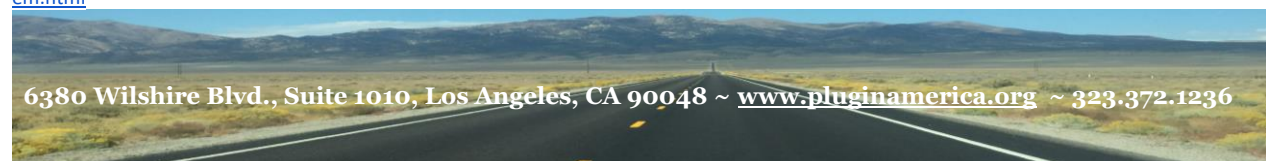
Who has one in the market?

Currently, there are no vehicles on the market that are fully autonomous (SAE level 5), however the technology is growing and many automakers are partnering with technology and carsharing companies to develop a new fleet of AVs. Car companies like Tesla and GM already have vehicles that exhibit level 2-3 self-driving capabilities and are testing higher level AV functions in public streets. Other auto companies have announced plans to release fully autonomous vehicles by the year 2021, including Ford and BMW.[6,7]

How are these vehicles regulated in terms of safety and testing procedures?

There are 13 states that have passed legislation regarding AVs, safety and testing procedures, and many states are currently introducing similar legislation.[8] In September 2016, NHTSA updated their guidance on the safe development of highly autonomous vehicles, including vehicle performance guidelines, model state policy, current regulatory tools and possible new regulatory actions. NHTSA also included a set of 15 best practices to help AV manufacturers and technology developers ensure safe pre-deployment design and testing before operating on public roads or beginning commercial sales.[9]

Which cities are looking at AVs?

Many cities are already preparing for the emergence of AV technology, and some have even taken actions to be the testing grounds for these vehicles. Some of the leading cities with AVs include:

- Los Angeles, California- One of the main strategies within the "Urban Mobility in the Digital Age" report and plan for the city is to prepare for an automated future.[10] The report includes policy plans and both short-term and long-term goals for the development and deployment of AVs within Los Angeles. Some of these goals include launching an AV pilot program and developing an AV network that incentivizes sharing of the vehicles.
- Orlando, Florida - The city has already passed many supportive laws on AVs and has partnered with local academic, private sector and government agencies to form the Central Florida Automated Vehicle Partnership.[11] In addition, Orlando was chosen by the Department of Transportation (DOT) as one of ten designated Automated Vehicle Proving Grounds, in which the chosen groups share best practices for safe testing and deployment.[12]
- Pittsburgh, Pennsylvania - The city of Pittsburgh has attracted both Uber and Ford Motors to invest and partner with the city to accelerate the development of AVs.[13] Pittsburgh was also named one of the Automated Vehicle Proving Grounds, furthering their position as a leader in embracing AV technology.

Are AVs growing in the global market?

Multiple city centers and car manufacturers across the world are joining the race toward AV deployment. In Tokyo, the Japanese government and business leaders are looking to transform the

[6] https://corporate.ford.com/innovation/autonomous-2021.html
[7] https://techcrunch.com/2017/03/16/bmws-self-driving-car-will-aim-for-full-level-5-autonomy-by-2021/
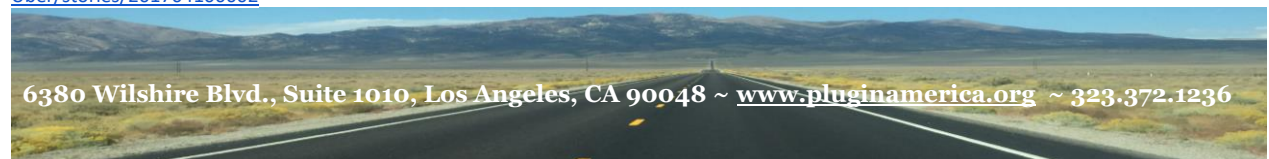[8] http://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx
[9] https://www.nytimes.com/2016/09/21/technology/the-15-point-federal-checklist-for-self-driving-cars.html
[10] http://www.urbanmobilityla.com/strategy/#
[11] https://qz.com/935963/orlando-aims-to-to-be-the-world-capital-for-self-driving-cars-by-clearing-the-way-for-autonomous-vehicles-on-its-streets/
[12] http://www.cityoforlando.net/news/2017/01/the-city-of-orlando-forms-partnership-to-seek-national-automated-vehicle-designation/
[13] http://www.post-gazette.com/local/city/2017/04/10/Driverless-cars-Pittsburgh-Ford-autonomous-car-Uber-self-driving-vehicle-Bill-Peduto-Uber/stories/201704100002

transportation sector in time for the 2020 Summer Olympic Games by integrating AVs.[14] A global startup company, NIO, has announced plans to release a fully AV to the US market by 2020.[15] South Korea is opening an 88-acre facility with road and parking features modeled after the city and suburban areas in order to allow for more rigorous and comprehensive testing without endangering the public.[16]

Are AVs safe?

In a survey conducted by the American Automobile Association (AAA) in 2017, about 78% of Americans are afraid of riding in a fully automated vehicle even though 59% want autonomous vehicle technology included as part of their next vehicle purchase.[17] Another study conducted across several countries found that the majority of consumers felt that fully AVs would not be safe, with percentages ranging from 62% to 81% depending on the country.[18]

However, according to NHTSA, 94% of car crashes are due to human error.[19] Additionally, the AAA Foundation for Traffic Safety found that 80% of drivers expressed significant aggression and road rage while driving, and in 2015 29% of traffic fatalities were due to alcohol-impaired driving and 10% to distracted driving.[20] The rising AV technology has the potential to save over 30,000 people each year who die from these fatalities or injuries caused by car accidents.

How far away is this technology?

The rapid action of legislators, technology companies and car manufacturers to create the proper environment that will allow for the development and deployment of AVs demonstrates how quickly the technology is evolving. A May 2017 report by an independent research group, ReThinX predicted that by 2030 and within 10 years of regulatory approval of fully autonomous vehicles, 95% of all U.S. passenger miles will be through fleets of AVs operating as transportation service providers.[21] However, this is just one prediction among many, with varying degrees of adoption.

About Plug In America

Plug In America is the nation's leading independent consumer voice for accelerating the use of plug-in electric vehicles in the United States to consumers, policymakers, auto manufacturers and others. Formed as a non-profit in 2008, Plug In America provides practical, objective information collected from our coalition of plug-in vehicle drivers, through public outreach and education, policy work and a range of technical advisory services. Our expertise represents the world's deepest pool of experience of driving and living with plug-in vehicles. The organization conceived National Drive Electric Week and has advanced workplace charging by pioneering ride-and-drive events at such leading corporations as Google, Mattel and Paramount Pictures. We drive electric. You can too. pluginamerica.org

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[14] https://www.forbes.com/sites/janetwburns/2016/09/08/japanese-leaders-aim-to-make-tokyo-a-self-driving-city-for-2020-olympics/#5242f26c1090

[15] https://www.theverge.com/2017/3/12/14898428/autonomous-car-start-up-nio-unveiled-self-driving-concept-vehicle-sxsw

[16] https://www.engadget.com/2017/05/09/korea-is-building-a-city-for-self-driving-cars/

[17] http://newsroom.aaa.com/2017/03/americans-feel-unsafe-sharing-road-fully-self-driving-cars/

[18] https://www2.deloitte.com/us/en/pages/about-deloitte/articles/press-releases/deloitte-study-future-of-autonomous-vehicles-in-minds-of-consumers.html

[19] https://www.nhtsa.gov/technology-innovation/automated-vehicles

[20] http://adage.com/article/digitalnext/driving-cars-safe/308673/

[21] https://static1.squarespace.com/static/585c3439be65942f022bbf9b/t/590a650de4fcb5f1d7b6d96b/1493853480288/Rethinking+Transportation_May_FINAL.pdf