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STUDIES PROJECT



The Autonomous Vehicle Crossroads

The Autonomous Vehicle Crossroads:

America's Innovation Advantage Hits the Adoption Roadblock

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Executive Summary

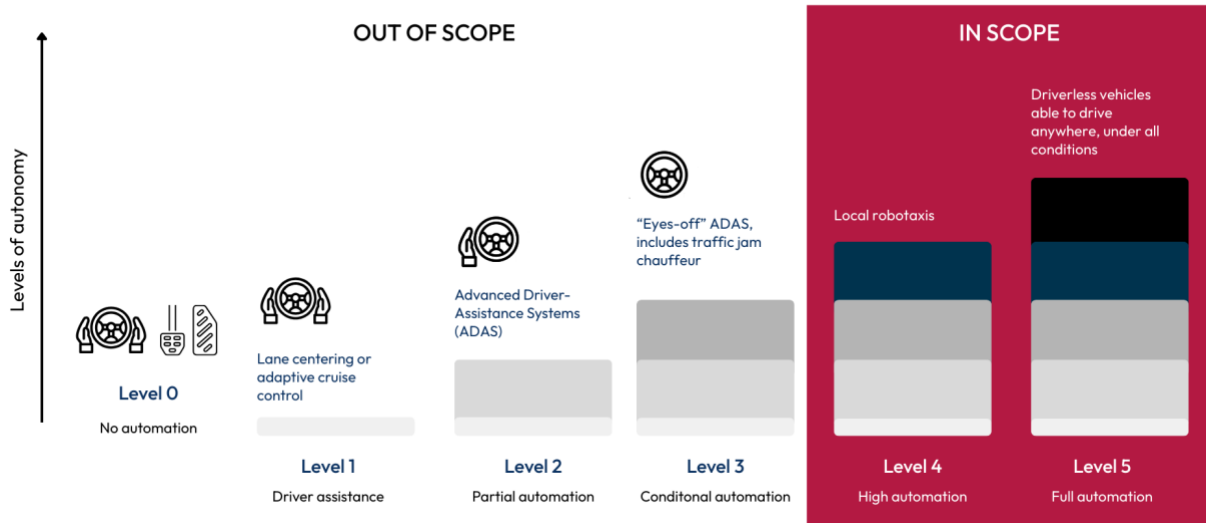
As the most advanced, large-scale proving ground for the future of robotics and physical AI, autonomous vehicles (AVs) are a critical catalyst for the global economy – and a race the United States is currently losing to China. This assessment identifies a critical adoption gap in AVs, where a lack of industrial capacity and regulatory support is neutralizing U.S. technical superiority. Leadership in the global AV sector is a strategic imperative and will catalyze the broader autonomy economy.

Analysis using the [SCSP Tech Scorecard](#) methodology indicates that China has a clear lead in the deployment and adoption of AVs.¹ The United States maintains an edge in Innovation Leadership but is falling behind in every other category, especially Industrial Capacity and National Leverage. China dominates the hardware layer, controlling the global majority of component production and deploying commercial AVs at a fraction of U.S. costs. The Chinese regulatory environment has also enabled testing at a larger scale, while the United States remains stalled by a patchwork of inconsistent state policies and a lack of a national framework.

China is projected to outstrip the U.S. market size and AV fleet size by 2035, and the U.S. software advantage faces a compounding threat as China seeks to develop a fully independent tech stack. To reverse this trajectory, the United States must focus equally on industrialization and innovation. Alongside the research race, the United States must implement a unified national framework, invest in testing and evaluation, and build supply chain resiliency.

¹ [SCSP Tech Competition Scorecard](#), Special Competitive Studies Project (2026).

Scope Note



The scope of this report is vehicles that are fully driverless and not conditional on human presence in the driver's seat. Thus, our analysis focuses exclusively on passenger AVs operating at Level 4 autonomy or higher.² AV systems are typically powered by sensors, of which there are two major types: LiDAR and RADAR. Additional key components include advanced cameras and external audio receivers. For this analysis, freight applications are out of scope. This report does not consider Vehicle-to-Everything (V2X) technology or infrastructure to be a form of on-platform AV technology.

² Levels of autonomy as defined by [SAE International](#) range from Level 1 to Level 5. Vehicles with Level 4 autonomy can drive fully autonomously under specified conditions. Vehicles with Level 5 autonomy can drive anywhere, during any conditions. Vehicles classified as Level 3 and below have one or multiple driver support functions, but are not considered autonomous.

Strategic Significance: The Race to AV Adoption Will Define Future Autonomy Innovation

AVs are the nearest-term instance of physical AI, the category of autonomous systems that can perceive the physical world and make complex decisions under uncertainty.³ AVs deploy AI systems that achieve this degree of perception and operation across millions of real-world miles, making AVs the most advanced large-scale embodiment of physical AI. Winning the first-mover advantage in AV adoption will catalyze other autonomous technologies and unlock advantages in economic growth and technical edge for the United States.

Getting AVs to Market Will Establish a Platform for Commercialization and Catalyze the Broader Autonomy Economy

AVs are a proving ground for the broader physical AI ecosystem. The global passenger AV market was worth \$4.43 billion in 2025 and is projected to reach over \$188 billion by 2034.⁴ The United States led the global market in 2025, but China is projected to grow at a faster rate. By 2035, the United States and China are projected to have a market size of \$36.5 billion and \$44.5 billion, respectively.⁵

The transition of AV technology into purpose-built service platforms establishes a standard industrial blueprint for autonomous operations. The Transport-as-a-Service (TaaS) commercialization model is expected to add a whopping 20%, or \$26 trillion, to Gross World Product (GWP) by 2030 through a reduction in accidents and transportation costs.⁶ The U.S. portion of this GWP increase will depend on the relative scale of AV adoption relative to competitors.

The autonomy economy refers to the integration of autonomous machines into the provision of goods and services, encompassing use cases like autonomous farms, smart factories, and self-optimizing energy grids, with unprecedented growth potential in productivity.⁷ The development of robust safety standards and infrastructure mandates to support AV adoption will create standardized regulatory environments applicable to and necessary for integrating autonomous systems into other industries. A successful TaaS model can be replicated for other industrial sectors of the autonomy economy, such as Robotics-as-a-Service models for logistics and

³ Aarian Marshall, [‘Physical AI’ Is Coming for Your Car](#), Wired (2026).

⁴ Precedence Research, [Robotaxi Market Size Worth USD 188.91 Billion by 2034 Driven by Autonomous Innovation and Sustainable Urban Mobility](#), Yahoo Finance (2025).

⁵ Lei Kang, [China's Robotaxi Market to Reach \\$44.5 Billion by 2035, Says TrendForce](#), CnEVPPost (2025).

⁶ Tasha Keeney, [Autonomous Taxis May Have The Most Impact On GDP Of Any Innovation In History](#), Ark Invest (2023).

⁷ [What is the Autonomy Economy?](#) The Road to Autonomy (2026).

agriculture. Signals of this shift are already evident: in March 2026, Chinese carmaker Xpeng announced it would legally change its Chinese company name from Xpeng Motors to Xpeng Group. President Brian Gu shared that the change reflected Xpeng's shift towards a company powered by physical AI.⁸ The commercialization of AVs and autonomous robots will be a critical inflection point, and China's national strategies have already created a favorable environment for its domestic autonomous industrial service companies to expand globally.⁹

Technical Advancements are Transferable to Other Autonomous Systems

The AV tech stack can power other emerging autonomous systems. The North American LiDAR market is expected to grow to \$4.8 billion by 2030, driven by rising AV adoption and supported by robotics, smart infrastructure, and industrial automation.¹⁰ These sensors are also used for surveying and mapping in autonomous drones and unmanned aircraft systems.¹¹ At the perception layer, Vision-Language-Action models optimized for real-time identification and object tracking on vehicle roads can be applied to other land, sea, and space environments. Motion-based techniques developed for AVs to predict object locations when blocked by weather and lighting can be used in industrial settings with moving machinery and workers.

The development of fully autonomous L5 AVs will also accelerate the development of edge computing. Edge computing is a distributed computing architecture that brings data processing and storage physically closer to the source. This architecture is critical for AVs because it eliminates the latency of cloud communication and will be especially important for bringing AVs to rural areas, where connection may be limited.¹² A December 2025 power outage in San Francisco resulted in AVs being disconnected from the cloud and left idle, blocking streets and causing traffic jams.¹³ Edge computing can bridge the gap between today's reality and a fully realized version of autonomy that can make locally generated decisions, less reliant on connectivity to the cloud. Such advancements are directly transferable to powering industrial and medical robots, agricultural drones, and smart grids.

⁸ Brian Gu, [LinkedIn](#) (2026).

⁹ [Embodied Intelligence: The Rise of Physical AI](#), Citi (2025).

¹⁰ [North America LiDAR Market Worth USD 4.80 Billion by 2030](#), Markets and Markets (2026).

¹¹ [LiDAR Drones: The Best Models for Surveying, Mapping, and More](#), Pilot Institute (2025).

¹² Shawn Vestal, [Study: Small 'Edge' Computer Could Help Self-Driving Cars Operate in Rural Areas](#), Washington State University (2026).

¹³ Sonia A. Rao, et al., [Waymo Suspended Service in San Francisco After Its Cars Stalled During Power Outage](#), New York Times (2025).

Cyber Vulnerabilities and Supply Chain Reliance Pose a Strategic Risk

U.S. reliance on PRC-origin LiDAR and other hardware components poses a supply chain risk. With the support of industrial policies and state funds, Chinese firms are scaling up rapidly and expanding across the global LiDAR market. Such remote sensing technologies are used not just for AVs, but also for satellites, space, smart cities, and military uses. In 2025, Hesai Technology, China's leader in LiDAR solutions, was listed as a military company in accordance with the William M. (Mac) Thornberry National Defense Authorization Act for FY 2021.¹⁴ Widespread deployment of Chinese LiDAR systems risks software vulnerabilities and data collection; the economic implications of U.S. dependency are addressed in the Industrial Capacity section of this report.

While proprietary software has a higher barrier to substitution than hardware components, outsourcing either front poses risk. The vast data collection required to train and enable AV systems poses privacy and cybersecurity risks if compromised. In 2021, China temporarily banned Tesla vehicles from military complexes over concerns of sensitive data being captured and stored by external sensors and cameras.¹⁵ Similarly, U.S. lawmakers have expressed concern about Chinese companies collecting and handling sensitive data while testing AVs in the United States.¹⁶

¹⁴ [P.L. 116-283](#), William M. (Mac) Thornberry National Defense Authorization Act for FY 2021.

¹⁵ [Tesla Cars Banned from Chinese Military Complexes on Security Concerns-Sources](#), Reuters (2021).

¹⁶ David Shepardson, [US Lawmakers Raise Concerns over Chinese Self-Driving Testing Data Collection](#), Reuters (2023).

Industry Overview

Major Chinese and U.S. Passenger Autonomous Vehicle Companies

	Apollo Go	Pony.ai	WeRide	Tesla	Waymo	Zoox
Parent company	Baidu	N/A	N/A	Tesla	Alphabet	Amazon
Approx. fleet size	1000	300	1200	200	2500	50
Rides completed	17 million	700,000	350,000	N/A	20 million	1 million miles tested
Cities of operation	22 cities	4 cities	30+ cities	Austin, TX	6 cities	Las Vegas, NV
Special features	First to market in China	Independent hardware and software stack	Extensive international testing permits	Does not use sensors, relies entirely on camera imaging	First to market in the US	Purpose-built vehicle, not retrofitted
Year founded	2013	2016	2017	2016	2009	2014

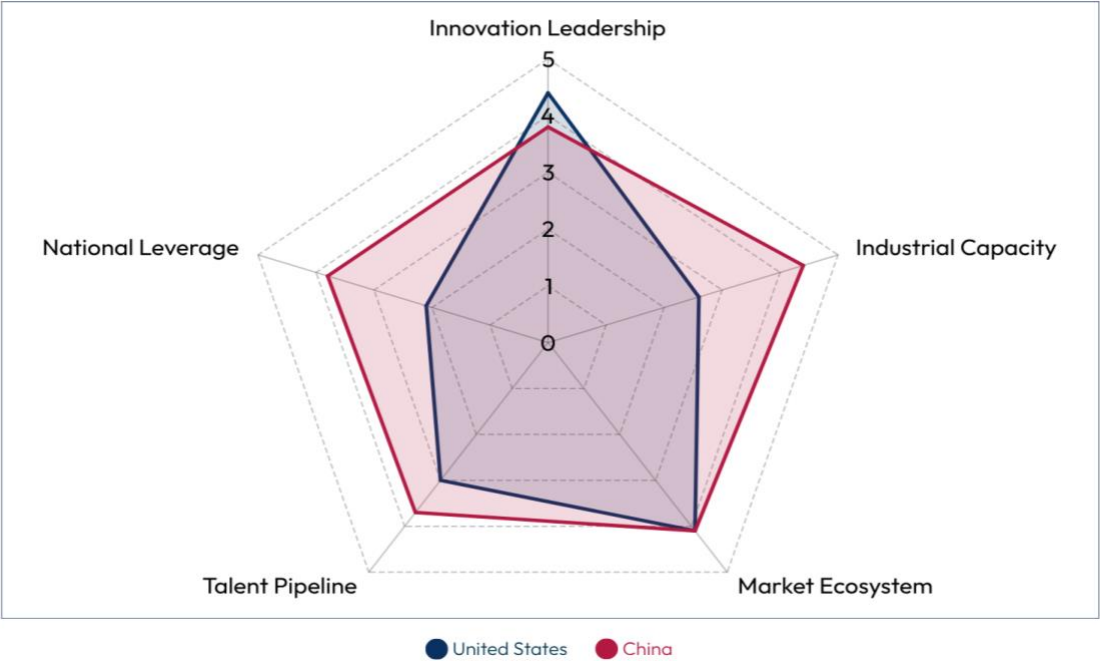
The three largest Chinese AV companies (left) and the three largest American AV companies (right). Sources: [Pony.ai](#), [Tesery](#), [Fortune](#), [Carbon Credits](#), [Rest of World](#); Data as of 2025

The three biggest players in the Chinese and U.S. AV markets are shown above. In our comparative analysis, the best-in-class AV performance metrics for each country are sourced exclusively from the companies listed above.

SCSP Tech Scorecard: U.S. Technical Innovation is Behind the Adoption Curve

China has the overall lead in the U.S.-China AV competition. As summarized in the radar chart below, China is outpacing the United States in every category except Innovation Leadership, capturing a greater share of the global AV market at a faster rate. In our assessment, the Innovation Leadership and Market Ecosystem categories account for the majority of the total metrics used, reflecting their roles as primary catalysts of technological maturity. We predict the lead will continue to trend towards China.

Tech Scorecard: Passenger Autonomous Vehicles



SCSP Tech Scorecard

SCSP developed a comparative analysis framework to provide a comprehensive view of the state of the tech competition between the United States and China across a variety of key technologies. The scorecard compares quantitative and qualitative metrics across the five categories SCSP has determined are needed for technology leadership: Innovation Leadership, Industrial Capacity, Market Ecosystem, Talent Pipeline, and National Leverage.

The specific metrics considered are technology-specific and will vary across reports based on each technology's readiness level and resource needs. Data are compiled from open source analysis,

subscriptions, and expert surveys. This analysis uses road-test metrics from U.S. and Chinese firms operating on U.S. roads, as standardized testing data from China is undisclosed, and U.S. companies cannot test in China.

For more information, please see the appendix.

Innovation Leadership: the United States Has Definitive Lead in Software and Safety, China Accelerating

Leader: United States

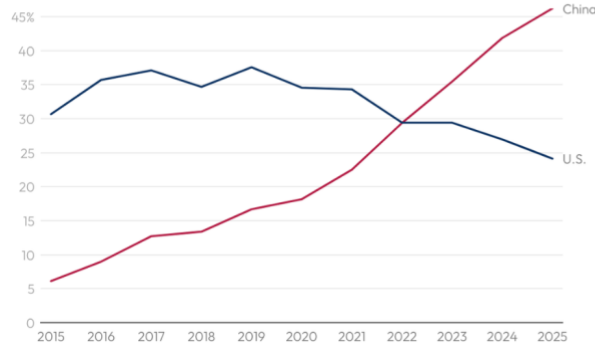
Trending Towards: United States

The United States retains a commanding lead in innovation, anchored by frontier models and a proven operational record. The most sophisticated software remains American; China is racing to close the gap and make up for its technical lag by increasing deployment volume.

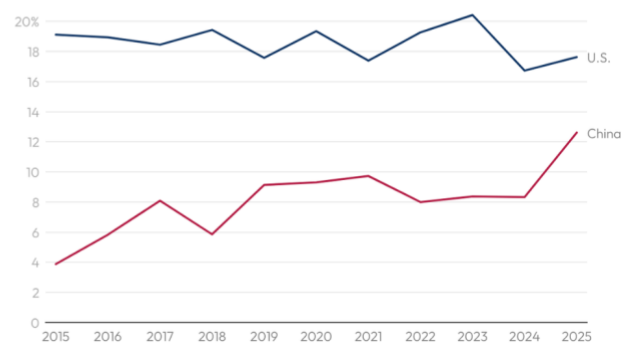
U.S. Model Leadership Drives the Autonomous System Edge

The U.S. dominance in Vision-Language-Action (VLA) models provides a critical technical advantage for the next generations of AVs.¹⁷ Frontier VLA models enable AV systems that are more interpretable and capable of generalizable, human-aligned decision-making.¹⁸ U.S. models remain the most advanced models, exemplified by Google’s RT-2 and Physical Intelligence’s $\pi 0$ models.¹⁹

Domestic Papers as a Share of Global Top Cited Autonomous Vehicle Papers



Industry-Academia Co-authored Papers as a Share of Total Domestic Papers



Source: OpenAlex²⁰

The United States is ahead in the successful translation of laboratory innovation into market-ready technology. Our analysis finds that, used as a proxy for tech transfer, AV papers co-authored by industry and academia representatives as a share of total domestic papers have been higher in the United States over the past 10 years. China surpassed the United States in

¹⁷ Vision-Language-Action models fuse Visual-Language Models (VLMs), which take visual inputs from sensors and language inputs from textual information, to interpret driving scenarios and execute actions. We use AV papers co-authored by industry and academic representatives, as a proxy for tech transfer, as a share of total domestic papers.

¹⁸ Tianshuai Hu, et al., [Vision-Language-Action Models for Autonomous Driving: Past, Present, and Future](#), arXiv (2026).

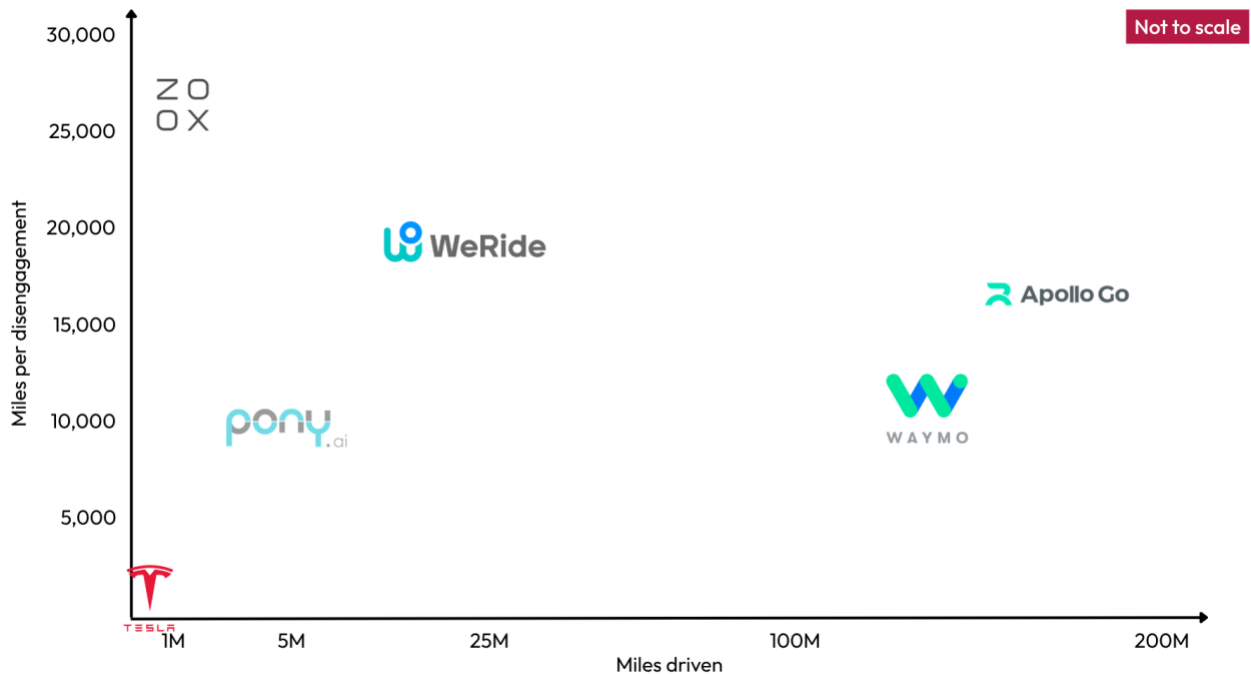
¹⁹ Oliver Hsu, [The Physical AI Deployment Gap](#), a16z (2026).

²⁰ SCSP analysis of [OpenAlex](#) data (accessed 2026).

sheer quantity of co-authored papers in 2024 (not shown), reflecting a heightened effort to commercialize. Chinese papers made up a greater share of top-cited papers globally beginning in 2022, though such metrics place greater emphasis on quantity over industrial utility.²¹ In contrast, patent data reflects U.S. technical superiority: as of 2025, the United States holds 69.23% of global forward-cited patents for AVs, compared to just 9.23% for China.²² The difference in patent quality signals that U.S. breakthroughs remain the primary drivers of global industry standards.

U.S. Cars Are Safer

Major Passenger Autonomous Vehicle Companies by Miles Driven and Miles Per Disengagement



Sources: [State of California DMV](#), [CleanTechnica](#), [WeRide](#), [Pony.ai](#), [Waymo](#), [Mashable](#),²³ [CNET](#),²⁴ (Data as of 2025).

U.S. AVs are generally safer and more reliable. Chinese firms operate in the middle range of total miles driven and miles per disengagement (MPD), the distance a car travels before human intervention is required. Taking the highest-ranking company in each country, Zoox outperforms WeRide by 27,996 MPD to 20,064 MPD. Though Baidu Apollo is reported to outpace Waymo in total miles driven and MPD, the former’s MPD data is likely inflated due to

²¹ SCSP analysis of [OpenAlex](#) data (accessed 2026).

²² SCSP analysis of [Lens Patent Search](#) data (accessed 2026).

²³ Tesla MPD calculated from 11 disengagements as reported by Mashable over 7,000 miles driven as shared in Tesla’s Q2 2025 earnings call

²⁴ Baidu MPD calculated from 0.06 disengagements every 1,000 miles as reported by CNET

significantly fewer test miles in the United States, roughly 150,000 miles.²⁵ Such statistical discrepancies underscore that industry-standard benchmarks in the United States may be an incomplete measure of national competitiveness.

A more definitive measure of operational safety lies in the frequency of critical failures, such as airbag deployments, where Waymo currently stands as the global gold standard. The company reports approximately 20 million miles per airbag deployment,²⁶ nearly three times the approximately 6.2 million miles per airbag deployment reported by Baidu Apollo, China's industry leader for this benchmark.²⁷ Basic operational specifications, such as maximum speeds, show U.S. and Chinese companies at a comparable level—Zoox reporting 75 miles per hour and Baidu Apollo reporting 84 miles per hour—but top-line figures mask the deeper software sophistication required for passenger safety.²⁸

Software recall frequency offers a compelling metric for safety comparisons, but its utility is undermined by the different disclosure standards governing the U.S. and Chinese industries. U.S. companies have filed eight recalls under the NHTSA, compared to one by Pony.ai, but this disparity also reflects the limited scale of Chinese operations in the United States.²⁹ U.S. recalls are generally more reactive than proactive, prompted by a defect that has already occurred. In December 2025, Waymo filed a software recall after its vehicles failed to stop for school buses.³⁰ Chinese companies must report all software updates related to safety and performance to the Ministry of Industry and Information Technology for approval. This stricter compliance standard reflects a greater level of government monitoring and control over the development trajectory of priority technologies. It may also give companies greater ability to cover up defects proactively, but high-risk incidents have occurred in China nonetheless: a robotaxi belonging to Alibaba-backed Hello struck two pedestrians in the same month.³¹ Challenges remain for both countries to realize complete technical maturity.

²⁵ Egil Juliussen, [California AV Tests: Examining 10 Years of Data](#), EE Times (2025).

²⁶ [Waymo Safety Impact](#), Waymo (2026). Waymo researchers report a human benchmark metric of roughly 900,000 miles per airbag deployment.

²⁷ Evelyn Cheng, [China's Baidu Says Weekly Robotaxi Rides Hit 250,000 — Same as Alphabet's Waymo This Spring](#), CNBC (2025).

²⁸ Alan Ohnsman, [Feds Greenlight Amazon's Zoox To Operate Robotaxis With No Steering Wheel Or Pedals](#), Forbes (2025); John Koetsier, [Meet The Robotaxi Doing 250,000 Rides Per Week That Isn't Called Waymo](#), Forbes (2026).

²⁹ [NHTSA Equipment Search](#) (accessed 2026).

³⁰ Jeff Brady, [Waymo Will Recall Software After Its Self-Driving Cars Passed Stopped School Buses](#), NPR (2025).

³¹ Zhai Shaohui, [Robotaxi Crash in Hunan Stokes Fears of Regulatory Backlash](#), Caixin Global (2025).

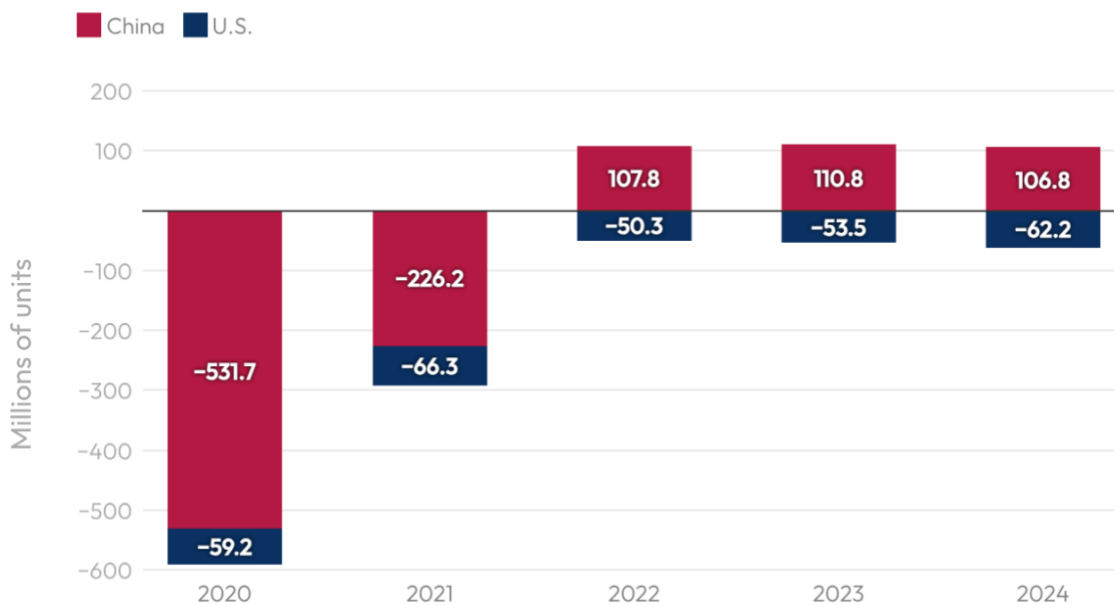
Industrial Capacity: China Controls the Entire Hardware Supply Chain

<i>Leader: China</i>	<i>Trending Towards: China</i>
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While AV software is the layer where the innovative edge is defined, technical superiority can only scale when supported by a robust, accessible hardware supply chain. China currently dominates this physical layer, maintaining a commanding lead from raw material processing to vehicle manufacturing.

Chinese Hardware Dominance Threatens U.S. Scalability

U.S. and China Net Export Volumes of Autonomous Vehicle Equipment



Source: [UN Comtrade](#)³²

At the component level, the United States faces significant vulnerabilities. China dominates the global supply of critical minerals essential for the laser diodes used to make LiDAR systems, controlling 98% of the world's gallium supply and over 60% of its germanium.³³ Furthermore, China controls over 90% of global LiDAR production.³⁴ Should U.S. firms attempt to transition to exclusively domestic LiDAR, the manufacturing cost per sensor unit would increase fivefold.³⁵

³² Equipment includes: Radar apparatus, surveying equipment, optical devices, automatic data processing machines.

³³ [Artificial Intelligence and the Critical Minerals Crunch](#), Foreign Policy (2025).

³⁴ Jin Yufan, [LiDAR, Why Is It So Difficult To Make Money?](#), EE World (2025).

³⁵ [Crackdowns on Chinese Lidar Can't Mask U.S. Industry Plight](#), S&T Daily (2025).

China's control of the AV supply chain is evidenced by its trade shift; in 2022, China became a net exporter of AV equipment, while the United States remains a net importer.

The cost disparity is equally stark at the vehicle level. Chinese passenger AV companies outfit domestic vehicles, benefiting from a streamlined manufacturing ecosystem that brings production costs down to \$40,000 per robotaxi. In contrast, U.S. production costs range between \$130,000 and \$200,000 per robotaxi.³⁶ U.S. companies primarily outsource their vehicles: Waymo previously chose to outfit Jaguar cars, a British brand now owned by the Indian company Tata Motors, and recently announced a shift to Zeekr, a Chinese manufacturer, for its new "Ojai" model.

Waymo's decision to use a Chinese model underscores the hollowed-out U.S. industrial base, of which limitations are exacerbated for AV companies by industry dynamics and policy shifts. In part, motivated by California's state policy and as part of the company's publicly declared climate goals, Waymo's commitment to a fully electric fleet and subsequent choice of a Chinese supplier reflect that the United States has long lost the cost-effective electric vehicle race to China. Additionally, while Chinese AV companies have established mutually beneficial partnerships with vehicle manufacturers, leading U.S. manufacturers, namely General Motors, Ford, and Tesla, are competitors in the autonomous driving space, giving companies little incentive to sell their proprietary car models.

Notably, Waymo has taken strides to bolster U.S. industrial capacity. The company's Hyundai models, acquired in 2024, are assembled at Hyundai's electric vehicle mass-production plant in Georgia.³⁷ The Waymo Driver integration plant, where vehicles are outfitted with Waymo's autonomous systems, was established in Arizona in 2025.³⁸ The system's core components, including sensors and optics, are designed and built in California.³⁹ Despite these efforts, a long road to recovery remains to provide the cost-effective vehicle platforms necessary for national-scale AV expansion. China's superior industrial capacity has allowed it to deploy services in over double the number of cities as the United States: as of early 2026, China has a domestic fleet size of approximately 4,100 AVs, compared to the U.S. total of roughly 2,800.⁴⁰

³⁶ [Why China Is Pulling Ahead in the Robotaxi Race](#), The Economist (2025).

³⁷ [Waymo and Hyundai Enter Multi-Year, Strategic Partnership](#), Waymo (2024).

³⁸ [Scaling Our Fleet through U.S. Manufacturing](#), Waymo (2025).

³⁹ Satish Jeyachandran, [Beginning Fully Autonomous Operations with the 6th-generation Waymo Driver](#), Waymo (2026).

⁴⁰ [China's Robotaxi Market - The Road to Commercialization](#), Goldman Sachs Research (2025); SCSP analysis of U.S. company reports.

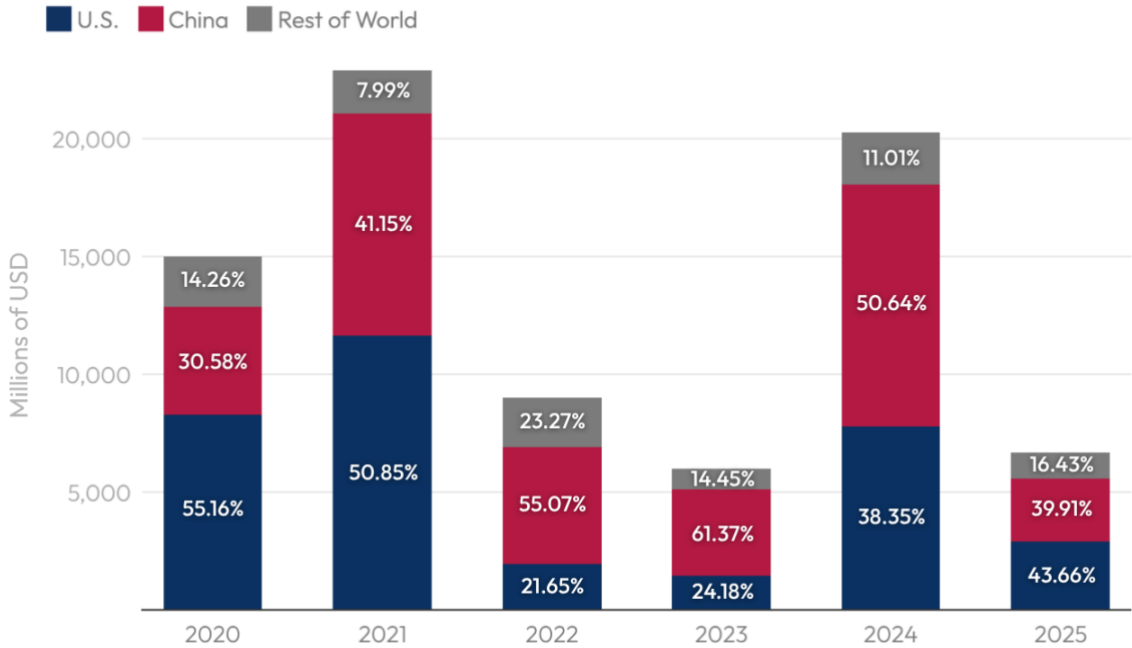
Market Ecosystem: U.S. Financing Edge Offset by China’s Dominant Adoption Curve

Leader: Contested	Trending Towards: Contested
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While U.S. industry leaders maintain a dominant share of global funding, China’s aggressive approach to expansion has successfully cultivated a larger domestic and international footprint. If not used effectively to build market resiliency, the U.S. advantage in high-value private capital may be increasingly offset by China’s greater adoption and growth projections.

U.S. Capital Concentration Versus China’s Broad Industrialization

Global Autonomous Vehicle VC Funding by Region

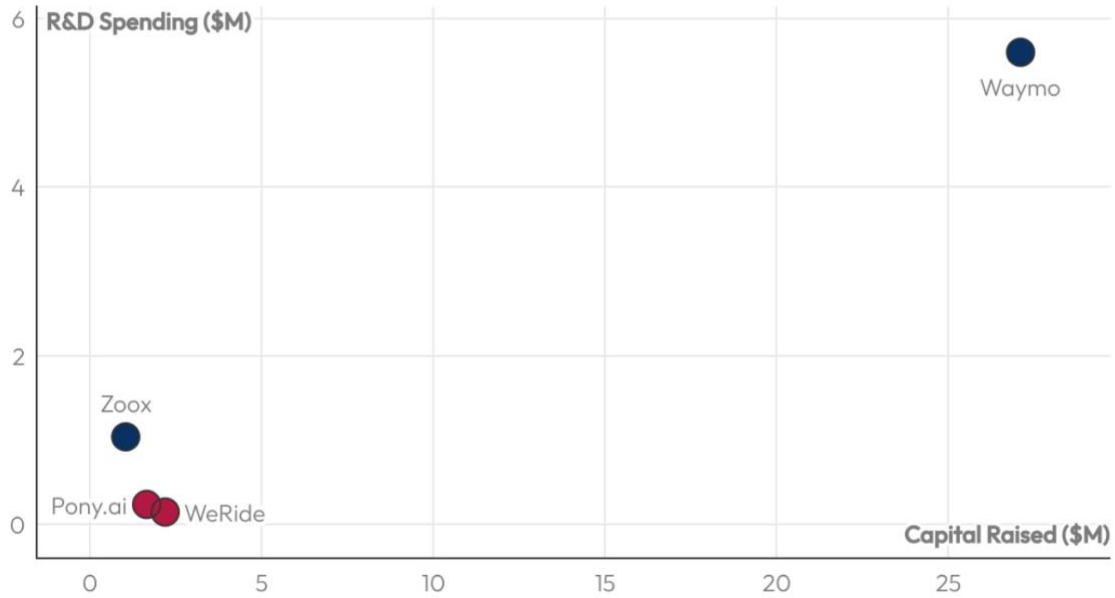


Source: Pitchbook

The United States and China have consistently attracted substantial global VC funding for AV companies over the past five years. Following two years of China taking the lion’s share in 2022 and 2023, the U.S. share rebounded to 43.66% of global funding in 2025, with China accounting for 39.91%.⁴¹

⁴¹ SCSP analysis of Pitchbook data (accessed 2026).

Autonomous Vehicle Companies by Capital Raised and R&D Expenditure



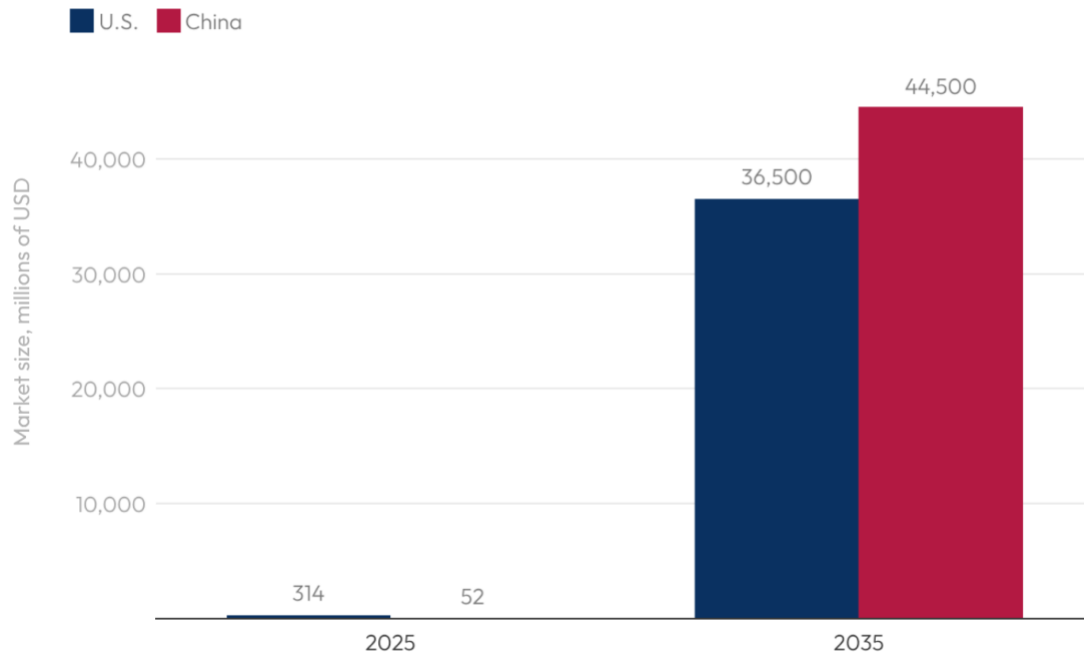
Sources: [Alphabet](#),⁴² [Pony.ai](#), and [WeRide 2024 Annual Reports](#); [CNBC](#)

An overwhelming majority of U.S. funding is captured by Waymo, which has raised significantly more capital and spends much more on R&D than any other global competitor. In contrast, Chinese firms like Pony.ai and WeRide, despite being national champions, operate with a fraction of that capital. The difference in capital distribution suggests that newer, more capital-intensive Chinese companies are being funded, and that the Chinese ecosystem is successfully industrializing AV technology at a greater scale and speed than the United States, despite lower funding.

⁴² Investment in Waymo reported as 5.6 billion USD, the majority of which was funded by Alphabet.

Adoption Metrics Reveal a Widening Implementation Gap, but Market Resiliency is Unclear

Current and Projected Autonomous Vehicle Market Size in the U.S. and China



Source: [TrendForce](#)

While the United States currently has a greater AV market size, the Chinese robotaxi market is estimated to grow at a 96% Compound Annual Growth Rate (CAGR), significantly higher than the U.S. estimate of 61%.⁴³ Robotaxi penetration rates are estimated to reach roughly 30% in the United States compared to 25% in China by 2035,⁴⁴ but the Chinese fleet size will be 500,000 vehicles larger.⁴⁵

The U.S. commercialization model is more lucrative per unit, but China's low-cost approach is driving higher volume, likely creating a flywheel effect. As of early 2026, Chinese companies have completed approximately 30 million robotaxi rides in total, about 50% more than in the United States.⁴⁶ The U.S. ecosystem has higher-margin returns, with an estimated revenue per

⁴³ Lei Kang, [China's Robotaxi Market to Reach \\$44.5 Billion by 2035, Says TrendForce](#), CnEVPost (2025).

⁴⁴ Adam Spatacco, [One Analyst Thinks Tesla's Robotaxi Revenue Could Soar to \\$250 Billion by 2035. But Here Are 3 Things Investors Need to Know](#), NASDAQ (2026); [Global Technology: China's Robotaxi Market - The Road to Commercialization](#), Goldman Sachs (2025).

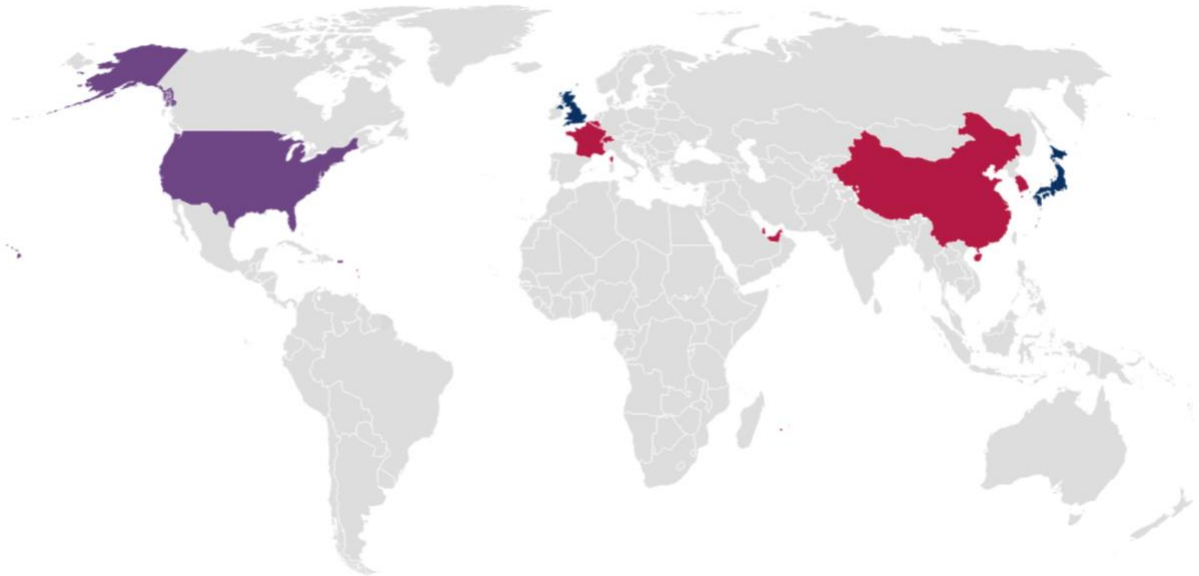
⁴⁵ [Here at Last: The Evolution of the Robotaxi](#), Boston Consulting Group (2026).

⁴⁶ Nick Corvino, [Is China Cooking Waymo?](#) ChinaTalk (2026).

vehicle of \$120,000 compared to \$1,300 for Chinese robotaxis.⁴⁷ Greater proliferation in China will lead to greater domestic adoption, more benefits for the Chinese population, and ultimately a larger share of the global AV market and mindshare.

International Autonomous Vehicle Testing Permits held by U.S. and Chinese Companies

■ US ■ China ■ Both



Sources: [WeRide](#), [Pony.ai](#), [Waymo](#)

China is already pulling ahead in international expansion: Chinese AV firms have secured testing permits in over 10 foreign countries, while U.S. firms have only two.⁴⁸

⁴⁷ Alan Ohnsman, [Waymo Targets 1 Million Robotaxi Rides A Week](#), Forbes (2025); [Global Technology: China's Robotaxi Market - The Road to Commercialization](#), Goldman Sachs (2025).

⁴⁸ [Where Waymo is Driving](#), Waymo (accessed 2026); [Global Technology: China's Robotaxi Market - The Road to Commercialization](#), Goldman Sachs (2025).

Talent Pipeline: China Is Building a Specialized Ecosystem, Challenging

U.S. Research Lead

<i>Leader: China</i>	<i>Trending Towards: China</i>
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While both nations have robust university-industry partnerships, China is constructing a more comprehensive, specialized academic ecosystem. By institutionalizing targeted programs beyond general robotics and autonomy, China has established a more direct talent funnel into its domestic AV industry.

	United States	China
SPECIALIZED UNIVERSITY PROGRAMS	General B.S. and M.S. degrees offered in robotics and/or autonomy	40+ universities offer degrees in intelligent vehicles, SVM and ETS Lab @Tsinghua
UNIVERSITY-INDUSTRY CLUSTERS	CMU-Argo AI, Mcity @UMich, Transportation Institutes @Texas A&M, VTech, MIT AVT Consortium, VAIL @Stanford	IC2EV and Huawei Academy @SJTU, Baidu Apollo Ecosystem, Beijing E-Town, Unmanned Testing Center @Tongji

The United States is home to roughly two-thirds of the world’s leading AI researchers, compared to only 10% in China.⁴⁹ However, departures of Chinese scientists from U.S. institutions increased to 67% in 2021, and of those remaining, it is unclear how many researchers are focused on AV-specific fields.⁵⁰ At the engineering level, there is a stark difference in the sheer volume of talent. Only 6% of all U.S. undergraduates are engineering majors,⁵¹ whereas they represent 36% of the student body in China.⁵² Additionally, while U.S. universities offer world-class general robotics degrees, Chinese universities have developed a specialization in intelligent connected vehicles (ICVs), a complementary field with significant technical crossover for AV development. In 2021, 43 Chinese universities introduced 12 new majors in electronic information and AI, specifically including intelligent transportation and intelligent vehicle technology.⁵³

⁴⁹ Ellen Zentner, [Who Is Leading the Global AI Race?](#) Morgan Stanley (2026).

⁵⁰ Li Yan, [Number of Chinese Scientists Leaving U.S. Increasing Yearly](#), China Daily (2024).

⁵¹ [Most Common Undergraduate Fields of Study](#), National Center for Education Statistics (accessed 2026).

⁵² [China’s New Army of Engineers](#), The Economist (2025).

⁵³ Cui Fandi, [China Adds 37 New College Majors, One Third in AI, Information Technology](#), Global Times (2021).

Both nations maintain comparable world-class laboratories. Tsinghua University's School of Vehicle and Mobility houses the Emerging Transportation Solutions Lab, a primary hub for Chinese AV innovation. The University of Michigan's Transportation Research Institute operates Mcity, the world's first purpose-built proving ground for automated vehicles. In 2022, Mcity received a \$5.1 million National Science Foundation grant to develop remote-accessible testing in partnership with leading AV firms.⁵⁴ Similarly, in 2024, Tongji University in Shanghai launched the world's first cloud-controlled unmanned testing center.

Despite well-established academic-industry partnerships in both countries, a significant knowledge-sharing disparity persists across the ecosystem. While U.S. leaders like Waymo release limited datasets for research, Baidu Apollo open-sources much of its autonomous driving software stack, allowing researchers and innovators to build, test, and adopt AV driving capabilities on a shared foundation⁵⁵. This more open approach is likely to enable the development of a wider variety of applications across the Chinese market.

⁵⁴ Jim Lynch, [\\$5.1 Million NSF Award To Enable Next-Generation AV Testing at Mcity](#), Mcity (2022).

⁵⁵ Charles Clover & Sherry Fei Ju, [Baidu to Open-Source its Autonomous Driving Technology](#), Financial Times (2017).

National Leverage: Without a National Framework, the United States Cannot Scale

<i>Leader: China</i>	<i>Trending Towards: China</i>
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	United States	China
NATIONAL STRATEGIES	No national structure for testing and deployment	MIIT National Safety Standards, autonomous driving designated priority in Ministry of Transportation’s AI+Transportation Plan
REGIONS WITH TESTING POLICIES	31 states (19 for operation, 12 for testing only)	50+ cities, 20+ designated pilot cities with integrated V2X (Vehicle-to-Everything) technology infrastructure

China has maintained a consistent national emphasis on developing AVs. In 2015, autonomous vehicles were designated a priority sector in the Made in China 2025 blueprint.⁵⁶ In 2020, eleven central government departments jointly issued the *Strategy for Innovation and Development of Intelligent Vehicles*, which outlines goals across the AV ecosystem. The Strategy emphasized R&D throughout the supply chain, covering sensors, chips, and operating systems, while encouraging cross-industry integration, international cooperation, and the development of intelligent road infrastructure.⁵⁷ Furthermore, the Ministry of Transportation’s 2025 *AI+Transportation Implementing Opinions* declared that China will lead the world in AI-powered transportation by 2030, and highlighted autonomous driving as a key application to be accelerated through large models, evaluation systems, and pilot programs.⁵⁸

Global AV development is in a critical testing phase, and China’s standardized regulatory environment provides a distinct advantage. The Ministry of Industry and Information Technology released China’s first safety standards for higher-level autonomous driving in 2026. One key mandate requires that every vehicle be equipped with a data recording device to

⁵⁶ Rachel Cheung, [A Slow but Steady Acceleration](#), The Wire China (2026).
⁵⁷ Mark Schaub & Atticus Zhao, [China Releases Big Plan for Autonomous Vehicles](#), China Law Insight (2020).
⁵⁸ [交通运输部 国家发展改革委 工业和信息化部 国家数据局 国家铁路局 中国民用航空局 国家邮政局关于“人工智能+交通运输”的实施意见](#) (2025).

capture operational data.⁵⁹ China’s centralized approach has enabled testing in over 50 cities,⁶⁰ including 20 designated pilot cities with V2X infrastructure designed to advance safety.⁶¹

Meanwhile, there is no national framework for AV testing in the United States. While 31 states have testing-friendly policies, inconsistent requirements make it difficult to scale effectively.⁶² There is no national standard for disclosing testing data, aside from isolated mandates such as those issued by the California Department of Motor Vehicles. Many U.S. firms claim operational data as business intelligence, leading to a lack of data transparency. This gap has led to lower public trust: where 60% of the Chinese population is receptive to passenger AVs, only 30-35% in the United States is receptive.⁶³ Deployment and adoption are equally crucial to bringing AVs to market, and the lack of cohesive standards in the United States poses a significant barrier to national adoption.

⁵⁹ Liu Miao, [New Chinese Regulations Push L3 Autonomous Vehicles Closer to L4 Capabilities with Enhanced Safety Protocols](#), Car News China (2026).

⁶⁰ An Ranran, [Over 50 Chinese Cities Have Brought Out Rules for Self-Driving, Smart Connected Vehicles](#), Yicai Global (2025).

⁶¹ [China Unveils Details of 20-City Pilot for “Vehicle-Road-Cloud Integration”](#), 7ITS News (2024).

⁶² [Autonomous Vehicle Statutes and Regulations Across the 50 States](#), Baker Donelson (2024).

⁶³ Markus Hagenmaier, et al., [Here at Last: The Evolution of the Robotaxi](#), Boston Consulting Group (2026).

Autonomous Vehicles for Freight: U.S.-China Overview

The global landscape for autonomous freight transportation has entered an inflection point for commercialization. Driverless trucks have the transformative potential to mitigate driver shortages, reduce logistical overhead, and enhance roadway safety at a scale never achieved before. The global autonomous long-haul trucking market reached approximately \$2.7 billion in 2024, of which the U.S. market constituted almost 40%. However, the Asia-Pacific region, led predominantly by China, is identified as the fastest-growing market.⁶⁴ By 2035, the domestic revenue pool is estimated to reach \$178 billion in the United States and \$327 billion in China.⁶⁵

In China, Inceptio Technology has emerged as the global leader in operational volume. As of early 2026, the Inceptio fleet includes over 4,000 autonomous trucks with over 240 million miles logged. However, Inceptio's trucks operate solely at the L2+/L3 level; the company does not expect to realize L4 deployment until mid-2028.⁶⁶ The U.S. sector is led by firms like Aurora Innovation, Kodiak Robotics, and Gatik, which prioritize deployment at Level 4 autonomy. Aurora launched commercial driverless freight services in April 2025 and expanded its network to ten active lanes across the Sun Belt in February 2026. With over 250,000 driverless miles logged, the company's fleet currently includes 30 trucks, with 10 operating fully driverless.⁶⁷ Aurora's success is characterized by a "hub-to-hub" model, where driverless trucks operate across long-haul highway segments and are handed off to human drivers to handle local, complex "first and last-mile" driving.⁶⁸ In January 2026, Gatik became the first company in the United States to deploy fully driverless trucks at a commercial scale.⁶⁹ While the total U.S. fleet size is currently smaller in raw units compared to China's L2+/L3 fleets, the United States is leading in operational maturity and technical complexity at the L4/L5 level.

China's national standards and road-testing regulations for AVs have generally covered both passenger and freight applications. However, the United States is taking a more segmented approach. Compared to national policy for passenger AVs, U.S. policy for autonomous freight vehicles is far more comprehensive. The AMERICA DRIVES Act, for example, was introduced in July 2025 and would establish a federal framework to regulate and accelerate the deployment of L4/L5 autonomous commercial trucks nationwide. The Act would override varying state policies and amend testing policy to exempt qualifying autonomous trucks from human-centric requirements.⁷⁰

⁶⁴ [Autonomous Long-Haul Trucking Market Size & Share 2025 - 2034](#), Global Market Insights (2025).

⁶⁵ Ani Kelkar, et al., [Will Autonomy Usher in the Future of Truck Freight Transportation?](#), McKinsey & Company (2024).

⁶⁶ [Inceptio Technology Outlines Commercial Roadmap for Scalable L4 Autonomous Trucks at Next Truck 2025 Conference](#), Inceptio (2025).

⁶⁷ Jacob Bethell, [Autonomous Truck Fleet Management 2026 | Self-Driving Freight](#), Fleet Rabbit (2026).

⁶⁸ [Aurora's Self-Driving Semis Hit Texas Highways, A New Era for Freight Logistics](#), TruckClub (2025).

⁶⁹ Jacob Bethell, [Autonomous Truck Fleet Management 2026 | Self-Driving Freight](#), Fleet Rabbit (2026).

⁷⁰ H.R.4661, [AMERICA DRIVES Act](#), 119th Congress (2025).

Outlook: Without U.S. Industrial and Policy Infrastructure, China Will Capture the Market

China's current momentum in AV development positions it to surpass the United States in scale and become the global leader in passenger AVs by 2035. While the United States retains a qualitative advantage in software and system architecture, this lead is increasingly undermined by a lack of regulatory cohesion, which, in turn, is slowing adoption. Although the hardware layer is technically distinct, the United States remains strategically vulnerable if its path to commercialization is economically tethered to Chinese manufacturing and components. If these structural weaknesses are not overcome, the United States risks losing the battle for the global AV market.

| Will American shortfalls in hardware prove detrimental to its AV competitiveness?

At the technical level, AV competitiveness is defined by software, not hardware. However, at the current stage of maturity, AV deployment is as much an economic challenge as a technical one, and reliance on hardware is a problem at the economic level. Waymo's decision to outfit the Chinese Zeekr model is a reflection that neither U.S. domestic capacity nor its allies can currently match China's manufacturing scale and cost-efficiency. U.S. ability to scale is constrained by the cost of fleet expansion, where China surges ahead: Baidu purchased electric vehicles for autonomous deployment for approximately \$30,000 per vehicle, a figure markedly cheaper than the estimated \$120,000 per vehicle spent by Waymo to purchase and retrofit the Jaguar I-PACE models.⁷¹

Therefore, U.S. dependence on China to scale and deploy fleets poses a significant strategic risk, including economic reliance and hollow manufacturing capability. This risk is compounded by expert predictions that China has a 74% probability of developing a sovereign software platform to hedge against geopolitical risk.⁷² Bolstered by independent supply chains, a successful regionalization of China's entire AV tech stack could render the current U.S. advantage in software negligible globally.

| Will China's Lead in Electric Vehicles Give it Absolute Advantages in AV Development?

In concept, AV development is not technologically dependent on electric vehicles (EVs), as AVs represent a software innovation while EVs are a hardware innovation. However, the two technologies have become economically intertwined. [China remains the global leader in the EV](#)

⁷¹ Marc Joffe, [Should We Worry about Waymos from China?](#), The Orange County Register (2025).

⁷² Where to next? [Insights from Autonomous-Vehicle Experts](#), McKinsey & Company (2026).

[market](#), creating high cost and significant efficiency advantages for deploying AV technology on EV platforms.⁷³

In terms of hardware, EV architecture is generally more suited to the performance demands of AV systems. A typical AV sensor suite requires a constant, substantial power supply that exceeds the 12V capacity of a traditional internal combustion engine (ICE), for which the electrical system is designed for basic auxiliary functions like lighting. EVs utilize high-voltage battery systems to balance propulsion with computation.⁷⁴ EVs also enable more reliable, instantaneous AI control via drive-by-wire systems. The instant power and fewer mechanical variables of the electric drivetrain eliminate mechanical lag, making it more suited to the precision and repeatability of AI systems.⁷⁵ Total cost of ownership for passenger vehicles is also lower for EVs than gasoline vehicles: EVs offer up to 50% lower maintenance costs and a significantly lower energy cost per mile, averaging approximately \$0.05 for EVs compared to \$0.17 for gasoline vehicles.⁷⁶

Currently, there are no non-electric AVs in significant operation. The primary application for passenger AVs, robotaxis, strengthens this reliance, as charging infrastructure is more accessible in the urban areas where these fleets are deployed.⁷⁷ While they are complementary rather than necessarily dependent technologies, an EV market collapse would drastically increase the per-unit cost of AV deployment and operation, likely stalling large-scale commercialization.

⁷³ Channing Lee, [Charging Ahead: How China is Driving Innovation to Dominate the Global Electric Vehicle Market](#), Special Competitive Studies Project (2025).

⁷⁴ Michelle Froese, [Why EV Architecture Changes the Rules for Self-Driving Systems](#), EV Engineering Infrastructure (2025).

⁷⁵ Ade Thomas, [Autonomous Vehicles Will End the ICE Debate: and That's Why EVs Will Win](#), Electric Drives (2026).

⁷⁶ [An EV Fleet Perspective of the Total Cost of Ownership \(TCO\)](#), Qmerit (2024).

⁷⁷ Ryan McCauley, [Why Autonomous and Electric Vehicles Are Inextricably Linked](#), Government Technology (accessed 2026).

Recommendations

1. Establish a national framework for AV permitting, safety evaluation, and data transparency.

The U.S. government should establish a national framework that governs the regulatory aspects of AV deployment. The gap left by a lack of federal policy has been partially filled by inconsistent state and local policies, slowing national AV expansion. An incremental, performance-based approach to permitting applied nationwide will properly and safely inform companies and regulators. Models like the conceptual framework published by the San Francisco County Transportation Authority can serve as guidance.⁷⁸ Federal mechanisms for assessing AV performance, understanding the extent of AV operations, and defining critical safety metrics will set a standard for safety, enabling companies to quickly expand the scale and complexity of their operations once these standards are met. Finally, operational data transparency mandates will strengthen public trust and increase all parties' capacity for informed risk mitigation.

2. Invest in the science of testing and evaluation to streamline the transition from innovation to commercialization.

The NHTSA, DOT, NSF, and other relevant agencies should establish a coordinated, dedicated funding line to support the science of testing and evaluation. To achieve market readiness, AVs are projected to necessitate up to \$3 billion in software validation costs.⁷⁹ Government agencies should fund non-industry actors to develop independent datasets, benchmarks, and assessment processes, as well as general research into simulations, road pilots, and risk estimation. Investments should also support the physical and digital resources required for testing, including shared and accessible testbeds, living labs, and compute facilities.

3. Safeguard the U.S. connected and digital transportation ecosystem from cyber threats.

The software that powers AVs must be treated as critical infrastructure. The technologies that control vehicle movement also record vast amounts of passenger data and high-definition information about American infrastructure. As AVs integrate into smart cities and digital transportation systems, there will be more opportunities for sensitive information to be exploited.⁸⁰ The cybersecurity stakes will encompass both physical passenger safety and

⁷⁸ [Conceptual Safety-Focused AV Permitting Framework](#), San Francisco County Transportation Authority (2025).

⁷⁹ Where to next? [Insights from Autonomous-Vehicle Experts](#), McKinsey & Company (2026).

⁸⁰ Joe Biden, [FACT SHEET: Protecting America from Connected Vehicle Technology from Countries of Concern](#), The American Presidency Project (2024).

national security. To protect the U.S. transportation ecosystem from cyber threats, the government should mandate secure-by-design standards specifically for autonomous driving systems and related connectivity layers. This includes requiring companies to avoid using software developed by adversaries and develop robust plans to proactively monitor for and respond to unauthorized access. Finally, federal support should be designated to help both industry actors and public transportation agencies implement unified cyber-resiliency measures.

Appendix: Tech Scorecard Matrix

The Tech Scorecard relied on expert scoring of quantitative and qualitative data across many technology-specific metrics relevant to each category of positional advantage in robotics for advanced manufacturing. Final scores were determined by a weighted average of the following metric scores. The 1-to-5 ranking corresponds to the following rubric:

- 1. Negligible / Nascent:** The country has minimal presence or capability in this metric. The data point is insignificant on a global scale.
- 2. Emerging / Minor:** The country is active but below the global average or industry standard. They are followers or niche players. Performance is functional but clearly inferior to top-tier competitors.
- 3. Competitive / Mainstream:** The country operates at the global industry standard. The metric represents a healthy, functioning ecosystem that meets current market needs but does not differentiate itself as superior.
- 4. Advanced / Leading:** The country is among the top tier globally. The metric shows performance, scale, or quality that exceeds the average and rivals the best.
- 5. State-of-the-Art / Dominant:** The country sets the global benchmark. This metric represents the absolute peak of what is currently possible.

	Metric	Source(s)	Weight	U.S. Score	China Score
Innovation Leadership	Share of top 10% global paper references	OpenAlex	Low	4	5
	Share of domestic papers co-authored by industry and academia	OpenAlex	Medium	4	3
	Leadership in VLA models	Industry Studies - Andreessen Horowitz, 36Kr	Medium	5	3
	Miles per airbag deployment	Waymo, Apollo Go	High	5	4
	Best-in-class robotaxi miles per disengagement	State of California DMV	Low	5	4
	Number of software recalls	NHTSA	Low	4	5
	Best-in-class max operating speed	Zoox, Forbes	Low	4	5
	Physical miles driven	Autonomous Vehicle Industry Association, SCSP analysis	Low	4	4
	Share of global forward cited patents	Lens Patent Search	Low	5	3

Innovation Leadership	Presence at IAA Mobility	IAA Mobility	Low	3	3
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Industrial Capacity	Per unit cost of production	The Economist	High	3	4
	Access to critical minerals	Foreign Policy	Medium	2	4
	Share of global LiDAR production	Yole Group	Low	1	5
	Cost of domestic LiDARs	Science & Technology Daily	Low	2	4
	Equipment net export volume	UN Comtrade	Low	1	4
	Fleet size	SCSP analysis of Waymo, Tesla, Zoox; Goldman Sachs	Medium	4	5
	Service availability	Business Insider, Visual Capitalist	Low	4	5

Market Ecosystem	Share of global capital raised	Pitchbook	Medium	5	4
	Number of rides completed	ChinaTalk	Medium	4	5
	Projected 2035 penetration rate	NASDAQ, Goldman Sachs	Low	4	3

Market Ecosystem	Projected 2035 fleet size	Boston Consulting Group	Low	3	5
	Market growth projection	TrendForce	Low	4	5
	Market size	TrendForce	Low	5	3
	Revenue per vehicle	Forbes, Goldman Sachs	Medium	4	3
	Foreign country testing permits	Waymo, Goldman Sachs	Low	3	5

Talent Pipeline	Specialized university programs	Global Times	Medium	2	4
	University-industry clusters	SCSP analysis of various press releases	Medium	3	3
	% of leading AI researchers	Morgan Stanley	Low	5	3
	Engineering undergraduates as % of all undergrads	NCES, The Economist	Low	3	5

National Leverage	Public acceptance	Boston Consulting Group	Medium	3	4
	Strength of data transparency policy for testing	Chinese Ministry of Industry and Information Technology	Medium	1	4

National Leverage	Strength of national strategy	China Law Insight, Bloomberg, Chinese Ministry of Industry and Information Technology	Medium	2	4
	Regions with robotaxi testing-friendly policies	Baker Donelson, Yicai Global	Low	3	3