Accelerating Progress:
U.S. Surface Transportation Research

Diana Furchtgott-Roth
Distinguished Fellow, Energy Policy Research Foundation

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Chairman Obernolte, Ranking Member Stevens, Distinguished Members of the Committee, thank you for the opportunity to testify today. I am a Distinguished Fellow at the Energy Policy Research Foundation and an adjunct professor of economics at George Washington University, where I teach graduate classes on the economics of supply chain. I have served in President Trump's first term as Deputy Assistant Secretary for Research and Technology at the U.S. Department of Transportation, where I directed a team of over 1,000 staff and $1.2 billion in transportation research spending, including the Volpe Research Center in Cambridge, Massachusetts and the Transportation Safety Institute in Oklahoma City, Oklahoma. Previous positions include Acting Assistant Secretary for Economic Policy at the U.S. Treasury; Chief Economist at the U.S. Department of Labor; and Chief of Staff of the Council of Economic Advisers.

Introduction: Suggested Priorities for Transportation Research

The U.S. Department of Transportation oversees over $1.5 billion in research funds in different modes of transportation. There have been exciting developments in transportation technology in recent decades, and private companies are investing in innovative products. In addition to private research, the Federal Government retains an important role in ensuring that, throughout these changes, the U.S. transportation system remains safe, resilient, modern, and secure. Three areas are of particular importance. First, because approximately 40,000 people are killed on the roads each year,[1] and millions are injured,[2] the government has an interest in reducing accidents on the roads, in the air, and on railroads. Automation has been shown to lower accident rates,[3] and research in this area should be a priority.

Second, foreign actors are increasingly attempting to disrupt the systems that Americans use on the roads, in the air, and on the seas for positioning, navigation, and timing by hacking and spoofing the Global Positioning System (GPS).[4] The Federal government

[1] Nat'l Hwy Traffic Safety Admin. (2025). Early Estimate of Motor Vehicle Traffic Fatalities in 2024 (Report No. DOT HS 813 710).
[2] *E.g.*, Nat'l Hwy Traffic Safety Admin. (2024). Summary of Motor Vehicle Traffic Crashes (Report No. DOT HS 813 643).
[3] Nat'l Hwy Traffic Safety Admin. (2017). Automated Driving Systems 2.0: A Vision for Safety (Report No. DOT HS 812 442).
[4] Diana Furchtgott-Roth, "The West is Terrifyingly Vulnerable to Chinese Hacking of GPS," Heritage Foundation *Commentary*, April 10, 2025.
https://www.heritage.org/china/commentary/the-west-terrifyingly-vulnerable-chinese-hacking-gps

provides GPS free of charge, and has an interest in research to protect GPS and test backup systems, and to install these backup systems in government transportation systems and make sure that they are available for purchase outside government.

Third, Chinese spying from electronic components[5] [6] and batteries[7] has been documented, and the Federal government should ensure that America can eventually transition to transportation equipment and components that are made domestically or by U.S. allies. This is a worthwhile area of research for national security reasons.

I. Automation

One major question is whether President Trump will continue his prior support for AVs and advanced driver assisted systems that can result in extensive progress over the next decade, or whether overly burdensome reporting requirements slow progress. The answer will determine whether America will regain its leadership in AV technology and stay ahead of China.

During President Trump's first term, the Transportation Department encouraged AVs to be developed safely and integrated into America's transportation system, unlocking billions in private investment and priming the development of new companies such as Nuro[8] and Waymo.[9] DOT's regulations promoted automated cars, buses, trucks, and trains. Voluntary guidelines encouraged safe deployment.

This progress slowed during President Biden's term as concerns about labor displacement eclipsed the need for technological advancement. The National Highway Traffic Safety Administration (NHTSA) imposed complex reporting requirements to discourage new technology.[10] Any new research, and the collection of any new datasets, needs to ensure that such data collection occurs in as painless and undemanding a manner as feasible, so as

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[5] *E.g.*, Mcfarlane, S. (May 14, 2025). Rogue communication devices found in Chinese solar power inverters. Reuters. https://www.reuters.com/sustainability/climate-energy/ghost-machine-rogue-communication-devices-found-chinese-inverters-2025-05-14/

[6] *E.g.*, Cybersecurity and Infrastructure Security Agency (September 3, 2025). Countering Chinese State-Sponsored Actors Compromise of Networks Worldwide to Feed Global Espionage System (Cybersecurity Advisory | AA25-239A). https://www.cisa.gov/news-events/cybersecurity-advisories/aa25-239a

[7] House of Representatives Select Committee on the CCP (June 7, 2024). Moolenaar, Lawmakers Introduce Bill to Ban DHS from Procuring Batteries Manufactured by Six PRC-Aligned Companies. https://selectcommitteeontheccp.house.gov/media/press-releases/moolenaar-lawmakers-introduce-bill-ban-dhs-procuring-batteries-manufactured

[8] Nuro. https://www.nuro.ai

[9] Waymo. https://www.waymo.com

[10] Nat'l Hwy. Traffic Safety Admin. (2023). Second Amended General Standing Order 2021-01.

to foster private sector innovation, and to encourage such innovation to occur of its own accord, even independent of DOT direction.
Congress has an interest in funding AV research for two reasons. First, automation increases the productivity of the economy and international competitiveness. Second, automation protects the health and safety of the public.

The World Robotics 2025 Report by the International Federation of Robotics shows that China represented 54 percent of global robotic deployments in 2024.[11] These robots are automating China's factories in the electrical/electronics industry, the automotive industry, and the metal and machinery industry.[12] All these products are used in transportation, and America has a national security interest in keeping up with China.

There are numerous examples where transportation automation can lead to increases in productivity. With a driverless vehicle, a plumber could do administrative work as he drives to the next job. Automation could alleviate the perennial shortage of truck drivers.[13] Driverless fire trucks and ambulances could reduce trip times to homes where people are in danger from fires or medical emergencies. On farms, automated tractors could make life easier for farmers by weeding and seeding or by fetching forgotten equipment.

AVs promise to be safer than vehicles with drivers and can help reduce deaths and injuries on the road.[14] As the population ages, it is even more important to give older drivers alternatives so they can preserve mobility and stay independent without risk to themselves or others. Going driverless is one excellent option.

As well as being safer on the road, some vulnerable populations might prefer not to ride with an unknown driver. Although the rate of assault as a share of Uber rides is fractions of one percent,[15] some are concerned that teenagers should not be riding with strangers. Automated vehicles are a solution to this problem.

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[11] Int'l Federation of Robotics. (2025, September 25). Global Robot Demand in Factories Doubles Over 10 Years [Press release]. https://ifr.org/ifr-press-releases/news/global-robot-demand-in-factories-doubles-over-10-years
[12] Int'l Federation of Robotics. (2025, September 25). China Tops World Record of 2 Million Factory Robots [Press release]. https://ifr.org/downloads/press_docs/2025-09-25-IFR_press_release_China_in_English.pdf
[13] Am. Trucking Ass'ns. (2019, July 23). ATA Releases Updated Driver Shortage Report and Forecast [Press release]. https://www.trucking.org/news-insights/ata-releases-updated-driver-shortage-report-and-forecast
[14] Kusano, K.D., Scanlon, J., Chen, Y.H., McMurry, T.L., Gode, T., & Victor, T. (2025). Comparison of Waymo Rider-Only crash rates by crash type to human benchmarks at 56.7 million miles. *Traffic Injury Prevention*, 1-13. https://doi.org/10.1080/15389588.2025.2499887
[15] Uber. (2021-22). U.S. Safety Report. https://uber.app.box.com/s/lea3xzb70bp2wxe3k3dgk2ghcyr687x3?uclick_id=062c770d-5c65-415c-a355-4444e6e013bf

The private sector is successfully commercializing vehicles at increasing levels of automation. Referring to the NHTSA levels of safety automation,[16] many new cars are now commercially available at SAE Level 2, which indicates partial automation at which the car is able to offer continuous assistance to the driver in terms of acceleration, breaking, and steering. The most prominently available systems in American car companies include Ford's BlueCruise,[17] GM's Super Cruise,[18] and Tesla's Autopilot.[19]

In the United States, we have only just begun to see SAE Level 3 vehicles, with conditional automation available in limited parts of the country through the Mercedes-Benz Drive Pilot system.[20] SAE Level 4 vehicles, with high automation, are available on an even more limited basis, such as through Waymo's autonomous taxi services, available in select cities.[21]

Yet even as the private sector consolidates its progress at SAE Levels 2 and possibly 3, through increasing commercialization, it will be necessary to encourage automation at Levels 4 and 5 to unlock further benefits. With overall performance standards, the private sector can consolidate the gains that it has already been making, and it is appropriate that the risk to any such research be borne by the parties that stand to gain the most profit from successful outcomes. The Transportation Department's greatest potential value is to direct its efforts at unlocking SAE Levels 4 and 5 until the path to commercialization exists at these levels.

II. Ensuring Navigation Systems Are Free from Interference

Global navigation satellite systems are free services that send positioning, timing, and navigation systems to phones, banks, and other electric utilities. These vulnerable systems depend on satellites, which can be damaged by electromagnetic storms or military attacks. Even with the satellites intact, hacking incidents proliferate, using inexpensive, easily available hardware.

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[16] Nat'l Hwy. Traffic Safety Admin. (2022). Levels of Automation. https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-05/Level-of-Automation-052522-tag.pdf
[17] Ford Motor Co. BlueCruise is Hands-Free Highway Driving. https://www.ford.com/technology/bluecruise
[18] Gold, A. (2025). Best Tech 2025: Why We Trust GM's Super Cruise Driver Assistance System to Take the Wheel. MotorTrend. https://www.motortrend.com/news/best-tech-2025-gm-super-cruise-driver-assistance
[19] Tesla. Autopilot. https://www.tesla.com/support/autopilot
[20] Mercedes-Benz USA. DRIVE PILOT. https://www.mbusa.com/en/owners/manuals/drive-pilot
[21] *Supra*, n.9.

Protecting global navigation satellite systems from interference from regimes such as China, Russia, and Iran is more important than ever and is a national security responsibility of the Federal Government. Disruptions, which are already occurring regularly in Europe due to the Russia-Ukraine conflict, would pose an immense economic and national security threat, potentially costing trillions of dollars. One incident of GPS interference disrupted operations at Denver International and Centennial Airports for 33 hours in 2022.[22]

China[23] and Russia[24] have shown that they have the capacity to take down Western satellites. University of Texas student Zach Clements has traced GPS manipulation to Iran.[25] Even with the satellites intact, hacking incidents proliferate, using inexpensive, easily available hardware.

The Coast Guard collects reports[26] of gaps in GPS coverage throughout the world. Examples in 2025 include ships in Finland, the Gulf of Oman, the United Arab Emirates, and Los Angeles.[27] In August, the plane carrying European Union Commissioner Ursula von der Leyen lost GPS as it was landing in Bulgaria. Russia was suspected of jamming GPS to the plane, which landed using paper maps.[28] In March 2024, a plane carrying Grant Shapps, then the Secretary of Defence of the UK, was subjected to spoofing (false signals substituted for real signals) when it was flying close to Kaliningrad, near Poland and Lithuania.[29]

Multiple technologies are available that could be used in the absence of GPS signals, including terrestrial radio signals, fiber networks for timing, low earth orbit satellites for encrypted signals, and Wi-Fi and cell signals for localization.

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[22] Cybersecurity and Infrastructure Security Agency (Dec. 2022). Global Positioning System (GPS) Interference. CISA Insights.
https://www.cisa.gov/sites/default/files/publications/CISA-Insights_GPS-Interference_508.pdf
[23] David, L. (2021, Nov. 17). "China's Anti-Satellite Test: Worrisome Debris Cloud Circles Earth." Space.com.
https://www.space.com/3415-china-anti-satellite-test-worrisome-debris-cloud-circles-earth.html
[24] U.S. Space Command Public Affairs Office. (2021, Nov. 15). "Russian direct-ascent anti-satellite missile test creates significant, long-lasting space debris" [Press release].
https://www.spacecom.mil/Newsroom/News/Article-Display/Article/2842957/russian-direct-ascent-anti-satellite-missile-test-creates-significant-long-last/
[25] Niles, R. (2023, Nov. 28). "GPS Spoofing Signals Traced to Iran." Aviation News.
https://avweb.com/aviation-news/gps-spoofing-signals-traced-to-tehran/
[26] U.S. Coast Guard. *GPS User Issue Detection & Evaluation (GUIDE) Tool*. https://www.navcen.uscg.gov/guide-tool
[27] *Id.*
[28] *E.g.*, Davies, M., & Vernon, W. (2025, September 1). "EU Chief von der Leyen's plane hit by suspected Russian GPS jamming." BBC. https://www.bbc.com/news/articles/c9d07z1439zo
[29] *E.g.*, Shevchenko, V. (2024, May 2). "Russia blamed for GPS interference affecting flights in Europe." BBC.
https://www.bbc.com/news/articles/cne900k4wvjo

The Transportation Department has been testing these technologies over the past year. For instance, TERN,[30] on whose advisory board I serve, is a new AI-powered positioning system that operates without spectrum, beacons, or subscriptions, and provides GPS backup for vehicles for a one-time low fee. TERN's technology was recognized in TIME Magazine's Best Inventions of 2025.

TERN's Independently Derived Positioning System (IDPS™) provides continuous, satellite-free vehicle positioning using only onboard sensors, pre-loaded maps, and proprietary artificial intelligence. This software-only approach offers a resilient alternative to GPS-dependent systems without requiring satellites, communication towers, radio frequency spectrum, or additional hardware installations.

TERN has recently been selected as a finalist for the 2026 NATO Defence Innovation Accelerator for the North Atlantic (DIANA) Challenge Programme in the area of Contested Electromagnetic Environment. TERN will gain access to NATO test centers, end-user feedback, funding opportunities, and potential adoption pathways across 32 Allied nations, further advancing American technology leadership.

This NATO selection follows TERN's recent win in the U.S. Army's xTech Overwatch competition, demonstrating rapid momentum for the company's dual-use technology in both defense and commercial applications. TERN has also secured contracts with the Department of Transportation for PNT development and is conducting commercial pilots with automotive manufacturers, logistics providers, and industrial operators.

As GPS vulnerabilities become increasingly apparent—with jamming and spoofing incidents affecting both military and civilian operations globally—technologies like TERN's represent the type of innovation necessary to ensure resilient positioning capabilities for defense systems, critical infrastructure, autonomous vehicles, emergency services, and commercial fleets. Investigating how GPS alternatives and complements could be used by AVs would be critical to making any nationwide use of ADS more secure.

The stakes are high. Americans use millions of GPS receivers in cellphones, commercial trucks and buses, and railroads. Cars have navigation systems. Ships, planes and drones use GPS for navigation. Trucks use GPS not only for location services but also for electronic logging devices, which show information such as whether drivers have been driving for

[30] Tern AI. https://www.tern.ai

too long or are getting sleepy. Emergency responders use GPS rather than maps to locate accident sites and transport patients to hospitals.

Americans should not have to wait for fire engines or ambulances when GPS is hacked or disrupted, particularly in an automated context that lacks a human driver who may be able to, in an emergency, travel without technological mapping or navigation aids.

Businesses also rely on GPS. Tractors reduce agricultural costs by pinpointing precise places to plant seeds and spread water and fertilizers. Builders use GPS to do the same with nails and studs. Surveyors use GPS for measurements that are out of their line of sight, especially in waterways. Electric power plants rely on this technology to synchronize generators and distribute energy to the grid.

Congress has on numerous occasions directed DOT to install a backup to civilian GPS.[31] In addition, President Trump in his first term assigned government departments the task of assessing the resilience of their GPS systems through Executive Order 13905.[32] This Executive Order remained in force under President Joe Biden.

Chairman John Carter of the House Appropriations Subcommittee on Military Construction, Veterans Affairs, and Related Agencies, is fully aware of the vulnerabilities of GPS. Congress has appropriated $5 million for the Department of Transportation to deploy backup positioning, navigation, and timing services. The funding is contained in the FY 2026 Transportation, Housing, and Urban Development (THUD) appropriations bill, passed by the Senate on January 30, 2026.

The global cost of GPS interference is too high for world governments to wait for it to fail, and Americans need reliable backups.

III. National Security Need for American Equipment

For too long, America has been sleepwalking into a dangerous dependency on Chinese technology in the transportation area, ranging from batteries to electric vehicles to drones. This is a major concern for national security, economic resilience, and the ability to stand firm in the face of geopolitical tensions. The stakes are high enough to justify use of

[31] The Frank LoBiondo Coast Guard Authorization Act of 2018 (P.L. 115-282; December 4, 2018) at Sec. 514, "Backup National Timing System," also known as the National Timing Resilience and Security Act of 2018."
[32] Exec. Order No. 13905, "Strengthening National Resilience Through Responsible Use of Positioning, Navigation, and Timing Services," 85 CFR 9359.

government research funds, particularly given the national security context that falls squarely within Federal government's scope of responsibility.

Chinese-made equipment, particularly those embedded with sensitive components, pose a dual threat. First, they can serve as conduits for data collection, quietly siphoning information from American infrastructure, and even potentially creating vulnerabilities to sabotage.[33] Second, in the event of a conflict, such as over Taiwan, China could simply flip the switch, and cut off battery supplies, crippling everything from our energy grid to our defense systems.

This is what Chinese battery maker Dongguan Poweramp Technology Ltd. did to drone company Skydio on the instructions of the Chinese Communist Party. In October 2024[34] Beijing banned[35] the export of batteries to Skydio after Skydio sold drones to Taiwan's National Fire Agency, which were critical to civilian safety.

Critical minerals such as lithium, graphite, iron, and phosphate can be sourced in the United States, including lithium from North Carolina, Nevada, and Arkansas; iron from Minnesota and North Dakota; and phosphate from Florida and Louisiana. There is no need to rely on cobalt from the Congo or nickel from Indonesia and Russia, and no need to play supply chain roulette with autocratic regimes.

Lithium iron phosphate (LFP) batteries are not just for cars. They power data centers, grid-scale energy storage, electric vehicle charging stations, and homes. They are also vital for defense applications, from aerial drones to underwater vehicles. Yet despite the construction of multiple LFP gigafactories by Tesla, Ford, GM, LG, and Samsung, one critical piece remains missing: the cathode active material (CAM), which is still made in China.

A possible approach for accelerating domestic content with a requirement of more than 85 percent domestic content by 2027 would involve a cross-agency collaboration (FAA, DOD, and DOE) and allow for a seamless transition to U.S.-made batteries. Ideally, this cross-

[33] Office of the Director of National Intelligence (2025). Annual Threat Assessment of the U.S. Intelligence Community at pp. 11-12. [Unclassified].
https://www.dni.gov/files/ODNI/documents/assessments/ATA-2025-Unclassified-Report.pdf
[34] Kesteloo, H. (2025, Apr. 16). "U.S. Drone Makers Struggle to Break Free from Chinese Parts Dependency." Drone XL.
https://dronexl.co/2025/04/16/us-drone-makers-struggle-to-break-free-from-china/
[35] Bry, A. (2024, Oct. 30). "China's Sanctions on Skydio." Skydio Blog.
https://www.skydio.com/blog/chinas-sanctions-on-skydio

agency collaborative effort working with the private sector (drone companies and battery manufacturers) would set up a phased approach whereby field pilots of drones and U.S.-made batteries satisfying the domestic content requirements are conducted with an accelerated timeline with well-defined milestones and deliverables.

An excellent example of the kind of domestic innovation that should be encouraged is Sparkz Inc. [36], a U.S.-based battery company that demonstrates how federal research priorities can reduce dependence on Chinese supply chains while advancing transportation technology. I serve on the advisory board of Sparkz. Reliable, domestically produced batteries are a national security imperative. Surface transportation systems—ports, rail, transit, logistics corridors, military installations, and emergency response—depend on resilient power and energy storage.

Sparkz was founded in 2020 to build America's fully domestic lithium iron phosphate (LFP) battery ecosystem. Sparkz designs and manufactures critical materials, battery cells, and battery energy storage systems (BESS) using U.S.-sourced materials. Sparkz LFP chemistry is especially well-suited for transportation uses because it is thermally stable and safer, long-lived and durable, and free of nickel and cobalt, reducing reliance on geopolitically sensitive materials.

By vertically integrating—from materials through systems—Sparkz reduces single-point failures and foreign dependencies that currently threaten U.S. transportation resilience. Sparkz batteries support surface transportation systems by providing batteries for different forms of transportation, ranging from drones to electric vehicle chargers. These batteries can also be used for backup power for transit and rail infrastructure, electrification of ports, depots, and logistics hubs, and grid resilience for transportation corridors during outages or cyber/physical attacks.

These capabilities are critical during natural disasters, grid disruptions, and military mobilization and emergency response scenarios. The battery cells and systems deliver higher power density and up to a 25% smaller footprint than conventional systems, with designs optimized for long-duration, high-cycle applications. Federal research investments can be translated into domestic manufacturing and deployment. A strong domestic battery industry, using American-sourced products and processes, ensures that the U.S. transportation system is safe.

[36] Sparkz Inc. https://sparkz.energy/

With the One Big Beautiful Bill Act removing incentives for Chinese equipment and helping the domestic market through the 45X advanced manufacturing production credit, Congress has provided both funding and incentives for industry to wean themselves off from these Chinese handcuffs.[37] Yet additional research is still needed in order to complete the quest for ACs to achieve true supply chain independence.

It is both an economic risk and a national security threat to allow the Chinese Communist Party to control critical supply chains for batteries. American companies must reorient towards domestic suppliers, the sooner the better, and research funds from the Department of Transportation can aid the process.

Conclusion

The Department of Transportation's research programs play a crucial role in maintaining America's leadership in transportation technology while ensuring the safety, security, and resilience of our transportation systems. By prioritizing research in automation, GPS backup systems, and domestic manufacturing of critical components such as batteries, DOT can address immediate safety concerns while protecting America's long-term national security interests.

I thank the Committee for the opportunity to testify today and look forward to your questions.

[37] Diana Furchtgott-Roth and Andrew Hale, "Extricating America from Its Chinese Handcuffs," Heritage Foundation *Special Report* No. 297, September 26, 2024
https://www.heritage.org/sites/default/files/2024-09/SR297.pdf