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Global Autos & Shared Mobility

Robotaxi Diffusion – Robots, Taxis and the Trillion-Dollar Traffic Portal

Converting the first 1% of the global taxi fleet to driverless isn't a trial but a multiplier. With the ecosystem ready, costs halved, and participants doubled, leading players will accumulate competitive advantages. Robotaxis' race to scale is a race to market cap. We see a US$1 trillion global opportunity.

Robotaxi shifting from tech pilots to commercial scale: Al advances, more ready players, falling hardware/training costs, and clearer regulation have moved robotaxis from tech pilots to commercial scale, with several driverless operators already running around the clock. The setup rhymes with early ride-hailing, handing an outsized advantage to whoever moves first.

We see a $1 trillion market opportunity by 2040 based on the global robotaxi model jointly built by MS Auto and Internet teams. We forecast unit economics to broadly reach break-even by 2028 with scaled operations by 2030. By 2035, we forecast a global robotaxi fleet of ~2.5mn-vehicles, evolving from centralized deployments into a distributed mobility network. At scale, this network could support daily passenger volumes comparable to the populations of countries such as South Korea, France, or Germany. The US and China lead today; Europe and broader Asia may emerge with increasing importance by mid-decade.

Material wealth creation/restructuring – AV gleaming, EV dim, ICEV's outlook turning grim. Autonomous mobility players that win the first 1% of land grab should see market caps multiply. A handful of EV incumbents look especially well placed for the L4 shift on technology and cost. Traditional ICEVs continue to face sales pressure across both consumer and fleet markets.

Two global bellwethers, multiple emerging regional players: We expect Waymo and Tesla to be global leaders, anchored by their installed base and tech depth, with strong regional players in four archetypes as AI-driven deflation democratizes capability - L4 start-ups with city-specific depth (Zoox, WeRide, Pony.ai); ride-sharing platforms (Uber, DiDi); EV makers with autonomy capability (XPeng); and tech heavyweights with compute and consumer reach (Baidu).

One major underappreciated accelerant is Chinese supply-chain deflation, compressing cost-prohibitive technology into a mass-market component. We see the BoM of China-made robotaxi solutions hitting US$35-40k in 2027, then falling at 3-5% CAGR through 2030.

How to play the theme? We introduce a "Robotaxi 30" framework mapping competitors and business models across regions and the value chain. Initial alpha is

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less likely to accrue to generic OEM assembly than to tech and consumer-access owners (e.g. Waymo via Alphabet [Brian Nowak], Tesla [Andrew Percoco]) and low-cost AV-stack enablers (e.g. Baidu, WeRide, Hesai, XPeng). For region-constrained investors, US exposure is largely through listed parents/platforms, China/HK offers more direct AV/EV-stack plays, and Europe/Asia ex-China remains mostly partnership-led. The race is not just to perfect L4, but to own the ride.

Catalysts and risks: Near-term catalysts include driverless expansion and regulatory momentum; further cost declines and end-to-end AI advances should accelerate adoption. Against that, uneven regulation could delay deployment, a safety incident could chill demand, and global expansion may prove harder than expected.

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CHINA AUTOS & SHARED MOBILITY

Asia Pacific
Industry View **In-Line**

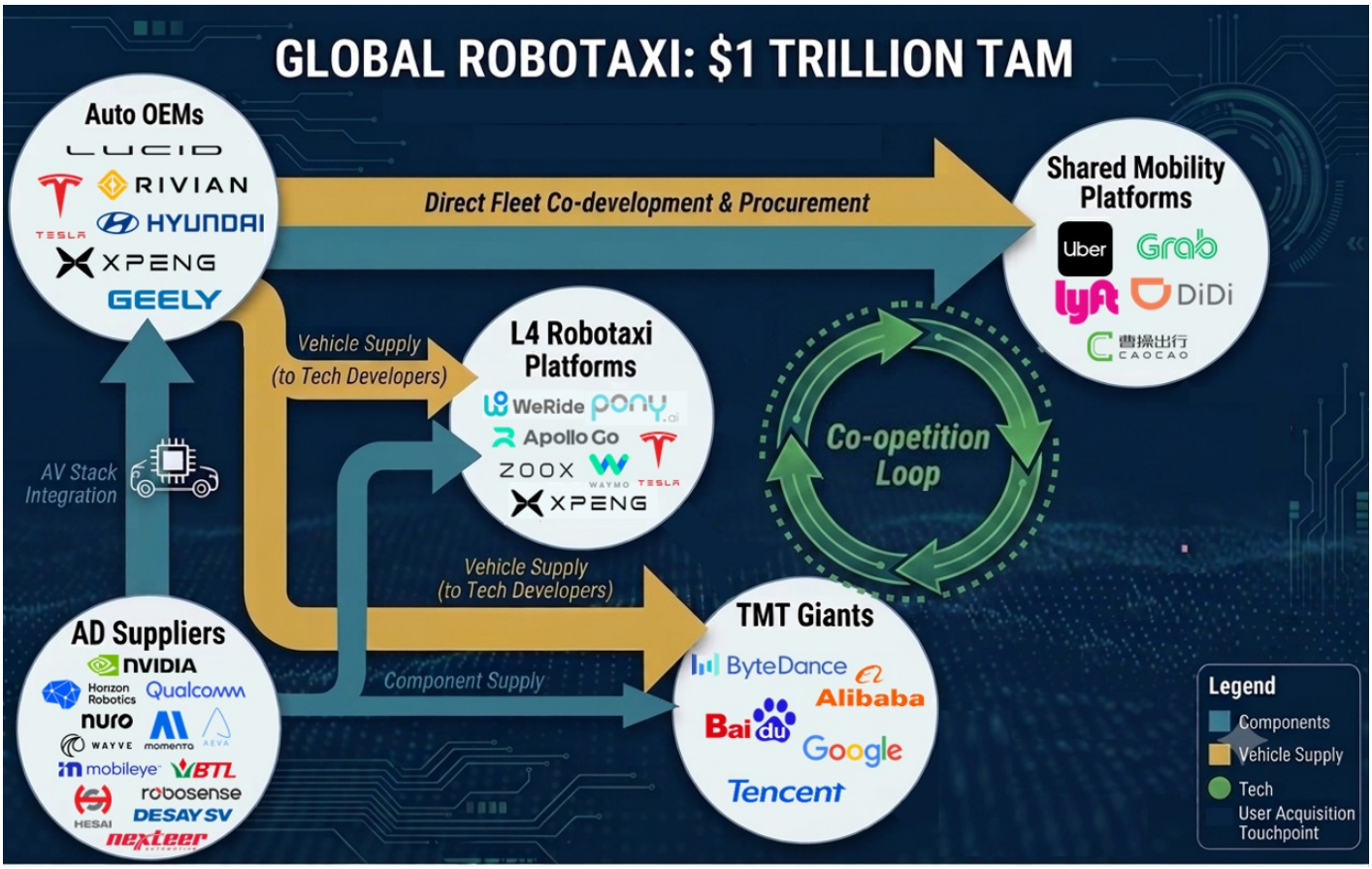
The Story in Charts

Exhibit 1: Robotaxi 30 – Who are the key players in the global robotaxi market?



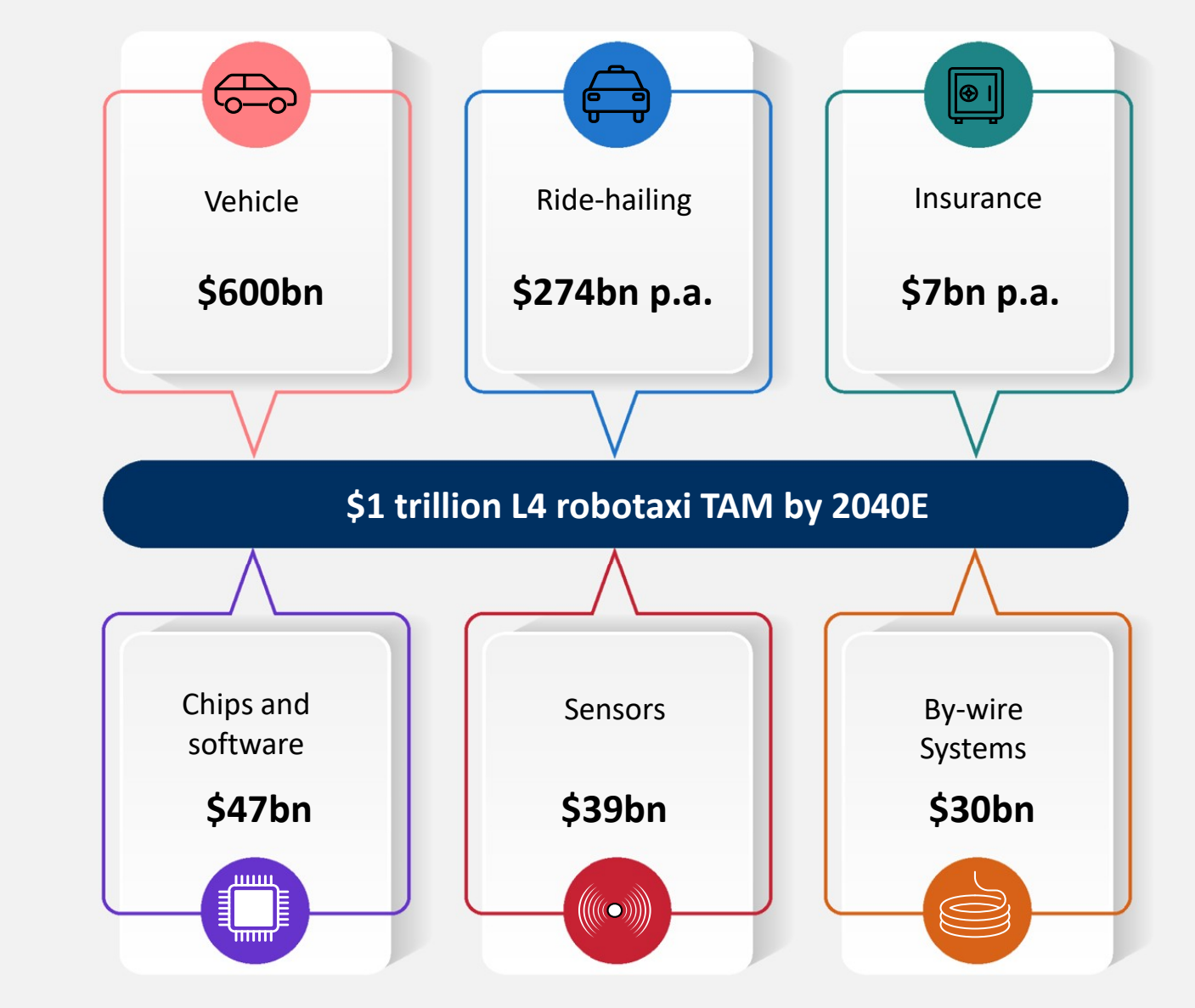
Source: Morgan Stanley Research

Exhibit 2: A US$1 Trillion Ecosystem in the Making



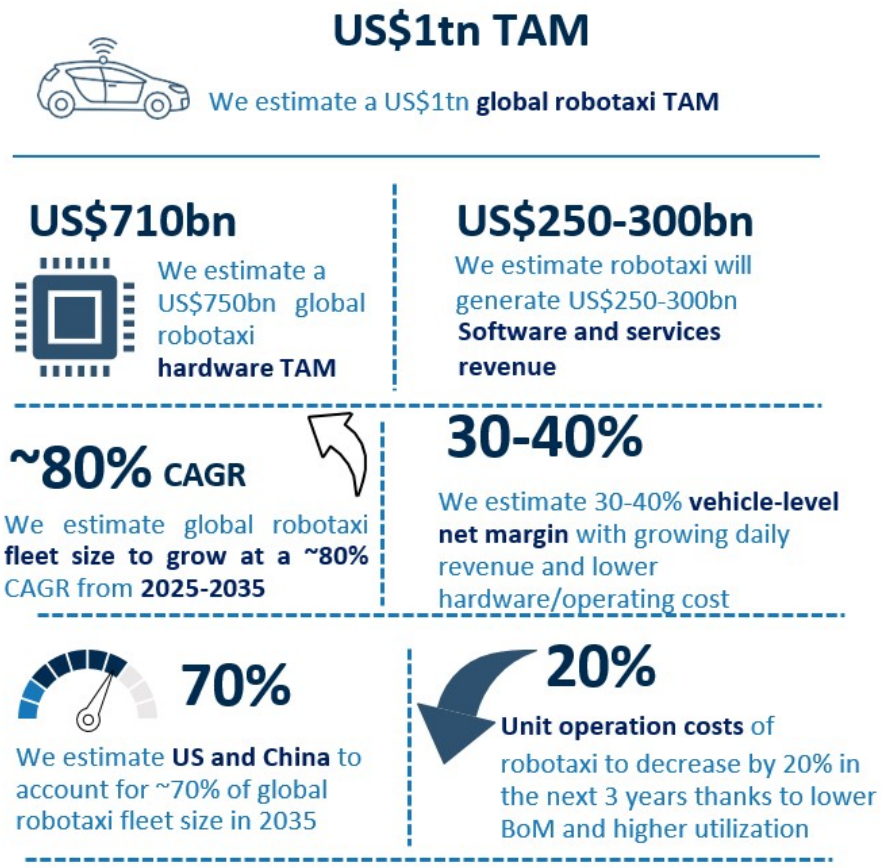
Source: Morgan Stanley Research

Exhibit 3: Robotaxi market to reach US$1 Trillion



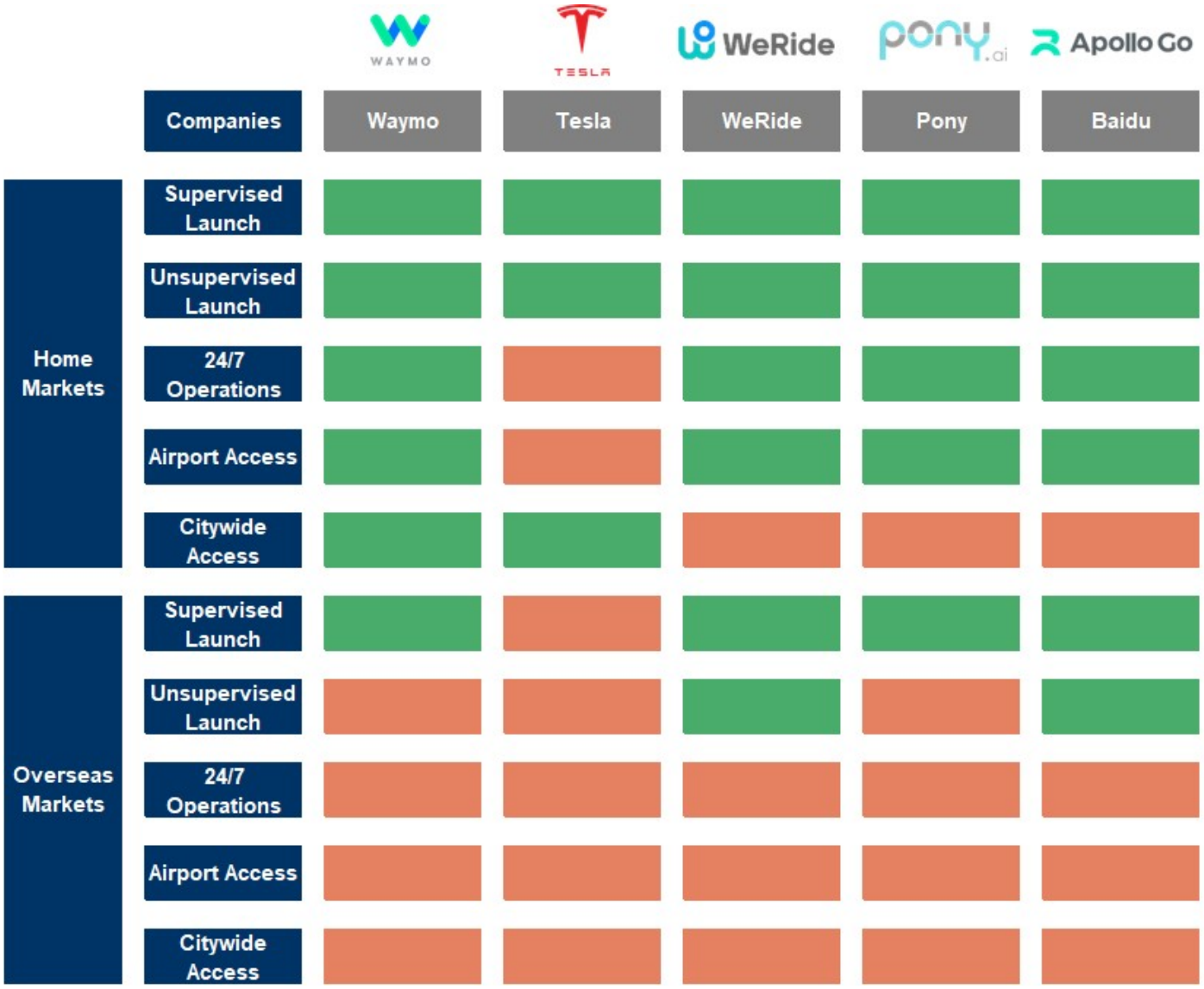
Source: Morgan Stanley Research estimates

Exhibit 4: Summary of robotaxi fleet forecasts



Source: Morgan Stanley Research estimates (E)

Exhibit 5: Where do we stand today?



Source: Company data, Morgan Stanley Research. This table only evaluates companies on their capabilities for commercial rides with a passenger at scale.

Executive Summary



Inflection Point: From Pilots to Commercial Scale

The global robotaxi industry is entering a decisive phase, shifting from limited pilots to early commercialization. Advances in artificial intelligence, falling hardware costs, and improving regulatory clarity are enabling real-world deployment, with several operators already running fully driverless services around the clock in select cities. As a result, the key question for investors has moved beyond technological feasibility toward identifying which players can scale most efficiently and profitably. This transition mirrors the early days of ride-hailing and sets up a potentially large first-mover advantage.

New Analysis: A US$1 Trillion Opportunity with Improving Economics

This report builds a differentiated, bottom-up view of the robotaxi ecosystem, estimating a total addressable market of roughly US$1 trillion across mobility services, vehicles, software, and adjacent industries. We forecast a global fleet of approximately 2.5 million robotaxis by 2035, with the US and China accounting for the majority of adoption. Crucially, detailed unit economics analysis shows that costs are already below US$0.50 per kilometer in some cities in China and trending lower globally, supporting the potential for 30–40% margins at scale. We also introduce a "Robotaxi 30" framework to map the competitive landscape and business models across regions and value chains.

Industry restructuring: AV gleaming, EV dim, ICEV's outlook turning grim

Robotaxi diffusion is structurally positive for technology enablers/operators and related components (sensors, compute, by-wire systems, and software), more neutral-to-mixed for NEVs, and potentially another push for the ICEV-to-NEV transition on a broader global basis. In addition, broader robotaxi availability could also have longer-term implication on the ownership of private passenger vehicles, shifting value from traditional vehicle sales toward autonomous fleets, mobility platforms, and service-based models.

Core Insight: A Platform Shift with Emerging Winners

Robotaxis represent a structural platform shift rather than just an extension of the auto sector, with value creation spanning OEMs, ride-hailing platforms, AI leaders, and semiconductor companies. Cost deflation – particularly driven by China's supply chain – acts as a key catalyst for adoption and intensifies competitive pressure globally. At the same time, early signs of winner-takes-most dynamics are emerging, as scaled operators benefit from data advantages and cost efficiencies. Market leadership is beginning to concentrate among a small group of companies, while the broader ecosystem evolves toward partnership-driven "co-opetition."

Catalysts: Scaling, Cost Parity, and AI Progress

Near-term catalysts include the expansion of driverless operations into new cities and the scaling of partnerships between autonomous technology providers and ride-hailing platforms. Over the medium term, further declines in hardware costs and improving utilization rates should drive robotaxis toward cost parity with traditional ride-hailing globally. At the same time, advances in end-to-end AI models and data accumulation are likely to strengthen the competitive positioning of early leaders, establishing barriers to entry and pushing industry consolidation.

Risks: Regulation, Execution, and Adoption Curve

Despite the strong long-term outlook, several risks remain. Regulatory progress may be uneven across regions, particularly outside the US and China, potentially delaying deployment. Safety concerns or adverse incidents could slow consumer adoption and invite stricter oversight. There is also a risk that unit economics improve more slowly than expected due to lower utilization or higher costs, while the capital intensity of scaling fleets may weigh on near-term returns. Finally, global expansion could prove more complex than anticipated, given differences in infrastructure, policy, and consumer behavior.

Investment Thesis – Robotaxi Ecosystem has Arrived; the Real Race Can Begin

Setting the Scene

A decade in the making. Try launching Uber or Didi in 2009. No smartphones, no mobile payments, no GPS, no app store. Even with flawless vehicles and drivers, it would have failed on arrival. For the past decade, robotaxis faced a similar reality. The vehicles were not capable, the tech wasn't ready, and the world around them remained deeply circumspect of the prospect.

That ecosystem has finally materialized. Robotaxis are moving from pilot programme to prime time, propelled by four converging forces: **1)** A flood of well-capitalized, diverse players. **2)** End-to-end Al breakthroughs. **3)** Collapsing hardware/training costs. **4)** Clearer, more constructive regulations amid intensifying global competition.

The journey is just beginning and substantial hurdles remain, but we are at an inflection point. Consumer skepticism towards robotaxis still runs high, but perception is shifting as autonomous ride-hailing moves from concept to commercial reality. The gap between public perception and industry momentum is narrowing - driven by "first ride effect", continuous tech advancement, and the accelerating pace of real world deployment, in scale.

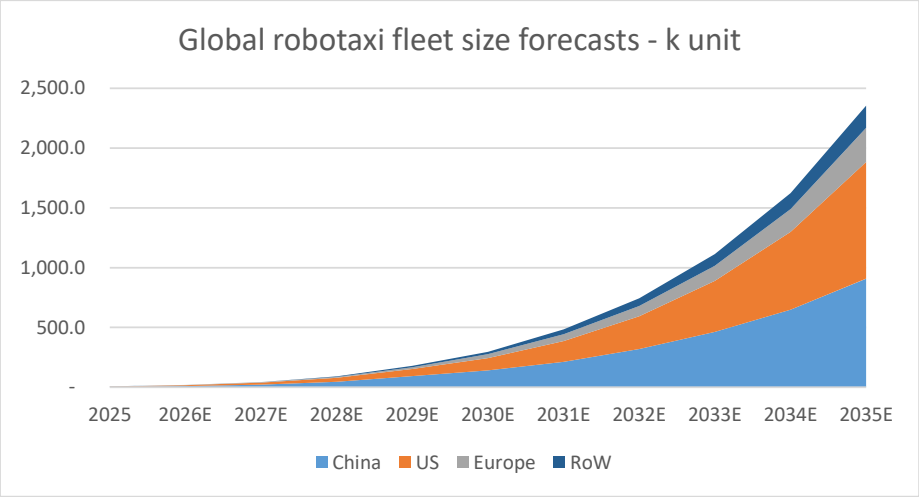
From 2026, the race stops being about proving it can be done, and becomes about who can move the furthest, the fastest, and the cheapest. Credible players, such as Waymo (covered by Brian Nowak), Baidu Apollo (covered by Gary Yu), WeRide (covered by Tim Hsiao), and Pony.ai (NC), are already running 24/7 fully driverless fleets across a growing list of cities.

Is regulation holding back robotaxi commercialization? Conflicts between consumer demand for autonomous mobility and regulators' focus on safety, liability, data governance, and urban traffic management are creating challenges for OEMs and robotaxi operators in major markets like China. While robotaxi technology may advance faster than regulatory frameworks at times, we believe enforceable standards are essential for scaling the industry responsibly. Clear rules should help build public trust, reduce operational uncertainty, and support the emergence of global leaders.

The Autonomy Inflection. MS Auto and Internet teams have jointly developed a proprietary global robotaxi model with high conviction – we expect unit economics (UE) breakeven by 2028, scaled commercial operations by 2030. By 2035, we see a 2.5mn-vehicle global fleet, serving daily demand at the scale of the population of S. Korea, France or Germany.

In our view, this is the transition that matters – from proof-of-concept to a genuine transportation utility. In the next decade, the robotaxi fleet will be no longer a collection of pilot programs but a distributed mobility grid. The US and China are gaining an upper hand in the near-term with respect to technological advances and fleet rollout, while Europe and broader Asia will play an increasingly important role in shaping the industry landscape over the longer term.

Exhibit 6: Global robotaxis forecasts



Source: Morgan Stanley Research estimates (E).

Behind The Scenes

Unit cost of operation is set to decrease 20% in 3 years…: We expect operational leverage to continue kicking in for the next 3 years, and a 20% or more significant cost decrease over the period. This, together with the rise of fare rate for robotaxi to catchup with ordinary taxis and shared mobilities, leads to a modest profit margin of ~10% by 2028 at the robotaxi vehicle level. At that level, robotaxis don't just compete with human drivers; they undercut private car ownership. Once scaled, these fleets can meaningfully alter the cost structure of current mobility industry, unlocking vehicle-level net margins north of 30% globally – and above 40% in developed markets.

… driven by two strong global leaders and multiple emerging regional players: We expect Waymo (covered by Brian Nowak) and Tesla (covered by Andrew Percoco) to be global leaders, anchored by installed base and tech advancement. AI-driven tech breakthroughs/deflation are democratizing capability and four distinct challenger archetypes are building credible positions: 1) L4 robotaxi start-ups with city-specific depth (Zoox [covered by Brian Nowak], WeRide [covered by Tim Hsiao], Pony.ai); 2) ride-sharing platforms (Uber [covered by Brian Nowak], DiDi); 3) auto OEMs with autonomous driving capabilities (XPeng [covered by Tim Hsiao]); and 4) internet and tech heavyweights with compute, mapping, and consumer access at scale (Baidu [covered by Gary Yu]).

Turning the focus to cross-border… The spotlight on US/China as key robotaxi markets, but we see momentum is also building in a handful of strategically important markets beyond them – Europe, the Middle East, and Southeast Asia. These regions are set to play a meaningful role in shaping the global robotaxi competitive landscape. And the playbook is shifting fast: Chinese players can optimize the cost structure of the vehicle (thanks to their head-start in NEV production), while local ride-sharing champions unlock utilization and market access.

… and partnerships across ride-sharing platforms, robotaxi operators, and tech/ hardware suppliers. For example, Uber (covered by Brian Nowak) is emerging as a key distribution platform, partnering with Waymo (covered by Brian Nowak) in the US, WeRide (covered by Tim Hsiao) across the Middle East and Europe, as well as Pony.ai,

Momenta, and Wayve in international markets. Meanwhile, Baidu's Apollo Go (covered by Gary Yu) has aligned with Lyft to deploy autonomous ride-hailing services across Europe, and Mobileye partners with MOIA in Oslo. WeRide is also expanding into Southeast Asia through its partnership with Grab, while Pony.ai is extending its international footprint through collaborations with ComfortDelGro in Singapore, Bolt in Europe, and Mowasalat in Qatar.

Partnerships Are Likely to Be Central to Global Robotaxi Scaling

Could ADAS-led OEMs and L4 fleet operators converge over time? We believe OEMs could pave an evolutionary path from ADAS up to L4 robotaxi. However, it would likely take much greater effort and time to ramp up a scaled autonomous ride-hailing network that demands intricate fleet logistics, regulatory savvy, and operational efficiencies. Those criteria will stay as an economic moat to incumbent fleet operators as scaling L4 fleets is a completely different operating model vs. ADAS commercialized today for passenger vehicles.

Key risks to commercialization: Regulatory fragmentation, safety skepticism, unit economics that disappoint, and high upfront R&D requirements still keep execution risk elevated.

Second-order implications are beginning to emerge across adjacent sectors: As L3/L4 liability shifts from drivers to OEMs and software stacks, insurers face a major reset with personal auto lines shrinking while new specialty coverage emerges. High-utilization electric fleets could accelerate gasoline-demand displacement beyond private EV adoption alone. Across the supply chain, x-by-wire, centralized DCUs, and perception hardware are entering volume ramp up, while steering-free cabins turn in-car space into monetizable real estate for displays, HMI, and immersive experiences. Mobility is being repriced from ownership to outcomes, shifting value toward platforms, content, and data. At the silicon layer, surging vehicle compute needs could support a meaningful semiconductor content upgrade cycle.

Rather than focusing on a single winner, focus on the factors that scale – Robotaxi 30: To better capture the opportunities throughout the journey, we have created a Robotaxi 30 list that we believe is well positioned for the L4 future. The real alpha right now isn't in picking the one winner, we believe; it's in backing the trio that determines who scales first: cost advantage, cross-border tie-ups, and direct consumer access. We think investors should focus on who owns the ride.

Exhibit 7: Robotaxi 30 – Who are the key players in the global robotaxi market?



Source: Morgan Stanley Research.

The conclusions and robotaxi value-chain mapping in this report are supported by supply chain checks, our global robotaxi model, and the insights of Morgan Stanley auto, Internet and tech analysts around the world, underpinning our bottom-up analysis of local competitive dynamics for individual stocks.

In response to investor feedback, we place greater emphasis on first-order 'enablers and explorers' that we believe will be most consequential to the development and scaling of the robotaxi ecosystem.

This framework is intended as a starting point for investors to identify public and private companies shaping the next phase of robotaxi development, with an emphasis on global industry landscape and commercialization potential. It is not intended to be exhaustive; rather, we welcome ongoing dialogue as the ecosystem continues to evolve.

The robotaxi industry is a fast-evolving vertical of embodied AI, where cross-sector collaboration is accelerating both innovation and investment opportunities. We segment the robotaxi value chain, as part of the broader autonomous driving ecosystem, into six key groups that capture the interaction among technology enablers, OEMs, and mobility service providers.

Robotaxi investment cases will largely depend on adoption speed, monetization and competitive moats. Investors are focused on credible deployment curves rather than isolated demonstrations, and keen to strip away the "mobility-as-a-service" buzzword to expose the unit economics and revenue levers that will make or break the robotaxi case. Separately, robotaxi isn't just competing technologies but business models, so spotting the commercially durable players is crucial to separate market calls from noise.

To verify the investible narrative, we address five key questions in this report:

- How Quickly Could Global Robotaxis Ramp up?

- What Are The Different Revenue Models?

- How Do Robotaxi Players Differ in Their Routes to Scale?

- Is Motor Insurance on the Brink of Structural Transformation?

- What's The Potential Impact on Job Markets?

Key Milestones and Catalysts

Setting the Stage for 2026 Commercialization

Over the past five years, automotive OEMs, ride-hailing platforms, tech start-ups, and autonomous driving suppliers have methodically constructed the commercial foundations to enable a global robotaxi market.

We see 2026 as the industry's inflection year – evidenced by Waymo, Baidu Apollo, WeRide, Pony.ai and a growing cohort of global players, each operating 24/7 unsupervised commercial fleets across an expanding base of cities with an increasing focus on commercial operations rather than pilot demonstrations.

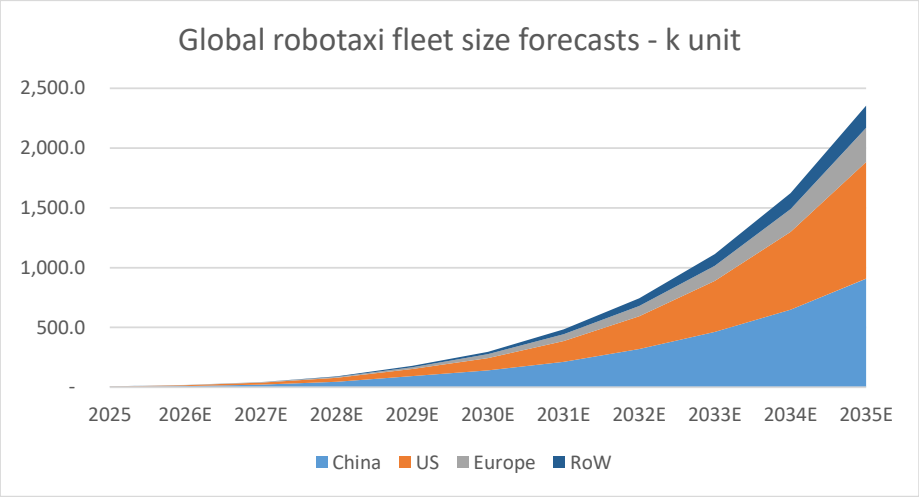
Our Central Projections

Supported by 1) a growing number of players, 2) rapid technology maturation, 3) falling costs, and 4) more constructive regulatory backing amid global competition, we project the global robotaxi fleet size to reach around 2.5mn units by 2035, driven by large-scale robotaxi deployment across the US, China and other developed markets. We expect significant valuation dispersion during these early adoption cycles as investors increasingly distinguish between companies that scale early and those that move more gradually.

From 2026 to 2035, we expect the US and China to function as early enablers of L4+ adoption, underpinned by favorable autonomous-vehicle policy frameworks, advanced technology expertise from tech and EV players, and mature ride-sharing networks that provide immediate demand channels. Simultaneously – and perhaps underappreciated by consensus – we see substantial potential emerging in Europe, the Middle East, and ASEAN, which could play a meaningful role in global fleet penetration and, in aggregate, represent an opportunity comparable to China's.

By 2035, we look for the global L4+ robotaxi fleet to reach 2.5mn units, serving daily demand equivalent in size to the population of S. Korea, France or Germany. The US and China would likely account for roughly 70% of fleet size with Europe alongside the Middle East and ASEAN capturing the remaining 30% – an absolute unit count large enough to accommodate multiple local winners.

Exhibit 8: Global robotaxi fleet size forecasts



Source: Morgan Stanley Research (E) estimates.

After years of cautious pilot trials, robotaxi adoption is approaching a steeper adoption phase, driven in our view by converging trends that self-reinforce:

- EV momentum is slowing while AV momentum is building: Major economies are becoming more engaged in shaping the development of L4 autonomous driving, supporting a more active policy backdrop that was largely absent over the past two years.
- Expanding operational design domains (ODD) generate more training data, which improves safety, which unlocks more permits, which expands ODDs further.
- Commercial rollout is accelerating, fuelled by a sharp increase in participants across automotive, technology, utilities, and beyond.
- These cross-sector players are pursuing distinct long-term strategies but share a near-term priority: scaling L4 ridership and data.
- A richer ecosystem and broader applications have shifted L4 autonomous driving from localized pilots toward broader commercial deployment.
- The network effects in data, where miles driven at L4 generate proprietary training signals, and enhance the competitive advantages for leading players who can scale fast.
- Early movers that remove drivers from just the first 1% of the 10mn vehicles on global taxi and ride-hailing platforms could see meaningful valuation upside; later entrants risk commoditization.

Four Powerful Catalysts Shifting Robotaxi Rollout into High Gear

Catalyst 1: Diverse Players Accelerated by AI Breakthroughs

End-to-end AI architectures are simultaneously lowering barriers to entry and raising performance ceilings. The transition from modular, rule-based autonomy stacks toward unified neural networks trained through world-model simulation - complemented by closed-loop reinforcement learning that exposes systems to the consequences of their own decisions - is dramatically compressing development timelines. The result is a

broader competitive field entering the space with commercially viable capabilities, accelerating both fleet deployment and the data flywheel upon which autonomous performance depends.

Globally, this AI wave has democratized access to L4-competitive technology in a way that pure hardware cost deflation alone never could. In the US, Waymo's (covered by Brian Nowak) hybrid AI-plus-rule-based stack and Tesla's (covered by Andrew Percoco) vision-only neural network approach represent two distinct approaches to long-run architecture - and both are maturing simultaneously. In China, WeRide (covered by Tim Hsiao), Pony.ai, and Baidu Apollo (covered by Gary Yu) have each crossed meaningful competency thresholds enabled by scale, with Chinese players benefiting from a regulatory environment that, unlike Europe, allows much broader testing permissions. In the Middle East, where operational design domains are less topographically complex and weather windows are broad, the AI maturity bar to commercial deployment has proven meaningfully lower – one reason WeRide was able to achieve unit economics breakeven in Abu Dhabi ahead of most other markets globally.

We highlight five categories of players: L4 pure-plays, OEM adjacents, ride-sharing platforms, solution providers, and tech heavyweights. Each are applying AI in ways that reflect their underlying competitive positioning.

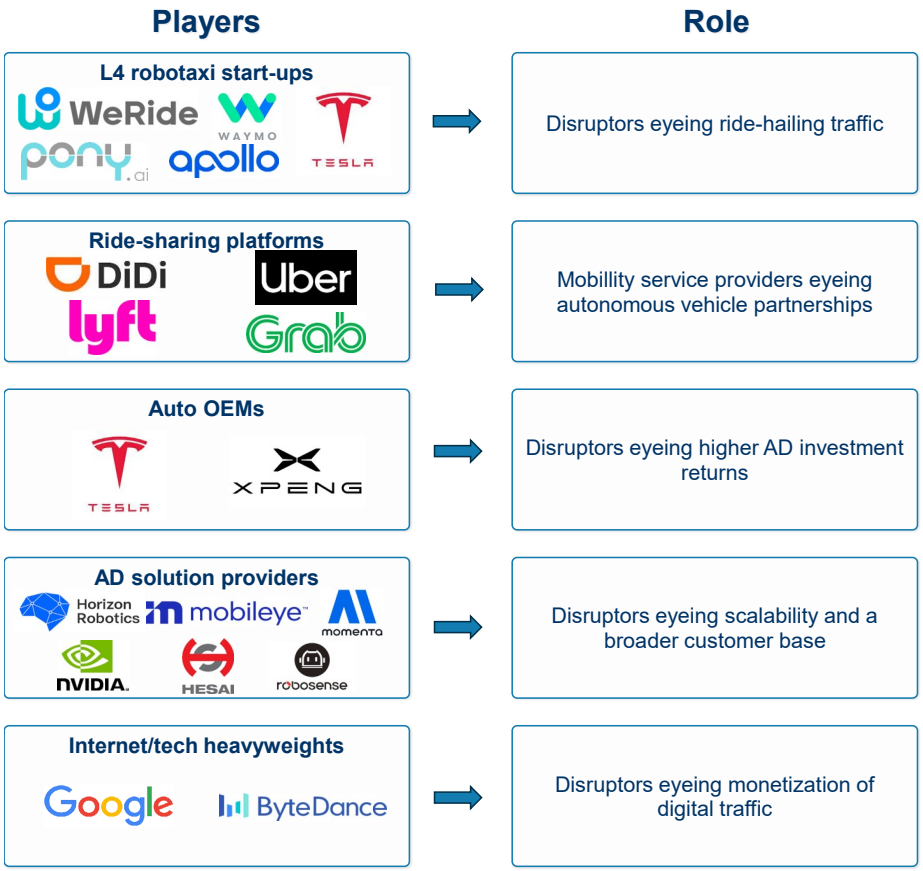
L4 pure-plays have the deepest algorithmic investment and the longest track record in driverless miles.

OEM adjacents have the broadest data corpus from consumer vehicle fleets, providing training signal diversity that purpose-built robotaxi operators cannot easily replicate.

Internet/tech heavyweights bring compute infrastructure and consumer distribution at scale.

We believe convergence of these capabilities is why 2026 feels categorically different from the hype cycles seen in both 2018 and 2021.

Exhibit 9: Key global robotaxi players



Source: Morgan Stanley Research.

Catalyst 2: Technology Maturation Meeting Commercial Scalability

Technological maturation is colliding with commercial scalability, driven by a fundamental shift toward end-to-end AI architectures. Leading robotaxi operators are demonstrating performance improvements measured in miles-per-intervention that would have seemed implausible two years ago. This evolution is complemented by advanced reinforcement learning techniques. Robotaxi players are exploring closed-loop training methods that more easily generalize, rather than relying solely on traditional behavior cloning methods. These improvements are directly reflected in MPI enhancements across major players.

Fleet operational data from Waymo's cumulative L4 miles globally, Pony.ai's city-wide deployments across China's four megacities, and WeRide's multi-continent operations are now generating the training signal volumes necessary for genuine generalization beyond geofenced competence. The distinction matters significantly for the medium-term competitive picture in our view – a system that can generalise can handle novel-edge cases without explicit programming, which is the prerequisite for expanding into new cities and geographies without proportional safety engineering investment.

In the US, Waymo's (covered by Brian Nowak) expansion to Washington DC and other snow markets represents geographic generalization corridors into markets with

meaningfully different driving environments.

In China, the maturation is particularly visible in the metrics that matter commercially. Pony.ai's 7th-generation robotaxi deployed to Guangzhou in late 2025 has hit the city-level unit economics breakeven threshold that the company had targeted for years. Baidu Apollo's system has cleared the same threshold in Wuhan. These are not demo metrics – they are production KPIs from fleets generating tens of thousands of rides monthly.

In Europe and the rest of the world, maturation is arriving at a lag but the pace is accelerating. For example, Uber (covered by Brian Nowak) is partnering with WeRide, Pony.ai, Momenta and Wayve across Europe, the Middle East, and several other regions. Baidu's Apollo Go and Lyft will deploy autonomous ride-hailing services across Europe while WeRide and Pony.ai are both expanding in SEA as well.

Catalyst 3: A Structural Change in Total Cost of Operation

Robotaxi total cost of ownership has declined sharply over the past three years, driven by operating leverage and continuous optimization of robotaxi vehicle BoMs. We project a further 20% reduction in operating cost per kilometer over the next three years, supported by ongoing sensor and hardware cost deflation, AI-driven software efficiencies, improving remote-assistance productivity ratios, and higher utilization as operational design domains expand.

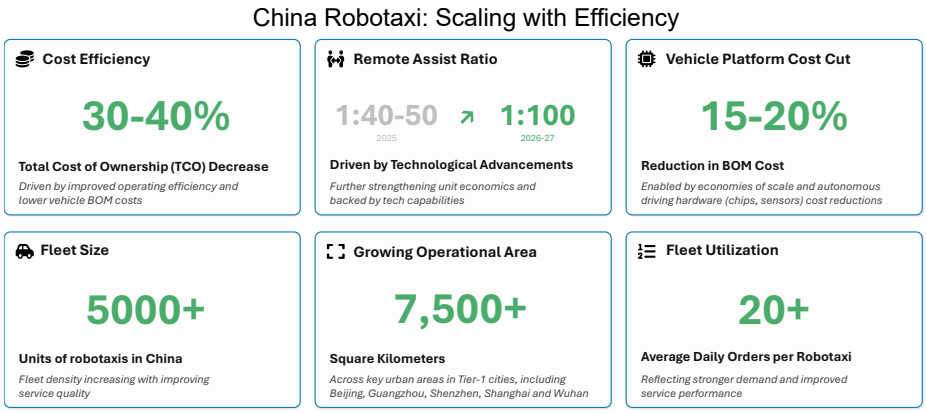
The profitability implications are transformative. L4+ robotaxi deployment can meaningfully reshape the ride-hailing cost structure, unlocking vehicle-level net margins of more than 30% globally at scale and more than 40% in developed markets, where comparable taxi fares are significantly higher.

In China, operating cost improvements have been particularly pronounced. Chinese OEM partners can manufacture purpose-built robotaxi platforms for US$35–40k per vehicle in 2026, representing a meaningful discount to Western equivalents and a fraction of the US $150k+ unit costs that characterized many early robotaxi deployments in the 2018-20 period. In several Chinese cities, operators have already demonstrated pathways to operating breakeven, supported by a highly competitive cost base, low electricity prices, and a relatively favorable insurance framework for autonomous vehicles.

Globally, the total cost of ownership equation is evolving along a different trajectory. Labor costs are higher, but so is revenue per ride. The key variable remains hardware cost deflation. As fleet sizes expand from several thousand vehicles to tens of thousands, LiDAR, compute, and sensor costs should decline along manufacturing learning curves, narrowing the operating cost gap with Chinese operators. We believe global operators could see more meaningful hardware cost inflection over the next five years.

For emerging robotaxi markets, particularly developed markets such as Europe, operating economics are more complex. Higher vehicle acquisition and registration costs, stricter data localization requirements that increase cloud and compute capex, and a fragmented regulatory landscape all raise the cost of scaling across multiple cities. That said, the revenue side of the equation is also more attractive, as taxi fares in cities such as London, Paris, and Munich rank among the highest globally. As a result, while European robotaxi economics may structurally lag China by three to five years, they offer some of the strongest long-term margin potential globally once the market reaches maturity.

Exhibit 10: China robotaxi cost of ownership decline



Source: Morgan Stanley Research.

Catalyst 4: A Strategic Priority – Constructive Regulatory Progress as Global Competition Intensifies

The major economies are increasingly engaged. Tesla is advancing Cybercab, while Waymo continues to strengthen its position in the US. This momentum is encouraging ride-hailing platforms globally to explore and formalize partnerships. The immediate beneficiaries are Chinese L4 players, such as WeRide and Pony.ai, whose cost structures make partnership economics compelling. At the same time, US competitive momentum is spurring policy attention in Beijing, where autonomous vehicles, including L4 robotaxis, are now viewed as the next strategic priority after EVs.

The market has focused heavily on US–China dynamics, but less on the regions in between. Europe, the Middle East, and ASEAN together represent a taxi and ride-hailing fleet of roughly 4 million units. Even 25% penetration implies around 1 million incremental L4 vehicles – an opportunity large enough to define competitive positioning for the next decade. While scaling will take time, governments across these regions increasingly recognize the importance of shaping the supply chain early. As a result, regulatory frameworks, permitting regimes, and local procurement policies are accelerating out of strategic necessity rather than enthusiasm.

Global collaboration is the new competition. Beyond technological advancement, the pursuit of cost-effective solutions and scalable operations is key. Consistent BoM reduction and rapid scaling will rely significantly on Chinese vehicle solutions, which should cost around US$35–40k per vehicle in 2026. Higher vehicle utilization and lower operating costs, in turn, depend heavily on strategic tie-ups with local ride-sharing partners that provide demand aggregation, consumer trust, and regulatory relationships.

Consequently, we expect a growing number of partnerships, such as WeRide–Uber in the Middle East and WeRide–Grab in Southeast Asia, to form over the next two to three years. Recent examples include Pony.ai's collaboration with Qatar's Mowasalat to begin L4 robotaxi testing in Doha, Momenta's partnership with Uber to roll out L4 robotaxis in Munich in 2026, and Ant Group-backed Hello's plan to launch its HR1 robotaxi in 2026, teaming up with Horizon Robotics and targeting a fleet of 50,000 units across 10 or more cities by 2027.

Across these developments, a consistent structure is emerging. Chinese technology and

cost discipline paired with local platform reach and regulatory credibility. This is not a transitional model, but the foundation of the global robotaxi supply chain. The pace of deal formation over the next two to three years will be critical in establishing competitive advantages.

The Path to Sustained Profitability: A Scale Game

Unit economics analysis divorced from operational context is analytically meaningless. Robotaxi profitability depends on three interdependent variables – fleet utilization, operational domain coverage, and order frequency – each of which improves non-linearly with scale. The compounding nature of this relationship explains why early-mover advantages in this industry are so durable and why investors should weigh demonstrated operational scale as heavily as technology metrics when assessing competitive positioning.

We believe L4+ robotaxi players can achieve vehicle-level net margins of 30% or more at scale. In developed markets, where labor and other operating costs account for a larger share of the total, we estimate robotaxis could unlock net margins exceeding 40% by 2030. The profit margin will then be distributed among different participants – fleet owners, shared mobility platforms, and technology enablers – to fund hardware and software R&D, operating licenses, and potentially taxation. Our projections point to a restructuring of both the cost stack of the traditional taxi business and the profit redistribution channel.

In the US, the unit economics trajectory of bellwethers such as Waymo is the key metric to watch, as early adopters are willing to pay for novelty and reliability. As volume scales, pricing power may moderate, but the structural elimination of labor costs in the US should more than offset any yield compression at reasonable utilization rates. The critical near-term metric is rides per vehicle per day, as each additional ride beyond the initial utilization threshold flows through at near-100% incremental margin, given the predominantly fixed cost structure of a robotaxi fleet.

In China, Pony.ai has disclosed that it achieved city-level vehicle breakeven in Guangzhou and Shenzhen in late 2025, while Baidu Apollo reached the same threshold in Wuhan. Our modeling indicates that average daily revenue of Rmb450–500 (~US$75) per vehicle represents the breakeven threshold on a broader operational basis. This translates to approximately 23–25 orders per day at prevailing Guangzhou fare levels – a target that is achievable under current operational area coverage and increasingly routine as ODDs expand.

Globally, WeRide has achieved unit economics breakeven for its robotaxi fleet in Abu Dhabi by removing safety drivers from vehicles and targets expansion to 300+ vehicles by year-end. The Abu Dhabi achievement is instructive because it demonstrates breakeven in a market with genuinely different operating characteristics – wider roads, lower traffic complexity, and higher average fares driven by affluent expatriate and tourist demographics – at a smaller fleet size than China's Tier 1 deployments. This has important implications for Middle East expansion economics and suggests the region may reach sustainable profitability faster than consensus assumes.

L2+ and L4 - two parallel universes or a single destination? Upgrading from L2+ to L4

will not be easy. Players have followed an evolutionary path from ADAS toward L3 and later L4, with numerous iterations in both hardware and algorithms. While L2+ players could theoretically evolve into L4 operators, running an autonomous ride-hailing fleet involves much more than offering an L4 technical solution. The sophisticated ride-hailing ecosystem – complex fleet logistics, regulatory relationships, fleet maintenance operations, dynamic dispatching, and consumer acquisition – gives incumbent robotaxi operators a significant economic moat that pure technology players are likely to underestimate.

Where could we be wrong? Regulatory hurdles remain a primary concern, as robotaxi services are subject to evolving, jurisdiction-specific regimes governing testing, deployment, data privacy, cybersecurity, and insurance. Safety concerns persist, with many consumers still questioning the reliability of autonomous systems in complex scenarios. Unit economics may not materialize as quickly as expected due to uncertainties in robotaxi pricing, vehicle utilization, and hardware costs. High upfront R&D capital requirements and prolonged development cycles could also erode profitability for players that lack the balance sheet depth to absorb extended pre-scale periods.

Broader Ecosystem Impact

Building on our prior research, the **Bluepaper From Horsepower to Brainpower – AI Takes the Wheel**, we delve deeper into the dynamics of the L4 robotaxi ecosystem, and examine the broader cross-sector and regional implications. Growing adoption of robotaxis not only opens a wealth of direct investment opportunities but also presents intriguing second-derivative plays tied to insurance, transportation, utilities, manufacturing, and semiconductors.

Auto Insurance: A Business Model in Transition

The robotaxi's impact on insurance is one of the most underappreciated second-order investment stories in the sector. Chinese insurers are developing L3/L4-specific products to meet new demands from robotaxi companies, and the current pricing models – built on actuarial tables derived from human-driven vehicle accident rates – are fundamentally inadequate for autonomous fleet underwriting. Current robotaxi insurance in China is typically structured as a commercial vehicle product with manual underwriting adjustments, reflecting the absence of actuarial data for autonomous fleet risk. As Waymo's 200mn L4 miles by year end, Pony.ai's Guangzhou deployment data, and WeRide's Abu Dhabi operations generate the statistical base for proper actuarial modelling, we expect the insurance market will reprice dramatically.

If L4 robotaxis demonstrate superior safety performance relative to human-driven vehicles, which the available evidence suggests they do in their operational design domains, the current pure risk premium is expected to sustain a downward trend over the long-term in a non-linear pattern, along with potential new risk exposures and insurance demand. This deflation benefits robotaxi operators directly by reducing one of their material fixed costs per vehicle. It may also impact incumbent auto insurers that face the prospect of an accelerating business structure transformation of their premium base as consumers shift from privately owned vehicles to robotaxi services. The European insurance market, where per-vehicle premiums are highest and profit pools are most concentrated among incumbent carriers, faces the most significant structural impact from this dynamic.

Car Ownership and Oil Consumption – Longer-Term but Real

Widespread L4 deployment could meaningfully reduce consumer appetite for private vehicle ownership, particularly if autonomous services prove more cost-effective and convenient at the price points we project for 2030. The car ownership impact is most plausible in dense urban environments, precisely the markets where robotaxi penetration will be highest. A household that currently owns two vehicles primarily for commuting and errand-running has a credible economic alternative to car ownership if robotaxi fares fall below the marginal cost of driving and owning a personal vehicle.

Oil Demand Implications are Twofold

The shift from private ownership reduces the total vehicle fleet over time, and the robotaxi fleet is predominantly electric, meaning each vehicle-mile that migrates from human-driven petrol or diesel to autonomous electric represents a permanent oil demand reduction. The timeline of this impact is long – operating over decades rather than years – but the directional signal is unambiguous and relevant for energy sector investors thinking about the 2030+ demand picture. The Middle East markets most aggressively adopting

robotaxis are also the world's largest oil producers, an irony that has not been lost on sovereign wealth funds from Abu Dhabi and Riyadh that are simultaneously investing in autonomous mobility and managing national oil company revenues.

Auto Manufacturing – Platform Disruption

The rise of robotaxis will have significant implications for manufacturing volumes, vehicle design philosophy, and supply chain dynamics across the global auto industry. Robotaxi platforms require meaningfully different design specifications than consumer vehicles: commercial-grade durability for higher utilization cycles; interior configurations optimized for passenger comfort without a driver seat; sensor mounting infrastructure integrated into body panels; and compute chassis capable of supporting 2,000+ TOPS of processing power. These specifications do not map cleanly to existing consumer vehicle platforms, requiring either purpose-built robotaxi vehicles or extensive modification of existing platforms.

Chinese OEM manufacturers, e.g. BAIC-Bluepark, GAC, XPeng, and emerging robotaxi-specialist manufacturers are best positioned to capture the purpose-built robotaxi vehicle market given their cost structures and their existing supply relationships with robotaxi operators. Western OEM manufacturers, with higher labour costs and less flexible production systems, are more likely to participate through modified existing platforms or through licensing manufacturing capacity to technology-led robotaxi operators. The manufacturing winner in robotaxis will ultimately be determined by cost and delivery speed rather than brand prestige, which will be a fundamentally different competitive framework than consumer automotive.

Automotive Semi – A Meaningful Upgrade Cycle

Mainstream L4 robotaxis currently run on 2,000+ TOPS of computing power, typically implemented through dual Thor configurations from Nvidia (covered by Joseph Moore). This represents a meaningful upgrade from the approximately 500 TOPS average that characterises L2+ passenger vehicles – a four-to-one improvement that flows directly to Nvidia's automotive revenue line and to the compute-adjacent supply chain, including memory, power management ICs, and thermal management systems. Looking forward, we expect robotaxi compute requirements to double to 4,000+ TOPS by 2030, if not earlier, as autonomous systems incorporate more complex sensor fusion, longer planning horizons, and higher-fidelity simulation loops. The semiconductor content per robotaxi vehicle at 4,000 TOPS is several multiples of the content per conventional passenger vehicle, making robotaxi fleet proliferation a meaningful revenue driver for auto semiconductor suppliers at scale.

Key Question 1: How Quickly Could Global Robotaxis Ramp Up?

Global robotaxi penetration is not a single curve but four distinct adoption trajectories that diverge meaningfully on timing, speed, and ultimate endpoint. Treating them as a monolith risks substantial forecasting error. The US and China are the sprint markets; Europe is the marathon; the rest of the world – anchored by the Middle East and ASEAN – is the wildcard that could outperform expectations if regulatory hospitality proves durable and Chinese vehicle cost structures are deployed effectively.

Our global forecast assumes a 2.5mn unit fleet size by 2035, with US and China accounting for approximately 70% – the remainder distributed across Europe, the Middle East, and RoW. This growth is supported by expanding operational design domains (ODDs) in each region, improving MPI metrics, and the continued entry of credible robotaxi makers/fleet operators in markets beyond China and the US. Average daily orders per vehicle reach 16-25 globally in relatively mature markets such as China, European and the US by 2035, consistent with current ride-sharing utilization benchmarks that robotaxi operators are targeting.

The US – Regulatory Clarity Meets Premium Economics (*Brian Nowak/Andrew Percoco*)

We look for total fleet size of 977k units in the US by 2035 supported by expanding ODDs in each region and improving MPI metrics. Average daily orders per vehicle reach 16 by 2035, consistent with current ride-sharing utilization benchmarks that robotaxi operators are targeting as their commercial proving ground.

The US robotaxi market is meaningfully more mature than most market participants appreciated two years ago. The regulatory environment is the most important variable determining the US ramp trajectory, and here the trend is meaningfully positive. The current administration's stance toward autonomous vehicles is broadly permissive, with an emphasis on maintaining the US's global pole position. Among major robotaxi players, Waymo's presence across major cities represents a genuine commercial footprint, not a perpetual pilot programme. Meanwhile, Tesla's entry is the variable that could significantly accelerate the US ramp up. MS US auto team projects Tesla to own and operate 30k robotaxis by 2030, scaling to 1mn by 2035.

China – The Industrial-Scale Lab (*Tim Hsiao/Gary Yu*)

We expect the fleet size of robotaxis in China to reach 907k units by 2035, largely comparable to that of the US. This is driven by expanding ODDs in each region, improving MPI metrics, and the continued entry of credible robotaxi makers/fleet operators. Average daily orders per vehicle reach 25 by 2030, and stabilize thereafter, consistent with current ride-sharing utilization benchmarks that robotaxi operators are targeting as their commercial proving ground.

China is the market where robotaxi deployment has advanced the fastest, operated at the largest scale, and demonstrated the most commercially relevant unit economics. We think the combination of policy support, manufacturing cost structure, ride-hailing platform

maturity, and a regulatory framework has produced a competitive environment, as Beijing has an explicit goal of enabling commercially autonomous operations.

Given regulatory permit concentration, we believe the data-dependence of autonomous driving algorithms, and the network effects inherent in fleet scale, mean the market will likely support three to four credible scaled operators rather than the dozens of EV brands that characterize China's automotive market. The cost structure advantage of Chinese OEM vehicle platforms (XPeng, Geely, BAIC-Bluepark, GAC as preferred robotaxi body manufacturers) is a shared resource that distributes vehicle cost benefits across all operators, meaning vehicle cost will not be the primary differentiator. Instead, the competitive levers are algorithm performance, regulatory relationships, operational efficiency and partnership quality.

We believe the driver population displacement concern is more politically sensitive in China than in any other major market, given the scale of the platform economy workforce and the historical precedent of the government mediating technology-driven labour transitions. We think the government will ultimately prioritize the strategic technology objective over labour concerns, particularly given the geopolitical context of the US-China Al race, but the path may be less linear than the base case assumes.

Europe – The Premium Market on a Deliberate Timeline (*Javier Martinez*)

We expect a total robotaxi fleet size of ~285k units in Europe by 2035, a late comer in terms of fleet expansion compared with China and the US. This also supported by expanding ODDs in each region, improving MPI metrics, and the continued entry of credible robotaxi makers/fleet operators. Average daily orders per vehicle reach 20 by 2035 as the business gradually matures over the decade, consistent with current ride-sharing utilization benchmarks that robotaxi operators are targeting as their commercial proving ground.

Europe's robotaxi story is the most nuanced of the major markets and the one most prone to underestimation. The continent offers a combination of factors that are simultaneously attractive and challenging – highest per-km taxi fares in the world in the major cities, extreme regulatory fragmentation across EU member countries and the UK, and infra density that creates genuine ODD complexity. The regulatory picture in Europe has improved meaningfully over the past 18 months but remains the critical bottleneck; in our view, what is still missing across most European markets is an unified permitting framework that would allow an operator to scale from Munich to Paris to Amsterdam without effectively rebuilding its regulatory relationships from scratch.

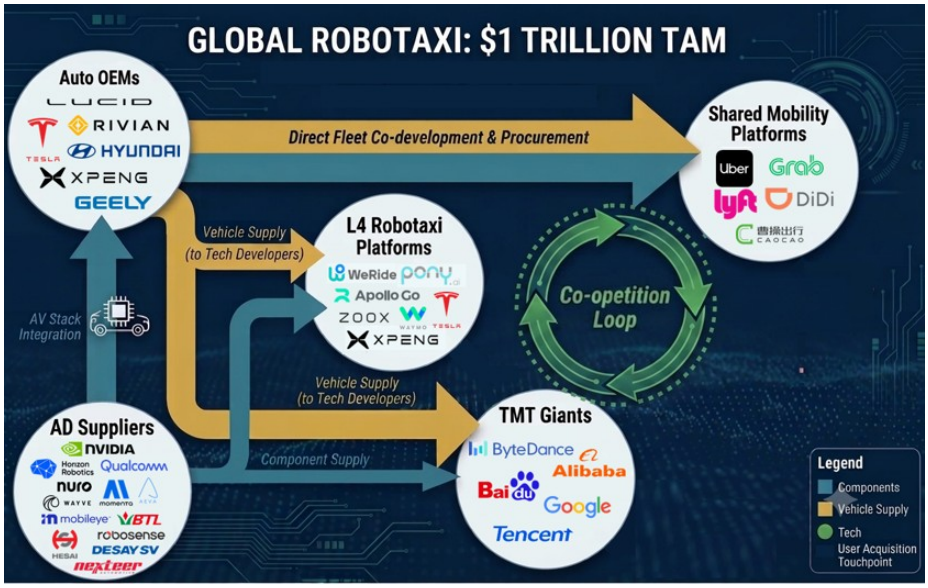
The European competitive picture will likely be shaped substantially by which Chinese fleet operators/robotaxi makers can establish early footholds and which local champions emerge as key players. We look for Europe to account for a meaningful portion of the global robotaxi fleet by 2030, concentrated in major economies, like Germany, the UK, France, etc., and then expand through the Nordic markets and Southern Europe through 2030-35.

Key Question 2: What Are the Different Revenue Models?

Given the global robotaxi industry remains in its early commercial stages and no universal revenue model has proven to be the most effective across all markets yet, we analyze the key players along the value chain and the current revenue models adopted by major players in each geography. The revenue model question is not purely academic. The structural position a company occupies in the robotaxi stack determines its addressable margin pool, its capital requirements, and its long-term competitive sustainability:

- **Robotaxi platforms:** They develop and maintain the L4+ AD solution, and they are also responsible for obtaining all the licenses required for commercial operations.
- **Fleet owners:** They purchase and manage robotaxi fleets, and often lease them out to robotaxi platforms, or ride-sharing platforms for operations.
- **Ride-sharing platforms:** They often partner with robotaxi players as the latter can leverage their large, existing user base.
- **EV OEMs:** They manufacture customized EVs for robotaxis
- **Suppliers:** They supply X-by-Wire, cameras, LiDARs, chips to robotaxis.

Exhibit 11: Key partnerships among L4 robotaxi players



Source: Morgan Stanley Research.

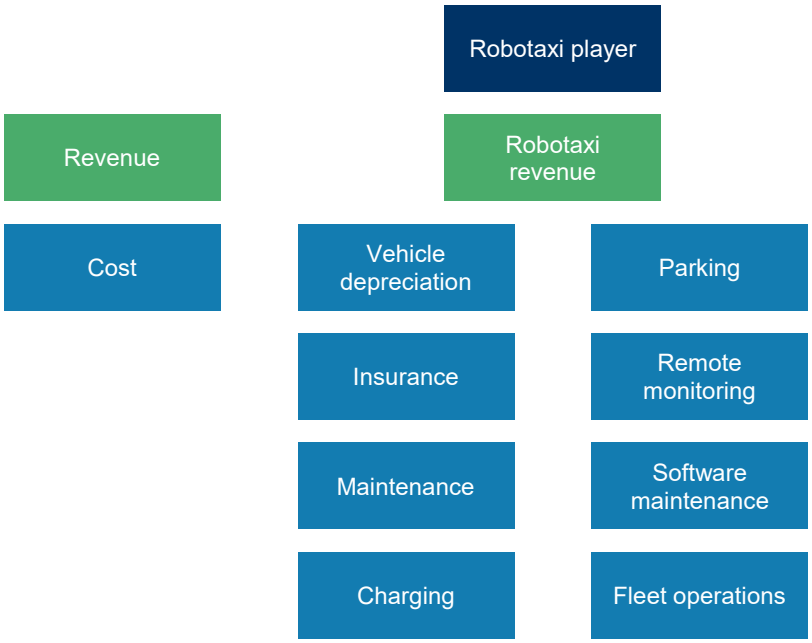
Revenue Model #1: Self-Operation (Primarily Domestic China, Early US)

This is the common business model for Chinese robotaxi start-ups in their early stages, where they own and operate the robotaxi fleet themselves. The capital intensity is highest under this model, but so is the control over the consumer experience and the data generated from operations. Without partnerships with ride-sharing platforms, customer acquisition costs are elevated. Robotaxi fleet operators must offer promotions and undercut conventional ride-hailing players to attract consumers and build brand awareness. Given the high costs of vehicle depreciation, insurance, maintenance, charging,

parking, and remote monitoring, reaching sustainable unit economics breakeven under this model requires higher utilization than the asset-light alternatives, making it more appropriate for mature markets with established consumer demand.

In the US, the self-operation model benefits from higher per-ride revenue that partially offsets the capital intensity, and it's important to have strong balance sheet support for the extended pre-scale period. Robotaxi heavyweights' choice to own and operate rather than wholesale its technology to fleet partners reflects both the strategic importance of owning the direct access to consumers and their assessment that technology licensing alone would be insufficient to achieve the operational excellence required to pioneer and lead the market in an early stage of tech/service rollout.

Exhibit 12: Self-operation model



Source: Morgan Stanley Research.

Revenue Model #2: Strategic Partnerships with Fleet Owners (Domestic China, Scaling)

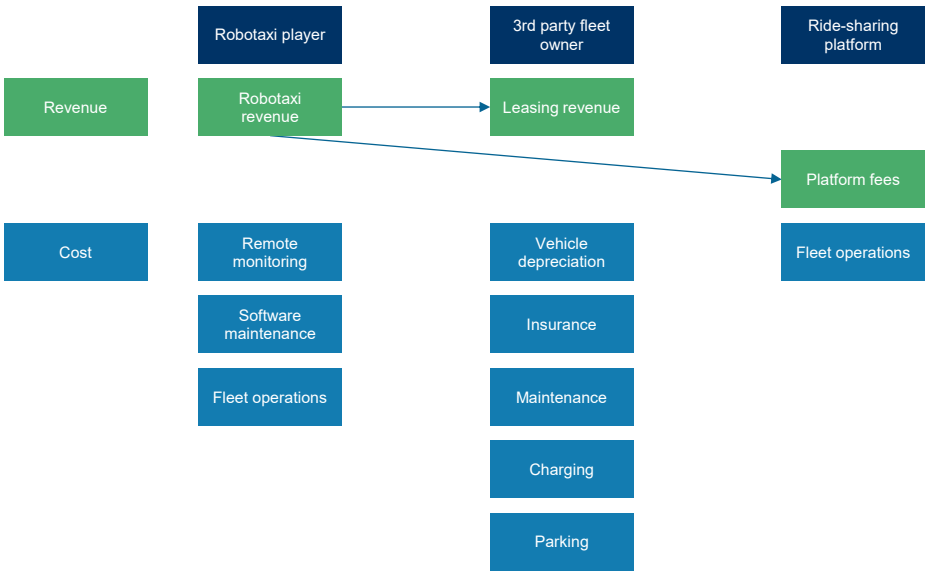
This has become the dominant business model for robotaxi platforms in the current phase, where they partner with third-party fleet owners operating under an asset-light structure.

Third-party fleet owners acquire and manage the robotaxi vehicles, bearing vehicle depreciation, insurance, maintenance, and related costs. In return, they receive leasing revenue from robotaxi operators, who typically retain approximately 20% of robotaxi operational revenue for providing the autonomous driving software licensing. Robotaxi players bear remote monitoring and software maintenance costs. In some cases, they also partner with ride-sharing platforms, where the platform charges about 10% for customers acquired through their channels. Of note, profit-sharing and/or licensing fee arrangements vary widely across regions, depending on factors such as scale and bargaining power.

This model is particularly attractive in the current period because it allows robotaxi operators to scale their deployed fleet without proportional balance sheet growth,

directing capital toward technology development rather than vehicle ownership. The fleet owner ecosystem in China, comprising leasing companies, local government investment vehicles, and ride-hailing subsidiaries, has developed rapidly to fill this capital need. We expect this model to remain the primary scaling mechanism for Chinese operators through 2028, with the self-operation model becoming more relevant as operators accumulate sufficient capital from operations to fund fleet ownership directly.

Exhibit 13: Strategic partnerships with fleet owners model



Source: Morgan Stanley Research.

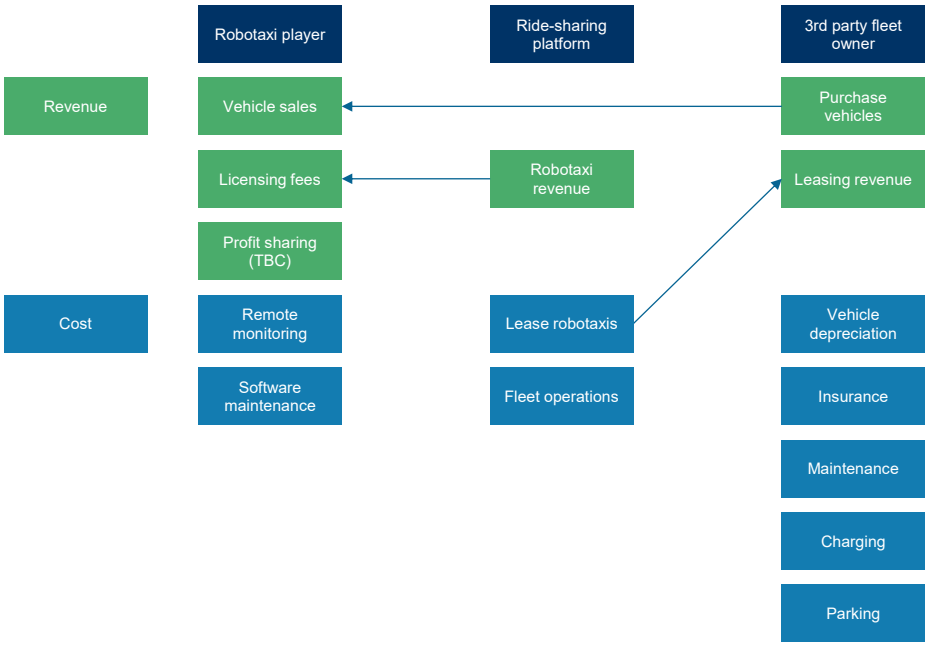
Revenue Model #3: Strategic Partnerships with Ride-Sharing Platforms (Overseas)

This is the primary business model for robotaxi platforms in overseas markets, where they partner with both ride-sharing platforms and third-party fleet owners. Robotaxi players recognize revenue through three streams. Robotaxi vehicle sales to fleet owners, licensing fees from ride-sharing platforms, and profit sharing with ride-sharing platforms as operations scale to profitability. They bear remote monitoring and software maintenance costs. For ride-sharing platforms like Uber, this structure typically involves the platform recognizing the full robotaxi operation revenue, then remitting around 60% to the robotaxi operator as a licensing fee and a separate portion to fleet owners as leasing revenue. We note that the licensing fee and/or leasing rate arrangements differ widely across regions, depending on factors such as scale and bargaining power.

This model has proven its viability in Abu Dhabi, where WeRide achieved unit economics breakeven under precisely this structure. The key advantage of the model in overseas markets is the platform's consumer distribution capability – Uber's app reach in the Middle East, ASEAN, and Europe eliminates the consumer acquisition problem that makes self-operation so capital-intensive in new markets. For Uber, the model provides a path to structurally remove the driver earnings component from the take-rate equation and converts a two-sided marketplace into effectively a technology licensing and demand aggregation business.

In Europe, the licensing fee model is likely to be adapted to reflect local data ownership requirements. European data localization regulations under General Data Protection Regulation (GDPR) create a compliance overhead for Chinese operators that is less burdensome in the Middle East or ASEAN, and the licensing fee structure may need to incorporate provisions for European data processing that increase operating costs relative to other markets. We believe this is one reason the European margin trajectory lags China and the Middle East by roughly 2-3 years even at equivalent utilization levels.

Exhibit 14: Strategic partnerships with ride-sharing platforms model



Source: Morgan Stanley Research.

Unit Economics Simulation: A Market-by-Market View

Base case in China – In China, Pony.ai has achieved unit economics breakeven in Guangzhou thanks to decreasing vehicle cost, operational efficiency from remote safety monitors, and lower insurance cost on the back of massive on-road records. For broader industry basis, our estimates suggest unit economics breakeven can be achieved when average daily revenue per robotaxi reaches Rmb450-500 (~US$65-75).

Key metrics in 2028 and 2030 – We look for average daily revenue per car to reach US $75 in 2028 and US$113 in 2030, assuming 23-25 orders per day at US$3.3-4.5 per trip. With a 60-80:1 ratio of robotaxis to remote safety monitors, a robotaxi can turn to profit in 2028 with a modest 12% vehicle-level net profit margin under this scenario, split among business participants.

Below we detail the cost assumptions in 2028/2030 from our simulation:

- **Vehicle depreciation:** We assume a USD33-36k vehicle cost depreciated over 5 years, in line with the cost of a leading robotaxi player in China.
- **Electricity:** We assume USD28-35 charging cost per day in our base case, based on roughly 310-400km of driving per day.
- **Insurance:** We assume USD1.2-1.5k per year, in line with that of current robotaxi

players in China.

- **Maintenance:** We assume USD4.5-5.7k per year.
- **Remote safety monitor:** We assume ~USD19k annual salary for a remote safety monitor person, in line with that of current robotaxi players in China.

US market unit economics differ fundamentally in their revenue structure. In the US, per-ride fares are higher than US$3.3-4.5 in Chinese cities, reflecting higher labour costs and early-adopter willingness to pay. However, insurance costs per vehicle in the US are substantially higher than in China, reflecting the more litigious claims environment and the absence of a track record that would allow actuarial underwriting on L4 fleets.

Key Question 3: How Do Robotaxi Players Differ in Their Routes to Scale?

Exhibit 15: Our framework of evaluating capabilities of L4+ global robotaxi players

	Companies	Waymo	Tesla	WeRide	Pony	Baidu
Home Markets	Supervised Launch					
	Unsupervised Launch					
	24/7 Operations					
	Airport Access					
	Citywide Access					
Overseas Markets	Supervised Launch					
	Unsupervised Launch					
	24/7 Operations					
	Airport Access					
	Citywide Access					

Source: Company data, Morgan Stanley Research. This table only evaluates companies on their capabilities for commercial rides with a passenger at scale.

1) L4 Robotaxi Platforms: Waymo, Baidu Apollo, WeRide, Pony.ai, Tesla, XPeng, etc.

Some companies started with a focus on L4 robotaxis, using sensor-fusion stacks (LiDAR, camera, MMWR, etc.) and purpose-built vehicles specifically designed for robotaxi applications. This L4-first path offers a head-start in autonomy algorithm development and regulatory alignment but demands sustained capital commitment across long pre-revenue periods. The leaders in this category, i.e., Waymo, WeRide, and Pony.ai most prominently, have each reached commercialization with technology stacks and operational track records that represent significant barriers to replication.

Meanwhile, companies like Tesla and XPeng iterate toward the robotaxi field, leveraging their advantages of massive data collection from consumer fleets, lower up-front hardware costs per vehicle (20-30% cheaper), greater economies of scale from shared platforms between ADAS and autonomy, and stronger brand leverage with the consumer base that will ultimately be robotaxi passengers. The primary challenge is demonstrating safety at the level required for fully driverless commercial operations without a safety driver, which requires overcoming both regulatory conservatism and genuine technical uncertainty about corner-case performance.

2) Ride-sharing platforms: Uber, Didi, etc.

The ride-sharing incumbents occupy a strategically fascinating position in the robotaxi ecosystem. They possess the one resource that pure-play autonomous operators structurally lack – a massive, engaged consumer base with established payment relationships and brand trust. The competitive question for incumbent fleet operators is whether they can leverage this consumer distribution advantage to capture a meaningful share of the autonomous ride economics as the fleet transitions from human-driven to autonomous supply, or whether they become mere demand aggregators with commoditized take-rates as multiple autonomous operators compete for platform access.

3) L4+ solution providers: Auto parts makers

The solution providers are the infrastructure layer of the robotaxi ecosystem. They capture value regardless of which specific fleet operators end up winning share, making them attractive investments for investors who want sector exposure without making a specific operator call. While the gold rush analogy is imprecise, we think it's directionally useful and relevant, as in a market where the outcome of the operator competition is genuinely uncertain, the companies supplying the picks and shovels deserve a place in the portfolio.

Key Question 4: Is Motor Insurance on the Brink of Structural Transformation?

By Rick Zhao, Richard Xu & Chenqian Liu

China's insurance regulator and insurers have been actively researching and piloting L2+ insurance products over the past few years, with regional regulatory files and products launched.

We believe top P&C insurers, including PICC P&C and Ping An P&C, can gain an early-mover advantage.

At the industry level, we do not expect motor insurance to contract noticeably over the next decade, as autonomous driving could introduce new risks and insurance demand, especially liability coverage.

However, over the longer term, after 2035, traditional auto insurance premiums could face greater contraction pressure due to lower accident frequency and more mature operating systems, while liability related insurance see increased and accelerated growth. Non-motor insurance could become more dominant in the P&C business at the time, and motor insurance profitability may further improve due to gradual rollout and ongoing regulatory supervision.

Regulators are actively exploring and developing industry standards for autonomous driving: In March 2026, the NAFR (National Financial Regulatory Administration) Beijing Bureau announced the development and application of commercial insurance for intelligent connected new energy vehicles (ICVs). We see this as a key regulatory filing guiding insurance's role in ICVs. Key points include:

- ICV insurance will upgrade from current NEV insurance...
- ... with expanded coverage for specific autonomous-driving scenarios and software and hardware losses;
- The "driver" remains central, and insurers can recover from manufacturers after claims;
- ICV-exclusive products will pilot on L2 new vehicles first, then expand to L3–L4 to ensure pricing accuracy.

We view Beijing's pilot as a regulatory sandbox offering an early read-through on how China may institutionalize insurance, claims, and liability handling for L2–L4 intelligent driving.

Exhibit 16: Key policy developments for intelligent connected vehicles (ICVs)

Date	Authority / Region	Measure	Coverage Scope	Key Implications
Nov-23	MIIT, MPS, MoHURD, MoT	Guidelines for Access and Road Testing of ICVs (Pilot)	L3–L4 pilot ICVs	● Establishes insurance as a prerequisite for autonomous vehicles to operate on public roads. ● Mandates compulsory coverage including Compulsory MTPL and traffic accident liability insurance (insured amount >= RMB 5mn).
Jan-25	NFRA	Guidelines on Promoting High-Quality Development of NEV Insurance	NEV insurance sector	● Requires insurers to proactively adapt to the intelligent driving trend. Calls for systematic assessment of the medium- to long-term impact of intelligent driving on auto insurance operations and pricing.
Aug-22	Shenzhen Municipality	Regulations on the Management of Intelligent Connected Vehicles in Shenzhen	L2–L4 ICVs	● Clarifies that liability rests with the driver where a human driver is present; and liability rests with the vehicle owner or operator where no human driver is present. ● Requires ICVs to maintain Compulsory MTPL and third-party liability insurance. ● Requires motor vehicle occupants' liability insurance for ICVs with passenger-carrying functions.
2024–2025	Shanghai / Wuhan / Guangzhou (pilot cities)	Robotaxi pilot operation frameworks	L4 Robotaxi	● Insurance solutions rely on multi-policy combinations: compulsory MTPL + high-limit TPL (>=Rmb5mn) + passenger liability coverage (>=Rmb2mn).
Mar-26	Beijing NFRA	Launch of dedicated commercial insurance products for L2–L4 intelligent connected NEVs	L2–L4 ICVs	● Upgrades and optimises existing NEV insurance products to further extend coverage to intelligent-driving-specific risk scenarios, including software- and hardware-related losses. ● Establishes unified applicability across L2 to L4 ICVs, forming a consistent insurance framework for different levels of driving automation. ● Protecting the rights and interests of victims is the first priority, and insurers can seek recovery from defective vehicle manufacturers and other responsible parties after paying claims upfront. ● For L2-level vehicles, regulators will prudently conduct pilot programmes for specialised insurance products. In the initial phase, such products will primarily apply to new NEVs, with the Beijing Insurance Association to publish, on a phased basis, the eligible vehicle manufacturers and designated models. ● For L3 & L4, specialised insurance products may apply to vehicles that legally conduct road testing or have obtained formal road-access approval in Beijing, in accordance with applicable laws and regulations.

Source: MPS, NAFR, Morgan Stanley Research.

Insurers are also actively researching and piloting L3/L4-specific products. Many insurers in China are researching intelligent driving, and some have partnered with auto companies to launch intelligent-driving services beyond CMTPL (compulsory motor third-party liability insurance) and commercial NEV insurance.

- **PICC P&C's** leadership in spearheading the Technical Standard for the Determination of Insurance Compensation in Intelligent Connected Vehicle Traffic Accidents underscores its role in industry rule-setting and public governance, as well as its ability to interface with traffic police, judicial authorities, and MIIT-related systems.
- By contrast, **Ping An P&C**, leveraging its strengths in technology, data, and productization, has been more proactive in implementing and commercializing intelligent-driving insurance across L2+/L3/L4 scenarios, positioning itself to potentially take the lead in converting this into scalable volume advantages over time.

Exhibit 17: Key insurers' developments in intelligent driving

Company	Date	Key Development
Ping An P&C	2018	Established a dedicated intelligent driving project team and began long-term participation in pilot explorations of intelligent driving insurance with local regulators.
	Aug-22	Entered into a partnership with PIX Moving, underwriting one of China's first batches of commercial insurance for L4 autonomous vehicles based on a "skateboard chassis" design, featuring no steering wheel and no driver cabin.
	Nov-24	Partnered with AITO (Seres Group) to launch China's first intelligent driving liability protection program — *"Smart Driving Worry-Free Service"* — covering full intelligent driving scenarios including automated parking and assisted driving.
	Dec-25	Deeply involved in insurance services for Beijing's first batch of L3 autonomous driving vehicles, providing up to RMB 2mn per seat for in-vehicle passenger coverage and up to RMB 5mn for third-party liability.
PICC P&C	2019	Initiated cooperation with technology companies in the autonomous driving field, providing risk coverage for projects such as unmanned logistics and robotics.
	2024	Launched a dedicated autonomous driving product, *"Intelligent Control System Liability Insurance Terms"* , covering risk scenarios including assisted parking and assisted driving.
	2025-Present	Jointly worked with CATARC, China Banking and Insurance Information Technology Co., and Insurance Association of China on the formulation of the *Technical Standard for the Determination of Insurance Compensation in Intelligent Connected Vehicle Traffic Accidents* , establishing a unified industry framework for liability determination in future L3/L4 accidents.
	Current	Leading industry efforts to develop dedicated motor insurance products tailored for L3 and above intelligent connected vehicles.

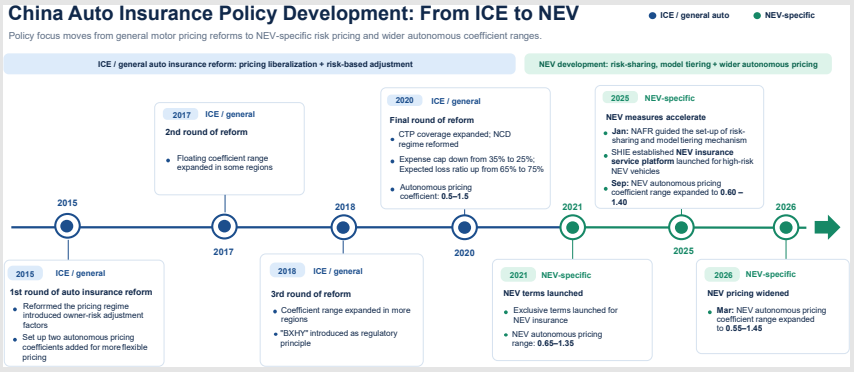
Source: Company data, Morgan Stanley Research.

Case Study: From ICE to NEV: How Insurers and Regulators Responded

China's auto insurance market underwent four rounds of reform during 2015–20. We have seen several key policy developments:

- Regulators guided premium rates and commissions lower and expanded coverage to improve customer benefits.
- For insurers, regulators capped expense loading ratios, increased expected loss ratios, and required "BXHY" (or filing-implementation consistency, meaning insurers' filed expense and commission assumptions must remain strictly consistent with actual execution) to improve expense structure and avoid irrational competition.
- Regulators reformed no-claim discount factors and expanded autonomous pricing coefficients, benefiting low-risk customers with more discounts and insurers with more flexible pricing.

Exhibit 18: Timeline of auto insurance regulatory development since 2015



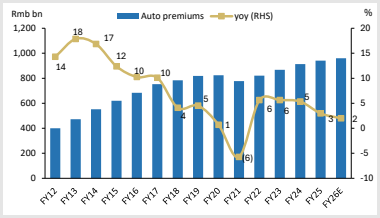
Source: CBIRC, NAFR, IAC, Morgan Stanley Research.

We see temporary pressure on P&C premium growth and underwriting profits esp. in 2021...

- Total auto premium growth notably moderated during the second and third rounds and declined 6% in 2021 after the final round launched in 2020.
- Industry-wide CoR rose to 101% from 99%–100% during the reform, driven by a higher loss ratio and slower expense cuts at small and mid-sized insurers, amid notable divergence in operating metrics across the industry.

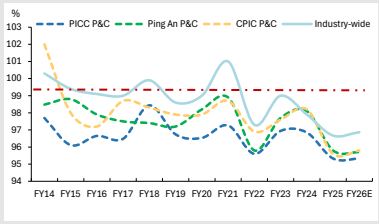
...while the longer-term outcome could prove effective. We believe reform helped P&C profitability over the longer term despite short-term impacts on premiums and underwriting. Overall, we see the regulatory structure for ICE vehicles as largely stabilized after the final round, with steady premium growth and continued CoR improvement thereafter.

Exhibit 19: Auto premium and growth



Source: NAFR, Morgan Stanley Research estimates.

Exhibit 20: Key players' and industry-wide CoR



Source: CAA, NAFR, company data, Morgan Stanley Research estimates.

When NEVs emerged and penetration accelerated in China, with different risk profiles versus ICE vehicles, regulators moved decisively to roll out a separate framework.

In 2021, NEV-specific insurance terms launched, establishing an autonomous pricing coefficient range of 0.65–1.35, narrower than ICE's 0.5–1.5. While the NEV premium mix has increased notably since 2021, we also see several challenges, including:

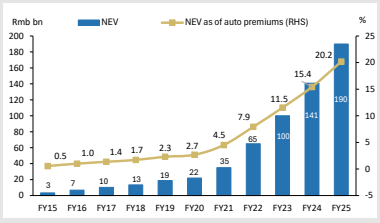
- elevated loss ratios due to design features and diverse model differences, high battery replacement costs, limited authorized repair channels, and more integrated vehicle architecture than ICEs, driving higher claim severity;

- a lack of long-term, stable actuarial data for pricing, given frequent model iteration and fast-evolving battery technologies;
- difficulty differentiating high-risk vehicles, especially commercial NEVs, due to less pricing flexibility, leading to lower accessibility for high-risk vehicles.

In 2025, regulators announced further NEV measures, including reducing repair and maintenance costs, optimizing autonomous pricing coefficients and fee-rate supervision, building a risk-sharing mechanism among P&C insurers, and studying a vehicle-model tiering mechanism. At the same time, Shanghai Insurance Exchange (SHIE) launched the NEV insurance service platform ("Hao Tou Bao") for high-risk vehicles, where insurers cannot decline coverage. We think the platform has effectively shared claim pressure and risks across P&C insurers and established a rudimentary risk-sharing mechanism.

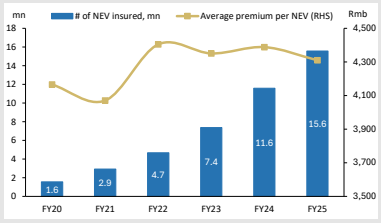
Since the dedicated NEV policy terms launched in 2021, the NEV premium mix as a share of total auto premiums has accelerated to >20% in 2025 from 4.5% in 2021. PICC P&C, China's largest P&C player, also saw strong growth in insured NEVs, while average premium per NEV declined slightly in 2025.

Exhibit 21: NEV premium mix increased notably over the past five years



Source: CAA, NAFR, Morgan Stanley Research.

Exhibit 22: PICC P&C: # of insured NEV and average premium per vehicle



Source: Company data, Morgan Stanley Research.

We expect ongoing policy development in the NEV market to better align pricing with risk, including:

- further relaxation of autonomous pricing coefficients for NEVs (expanding to 0.5–1.5 in September 2026) and potential adjustment to pure risk premiums to provide more pricing flexibility and better reflect differentiated risk profiles;
- further optimization of a more explicit risk-sharing mechanism to smooth volatility amid fast-evolving battery and autonomous-driving technologies;
- a vehicle-model tiering mechanism, likely released in 2026 and implemented in 2027, which should set explicit and transparent NEV safety assessments.

Taken together, we expect NEV insurance to achieve underwriting profit in 2027–28, helped by favorable regulatory policy, more accurate pricing, better underwriting mix (more older cars and more household vehicles), and declining claim frequency.

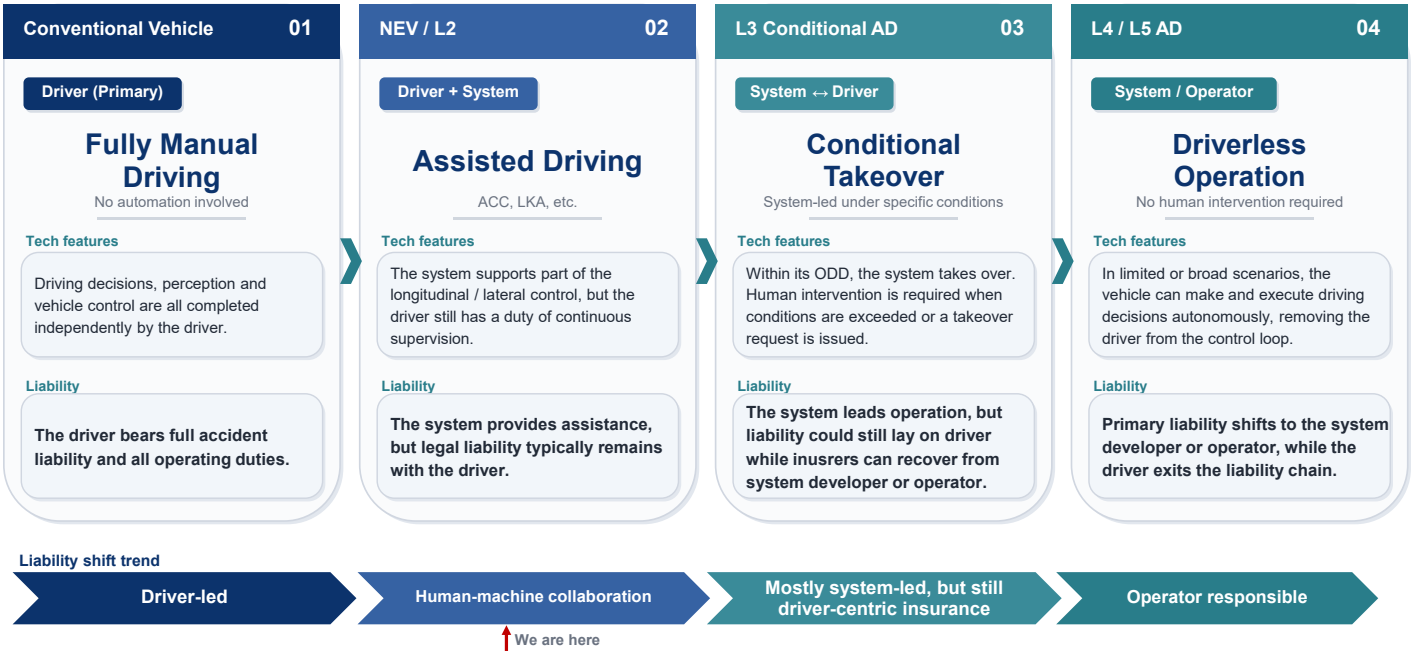
The higher the automation level, the more legal and commercial liability shifts from the driver to the system and operating entity, but the process will take time.

Currently, we are still in the assisted-driving period (NEV or L2), where the system provides assistance and legal liability typically remains with the driver.

As the market gradually shifts into L3 with conditional autonomous driving, more liability will move from the driver to the system, although controversy could remain. For example, based on the current industry draft, under activated L3 automation, liability hinges on driver response to takeover requests: if the driver retakes control and an accident occurs, the driver bears full liability; if the driver fails to take over, liability shifts to the vehicle manufacturer. Where automation is not activated, or required software updates are not installed, liability remains with the driver, a principle that may also extend to certain L4 scenarios. However, based on China's current regulatory and legal framework, L3 autonomous driving does not alter the outward liability structure of motor insurance, which remains driver-centric, although economic risk exposure has begun to shift internally toward the vehicle and the autonomous-driving system. At L3, insurers pay first under driver-centric insurance and recover later from OEMs or system providers.

Over time, the majority of liability could shift to the operator under L4/L5, while motor insurance contracts and liability insurance scales further.

Exhibit 23: Liability set to gradually shift from driver to systems and operators



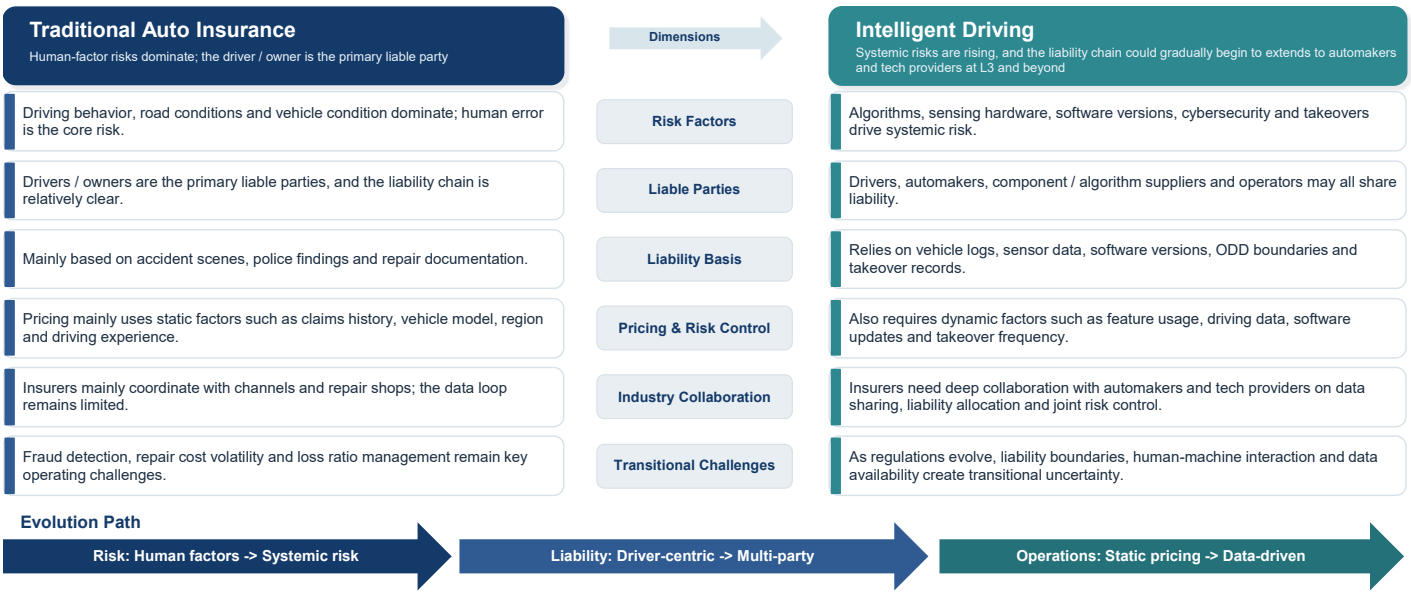
Source: Morgan Stanley Research.

Motor insurance could look very different under L3+. Currently, whether for ICE vehicles or NEVs, auto insurance products consist of several different coverages, including compulsory traffic liability insurance (CTPL) and several commercial insurance products with flexible coverage limits, including:

- Commercial third-party liability insurance: acts as a supplement to CTPL and covers bodily injury and property damage caused to third parties.
- Own-damage insurance: covers loss or damage to the insured vehicle itself.
- Driver and passenger accident insurance: covers bodily injury or death of the driver and passengers in the insured vehicle.

Even when the market reaches L3, we expect these motor insurance products will not undergo fundamental change. Traditional NEV insurance, along with additional liability insurance covering system and algorithm risks, could become broadly applied during the L3 period, which could likely increase overall insurance premiums. Over the longer term, insurance product design and pricing could see structural changes after the broad rollout of Level 4/4+ autonomous driving.

Exhibit 24: Differences between traditional auto insurance and intelligent-driving insurance



Source: Morgan Stanley Research.

In the near to medium term, a decline in accident or claim frequency remains uncertain... Based on empirical evidence from Waymo and other L4 robotaxi deployments, as well as operational experience from pilot and demonstration zones in China, accident rates per mile tend to decline in higher-level automated-driving scenarios (L3+/L4), where the system retains primary control within a defined operational design domain (ODD).

However, in the current market dominated by L2/L2+ human-machine co-driving, overall claim frequency is not necessarily lower than that of traditional vehicles. In this context, human-machine interaction itself has emerged as a new risk source, while the structure of single-accident loss severity may also differ. In addition, road conditions and levels of complexity can vary materially across markets and scenarios, for example China versus the US, and real road conditions versus ODDs. Even as L4 adoption scales, accident rates do not necessarily decline in a linear or monotonic fashion, given scenario expansion, tail-risk exposure, and system-level correlation effects.

...while over a longer period, well-defined ODDs and L4 deployment are likely to reduce accident frequency versus human drivers, which could reshape motor insurance pricing benchmarks. At the same time, the accompanying shift in risk concentration and structure is creating new system- and asset-centric insurance demand, rather than simply reducing overall risk.

We expect the motor insurance framework to undergo a structural shift over time, from a driver-centric liability model toward one centered on system-level liability and asset risk.

- Compulsory traffic liability insurance (CTPL) will likely remain in place as a social safety net for an extended period, although its functional role will gradually evolve from insuring driver fault to providing baseline third-party protection in system-led driving environments.
- Commercial third-party liability insurance remains the primary first-loss cover on the individual side at L3, but as drivers gradually exit the control loop from L4 onward, its relevance to individuals should diminish materially and largely disappear by L5, in our view, with liability increasingly transferred to OEMs, system providers, or operators.
- Own-damage insurance should persist throughout the automation continuum, but evolve from a high-frequency accident product into a low-frequency, high-value asset protection product.
- Driver and passenger insurance remains relevant up to L3, but will likely become increasingly marginal at higher automation levels as in-cabin safety improves structurally.
- In parallel, system/algorithm liability insurance should enter the insurance stack at L3 and become a core product at L4–L5, covering algorithm failures, system defects, and highly correlated tail risks, among others.

Exhibit 25: How automated driving wave could change auto insurance products

Dimension / Stage		ICE (L0)	NEV (L1–L2)	L3 (Liability Expansion Phase)	L4 (High Automation)	L5 (Full Automation)
Driving control		Human	Human	System-led + human on standby	System-led (within ODD)	System fully in control (all scenarios)
Whether a driver still exists		✅ Yes	✅ Yes	✅ Yes (continuous takeover required)	⚠️ Nominal existence / materially weakened	❌ No
Primary legal liability holder		Driver	Driver	Driver primarily; insurers may seek recourse from OEM / system provider	Transition from individual to OEM / system / operator	OEM / system provider
Insurance products	Compulsory traffic liability insurance (CTPL)	✅ Mandatory	✅ Mandatory	✅ Continues to be mandatory (social safety net)	✅ Continues to be mandatory (social safety net)	✅ / ⚠️ May evolve into a mandatory system-level liability cover
	Commercial third-party liability insurance	✅ Core product	✅ Core product (higher premium)	✅ First-loss cover (with expanded liability)	❌ Individual-side coverage weakens; shifts toward enterprise liability	❌ Largely exits individual side; replaced by enterprise/system liability
	Own-damage insurance	✅ Stable	✅ Core product	✅ Continues (lower frequency possible, but higher severity per claim)	✅ Continues (premium midpoint declines)	✅ Continues (evolves into low-frequency asset insurance)
	Driver & passenger accident insurance	✅ Common	✅ Common	✅ Still relevant	⚠️ Significantly weakened	❌ Largely disappears
	System / algorithm liability insurance	❌	❌	✅ Enters system for the first time (embedded / add-on)	✅ Core liability coverage	✅ Core liability coverage
Bearer of system liability insurance		n/a	n/a	Individual pays first, with post-event recourse	OEM / operator bears liability in a centralized manner	OEM / system provider fully bears liability
Nature of liability risk		Human error	Human error	Combination of human and system risk	Low-frequency, systemic risk	Extremely low-frequency, systemic tail risk
Pricing logic for liability insurance		Individual experience-based pricing	Individual experience-based pricing	Liability expansion → modest premium uplift	Scaled, system-level pricing	Scaled pricing + capital-constraint / tail-risk loading
Indicative premium level*		Per-vehicle premium ~RMB 3–4k	Per-vehicle premium ~RMB 4.5–6k	Per-vehicle premium ~RMB 4.8–6.5k (flat to slightly ↑)	**Individual:** CTPL + own-damage ~RMB 2.5–3.5k **Enterprise:** system liability ~RMB 300–600 / year	**Individual:** asset-type insurance ~RMB 2.0–3.0k **Enterprise:** system liability ~RMB 400–800 / year

Source: Morgan Stanley Research estimates. Note: L4/L5 insurance product assumptions are based on the current market, technology and regulatory landscape and are subject to change.

From a pricing perspective, automation does not imply a smooth or linear decline in premiums, but rather a "peak-then-normalize" trajectory, with L3 representing a transitional high point.

At the ICE and L0–L2 stages, higher NEV premiums primarily reflect elevated own-damage costs, while liability pricing remains largely unchanged.

At L3, although accident frequency may not rise materially, liability has not yet fully migrated away from individuals: commercial third-party liability remains in force, system/algorithm liability becomes explicit for the first time, and takeover, fallback, and system-recalibration events materially thicken the tail of own-damage losses. The combined effect puts upward pressure across multiple policy components, making L3 the effective peak of individual motor insurance premiums.

Only at L4 and L5, as liability becomes system-anchored, accident frequency declines, and responsibility boundaries become clearer, does individual-side premium normalization become feasible. That said, system/algorithm liability insurance is unlikely to decline in tandem, as increased liability concentration, correlation risk, and capital intensity continue to support a relatively rigid unit-cost profile.

Overall, L3 represents a transitional risk and pricing peak, while meaningful structural premium compression depends on the maturity of L4/L5 deployment.

Exhibit 26: Indicative premium levels by insurance type and technology stage (Rmb / vehicle / year)

Insurance Type / Technology Stage		Internal Combustion	NEV (L0–L2)	Conditional Automation (L3)	L4 (High Automation)	L5 (Full Automation, Steady State)
Traditional Auto Insurance	CTPL / Compulsory Insurance	~950	~950	~950	600–900	300–600
	Commercial Third-Party Liability	500–800	700–1,100	600–1,000	Weakened	Exit
	Own-Damage Insurance	900–1,400	1,600–2,400	1,400–2,600	1,000–1,800	1,000–2,000
	Driver & Passenger Accident Insurance	100–300	100–300	80–200	50–150	Marginalized
Newly System / Algorithm Liability Insurance		—	—	300–450	300–450	300–600
Total Annual Premium		**1,800–2,800**	**2,800–4,400**	**3,300–5,000**	**1,900–3,100**	**1,600–3,200**

Note: Premium data shown in the table is for reference purposes only, as actual premiums may vary significantly depending on vehicle type and value, driving and driver characteristics, insured limits, and overall risk profile, etc. L4/L5 insurance product assumptions are based on the current market, technology and regulatory landscape and are subject to change. Source: Morgan Stanley Research estimates.

Structural shift in motor insurance over the longer term. Based on our forecasts for autonomous-driving penetration, motor-vehicle parc, expected losses, risk and pricing factors, and regulatory actions, among other factors, we conduct our motor-related premium forecast through 2040. Key conclusions include:

Market transformation: The motor insurance market undergoes a fundamental shift from ICE-dominated to autonomous-vehicle-dominated by FY45–50E. We currently expect a two-phase pattern:

- **Phase 1 (2021–late 2030s):** total motor insurance market growth driven by NEV/ICV adoption; and
- **Phase 2 (late 2030s and beyond):** market contraction as automation reduces accident frequency.

As automation levels increase (L3 to L4 to L5), per-vehicle premiums could gradually decrease due to reduced accident risk, while system-level liability costs increase. We also factor in CTPL regulatory changes around 2040, when L4/L5 penetration reaches a relatively higher level and CTPL may evolve into mandatory system-level liability cover, although we still categorize this under motor insurance. This will accelerate the shift toward L4/L5 liability-based models.

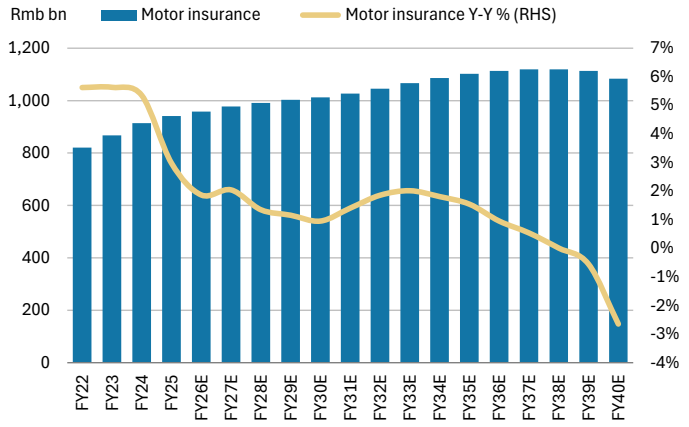
Solid but modest growth over the long term before 2035... Over the next five to 10 years, we believe motor insurance can still maintain modest premium growth even as NEV sales momentum slows, as:

- China's overall car park could still increase marginally over the medium term;
- NEVs could continue to gain share, with premiums ~1.6x vs. ICE vehicles;
- Commercial motor insurance penetration could still have some upside growth potential;

- New system and algorithm risks could emerge, allowing liability insurance to act as a growth engine over the medium to longer term while traditional motor insurance continues to exist;
- At L3, accident frequency does not necessarily decline and may even rise during early adoption, while higher uncertainty and loss severity justify a temporary increase in risk premium.

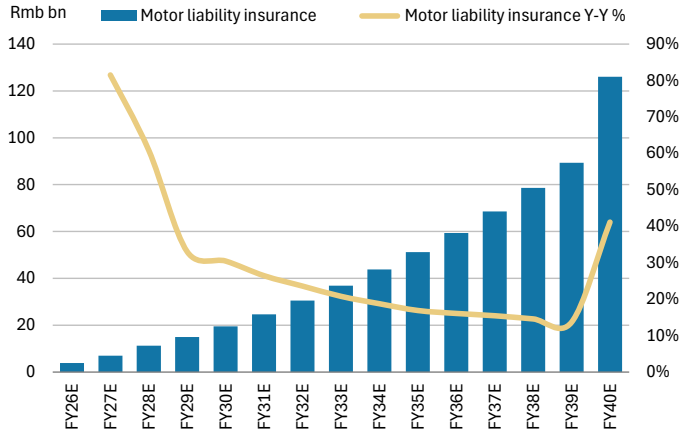
...and peak around 2035, followed by a gradual decline in the late 2030s, after which motor insurance premiums could continue to contract, especially in commercial third-party liability, as claim frequency continues to decline.

Exhibit 27: Motor insurance premiums could peak around the late 2030s and continue to contract afterward due to autonomous driving...



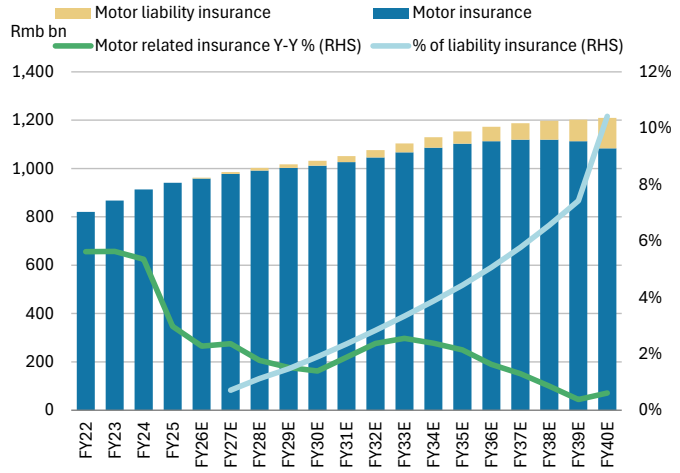
Source: NAFR, Morgan Stanley Research estimates.

Exhibit 28: ...while motor-related liability insurance could undergo strong growth momentum during this period



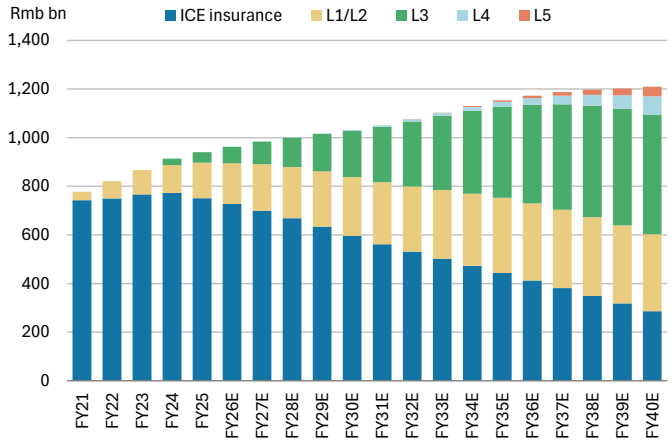
Source: Morgan Stanley Research estimates. Note: we expect CTPL regulatory changes around 2040E.

Exhibit 29: Motor-related liability insurance could reach >10% of motor insurance premiums in 2040E



Source: Morgan Stanley Research estimates.

Exhibit 30: ICE insurance premiums could further contract, while L3 and L3+ account for over half of motor-related insurance in 2040E



Source: Morgan Stanley Research estimates.

For P&C insurers, we believe motor insurance demand will not disappear, but undergo a structural shift. Top insurers, including PICC P&C (2328.HK) and Ping An P&C (a subsidiary of Ping An Group, 2318.HK), can continue to gain advantage. As autonomous driving advances, risk is migrating from human driving behavior toward system-, asset-, and liability-centric exposures, implying a reconfiguration rather than a contraction of insurance demand.

Personal motor insurance gradually loses weight (but remains the dominant segment), while system- and asset-centric coverage gains importance: Driver and passenger insurance is likely to remain an important component of the insurance ecosystem, although future growth may increasingly be driven by OEM liability, product liability and fleet/asset insurance.

Rising risk concentration and correlation materially raise industry entry barriers: These dynamics structurally favor large insurers over smaller players. While accident frequency may decline, L4-related incidents tend to exhibit higher severity, stronger tail risk, and system-level correlation, placing greater demands on capital buffers, reinsurance capacity, and portfolio diversification. System- and asset-centric risks require scale advantages in capital strength, underwriting sophistication, data and modeling capabilities, and reinsurance access – capabilities that are naturally concentrated among leading insurers. Smaller players are more likely to remain exposed to slower-growing, highly competitive personal auto lines.

The role of insurers evolves from pure risk carriers to long-term risk partners: In OEM, robotaxi, and autonomous fleet scenarios, leading insurers are increasingly embedded earlier in risk design, structuring, and commercialization, rather than acting solely as post-event payers.

Continued restricted expanse control policy (known as "BXHY") could continue to ensure a healthy cost structure: China's BXHY framework has been a cornerstone of motor insurance regulation over the past five years, and we expect it to remain firmly in place, with increasingly sophisticated implementation as the market evolves. Even as

autonomous driving evolves and new insurance products emerge, the framework should continue to support orderly and disciplined competition, while enhancing the industry's long-term profitability.

While premium growth could slow or even contract over the long term, CoR could remain healthy, underpinned by insurers' prior experience with pricing reform, sustained regulatory discipline across the industry, and more conservative pricing of long-tail risks by large insurers.

Key Question 5: What's The Potential Impact on Job Markets?

From a broader perspective, we think robotaxis should not be viewed solely as a labor replacement technology. Instead, they represent a restructuring of labor demand within the transportation sector. More importantly, labor shortages may ultimately become the dominant issue across many regions over the next two decades. As a result, robotaxis may be viewed as a mechanism for supplementing declining labor supply through technology and capital investment. The objective is not simply to reduce labor costs, but to maintain transportation capacity and economic activity despite shrinking labor pools.

1. How soon and how many drivers could robotaxis actually affect?
Under an extreme scenario in which robotaxis fully replace conventional taxi and ride-hailing services, millions of professional drivers globally could be impacted. In reality, however, robotaxi deployment is likely to be gradual due to several factors:

- Deployment remains limited to specific geofenced areas, and licensing/ regulatory approvals are likely to be phased in over time.

- Service coverage between operating zones is often fragmented and cross-regional operation takes time.

- Extreme weather and traffic conditions may still require human intervention.

- Fleet deployment requires substantial capital investment. Therefore, adoption rates will vary significantly across cities and countries.

- Charging and operational infrastructure must be built out.

As a result, even if autonomous driving technology continues to improve, meaningful robotaxi penetration is likely to occur over a 10-20 year timeframe rather than through an abrupt replacement of existing drivers.

2. What new jobs could robotaxis create?
Robotaxis are not simply "driverless vehicles." They require an entirely new ecosystem of fleet management, maintenance and operational support. Compared with traditional ride-hailing services, robotaxi operators will need to build centralized operational capabilities across multiple functions, including:

Fleet operations, such as vehicle scheduling specialists or energy management personnel.

Remote safety support that requires remote assistance operators, safety monitoring specialists, incident response personnel, etc.

Vehicle maintenance from maintenance technicians.

Vehicle preparation from cleaning staff.

Infrastructure operations from charging station operators.

Software and data services such as Al model maintenance and cloud operations.

3. How much of the job loss could be offset?
Robotaxis are unlikely to create one new job for every driver displaced. Otherwise, automation would generate little productivity benefit. However, assuming a future fleet of 1 million robotaxis, we could create additional jobs as follows:

Key Risks and Where We Could Be Wrong

Regulatory Fragmentation

Regulatory hurdles remain the primary concern across all markets. Robotaxi services are subject to evolving, jurisdiction-specific regimes governing testing, deployment, data privacy, cybersecurity, and insurance. In China, the permitting process can be rigorous, with operators typically required to complete at least one million kilometers of accident-free testing before obtaining approval. As a result, expansion into new cities can face meaningful delays. In Europe, the absence of a pan-EU framework means each national regulatory authority must independently develop its approach, creating a multi-year licensing timeline that will constrain the pace of European scaling. In the US, the interplay between federal and state authority over AV regulation creates ongoing uncertainty that could slow permitting even in markets where technology readiness is not the constraint. A major safety incident in any leading market could trigger moratoriums that set back the entire global industry.

Of note, China paused the issuance of new autonomous driving permits in April following concerns related to a technology incident in March. The pause covers fleet expansions, new pilot programs, and extensions into additional cities, and authorities have not announced a timeline for resumption. That said, we view the suspension as a temporary setback rather than a policy reversal. Beijing continues to regard robotaxis as an important component of its broader autonomous driving strategy, which suggests a constructive long-term policy stance. In addition, the remaining challenges appear increasingly engineering-related and therefore potentially more tractable over time. Finally, we believe China is unlikely to cede its position in the global race toward Level 4 autonomous driving, particularly as development continues to advance internationally regardless of the timing of domestic permit approvals.

Safety Concerns and Consumer Scepticism

Consumer perception remains a significant headwind, and perception can shift rapidly in adverse directions following safety incidents. The first-ride effect, where consumers who experience an autonomous ride typically become strong advocates, is a powerful positive force for adoption, but it requires consumers to take that first ride despite their pre-existing scepticism. Marketing robotaxi services to a mainstream consumer base that has been conditioned by negative media coverage of autonomous vehicle accidents is a genuine commercial challenge that pure technology metrics do not capture. A high-profile accident involving a fully driverless robotaxi in any major market could freeze adoption across multiple geographies simultaneously, creating asymmetric downside risk that justifies a more conservative penetration assumption than the central case.

Unit Economics Disappointment

Unit economics may take longer to materialize than expected due to uncertainties around robotaxi pricing, vehicle utilization rates, hardware costs, and the productivity of remote monitoring operations. Any delay in expanding ODD coverage or achieving the consumer adoption required to support high utilization could negatively affect operational efficiency. This risk is particularly relevant for pure-play operators without the balance sheet support of a larger parent technology company, as weaker-than-expected unit economics could lead to capital withdrawal and fleet contraction.

Capital Requirements and Competitive Attrition

The upfront R&D capital requirements and prolonged development cycles of L4 autonomous driving remain formidable barriers. Even operators that have demonstrated commercial viability in select markets face the ongoing cost of technology development, fleet maintenance, regulatory compliance across multiple jurisdictions, and the operational overhead of running 24/7 fleets in demanding urban environments. Players without access to sustained capital would be at risk before the industry reaches the scale at which autonomous ride-hailing becomes self-financing.

Implications for the US Market

By Brian Nowak/Andrew Percoco/Daniela Haigian/Julian Herrera

(Please reach out to your Morgan Stanley salesperson for our autonomous model.)

Autonomous Foot on the Accelerator...as '26 Primed to be a Year of Inflection: Over the course of the last two decades – and in particular the past ~5 years – a series of technological advancements have laid the groundwork for the rollout of scaled, generalizable autonomous vehicle offerings. While autonomous offerings are only available to consumers in ~12 cities in the US now, we think 2026 is set to be a year for inflection, as we see a path to 25+ more US consumer launches over the next 6 months (includes overlapping cities). Beyond city launches, we are also set to pass key industry technological milestones, including Waymo's deployment in the first snow exposed metros (Minneapolis, Denver, Detroit), airport transportation (in Phoenix, San Jose, and San Francisco), TSLA's first fully unsupervised consumer miles driven and expected early competition between Waymo and Tesla, new entrants emerging from Avride, Nuro and maybe others, and potentially agentic integration.

Autonomous Acceleration: 16bn Miles by 2032 in the Base Case, But Even Then Only ~0.5% of Total US Miles Driven. Our new bottom-up autonomous city and AV player model estimates that in '25, the US will have ~116mn autonomous miles driven. The acceleration is coming as our base case model assumes that AV miles grow at a 103% '25-'32 CAGR...reaching ~16bn miles in 2032. Said another way, we see annual US autonomous miles growing to be ~140x larger in 2032 than they were in 2025. Even then, AV miles only make up ~0.5% of total US miles driven and ~30% of US rideshare miles. Notably, this ~30% penetration assumes autonomous miles are not incremental to the broader rideshare market (more on this below). Our bottom-up models also imply that Waymo/Tesla are the industry leading AV tech providers...making up almost 70% (~38%/~29% respectively) of US autonomous miles driven in 2032.

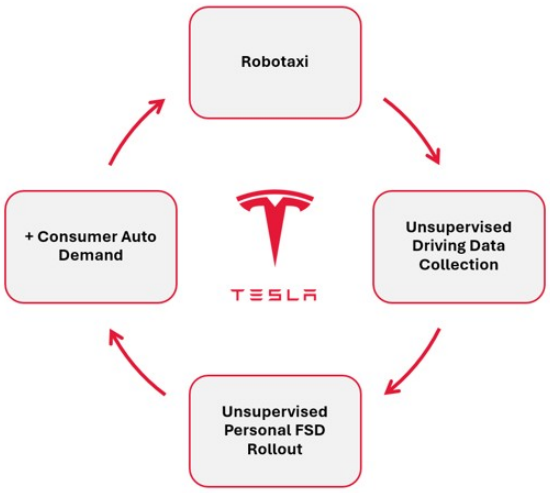
Waymo vs Tesla and What We are Watching For in '26... We model Waymo/Tesla combined to make up almost 70% of the US autonomous industry miles by 2032. Competition is set to evolve as Waymo and Tesla approach the autonomous market from two different angles. Waymo currently has a safety advantage, with redundant sensors, mapping and more restrictive geo-fences whereas Tesla has a cost per mile, production and install base advantage. The company that minimizes their respective disadvantage faster will likely be the first to scale.

For Tesla, that means improving miles driven per accident, which for Austin robotaxi, we estimate currently sits at ~50k+ miles per accident vs Waymo at ~460K across its entire fleet based on NHTSA data. Admittedly, the TSLA data is on a small sample size of miles (~250k per company disclosure) and accidents (5 per NHTSA, stripping out 0 mph incidents) as of year-end 2025 and acknowledge that this is likely improving, particularly as TSLA updates versions of its FSD. We think it is important to track this data over time to see the pace of improvement for TSLA. We can also map TSLA against Waymo's pace of improvement. Here, we estimate Waymo reached ~66k miles per accident in 1Q23 during which it drove ~750k total miles, with that scaling to ~350k+ range over a ~3 year period. It will also be important to monitor the pace at which Tesla expands the availability of its

unsupervised robotaxi fleet.. Meanwhile for Waymo, this means lowering its cost per mile which, we estimate, sits at $1.43 currently vs TSLA at $0.81, and scaling its install base of vehicles (~3.5k). We will closely be monitoring both of these metrics.

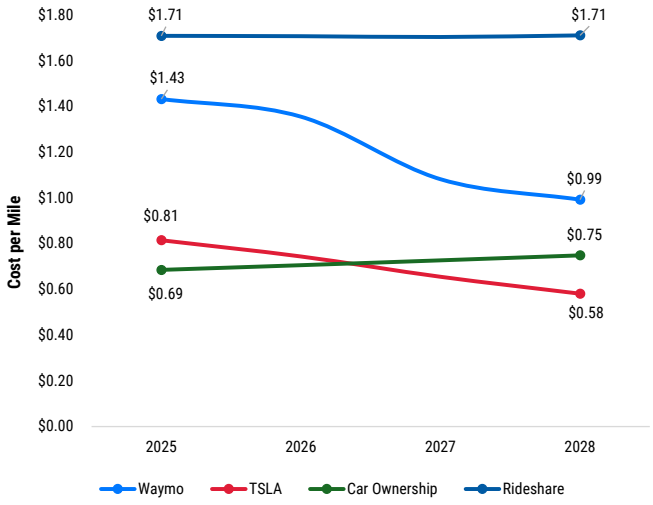
- **Cybercab – Tesla Ushers in Manufacturing of the Future:** Tesla is introducing several groundbreaking changes to the traditional auto manufacturing process with its Cybercab production line in Austin. The manufacturing process uses a modular "unboxed" architecture that replaces the traditional body in white paint, and sequential assembly. The vehicle is built from five major modules – front, central battery, rear cargo, and two side modules – that are assembled in parallel and later combined by a framing system. All exterior panels are plastic and produced via reaction injection molding, with color injected directly into the plastic. This approach allows greater access during assembly and reduces factory footprint, largely due to eliminating the paint shop. Through this process, Tesla aims to meaningfully reduce the robotaxi cost structure to ~US$0.30/mile, which is well below other robotaxi and rideshare peers. Start of production began in April 2026. **See: Tesla Inc: Unlocking the Robotaxi Flywheel.**

Exhibit 31: Tesla Robotaxi Flywheel



Source: Morgan Stanley Research.

Exhibit 32: Tesla Robotaxi Cost Advantage



Source: Company data, AAA, Morgan Stanley Research estimates

...And What About the Long-Tail Players? For the long tail of autonomous companies, we think closing any gap on both miles per disengagement and cost per mile vs TSLA/ Waymo represents a minimum hurdle, but to drive significant customer adoption, these companies must also find product differentiation or accelerate speed to market. Without this, they risk falling behind TSLA and Waymo who are deploying quickly and in the case of Waymo at an accelerating clip. That said, it is still early, and we have seen companies like Zoox accelerate pace of deployment and scale production capabilities. Meanwhile, partnerships with existing rideshare companies like we have seen with May Mobility, Avride and Nuro may help bridge any early lead established by TSLA/Waymo. As a result it will be critical to monitor pace of scaling across the long tail of autonomous companies as they launch over the next 12 months.

Waymo is Making Progress, But It's Still a Small Component To GOOGL's ~$4 trillion Current Enterprise Value: Waymo's latest funding round in early 2026, per the Waymo Blog, brought the company's valuation to ~US$126bn. However, Waymo would still represent a small fraction of GOOGL's overall valuation and is likely not a near-term driver of valuation upside for GOOGL. Waymo's ~US$126bn valuation amounts to only ~3% of GOOGL's US$4 trillion SOTP EV.

What About Uber and Lyft? Further Partnerships and Incrementality are Critical... To date, UBER and LYFT have looked to participate in the emerging AV landscape via partnerships with AV tech companies. Here, UBER and LYFT are aiming to leverage their network of riders to provide higher AV utilization as well as fleet management capabilities, and in turn drive better returns for AV tech companies and AV fleet owners. From a consumer perspective, given the still long road until AVs reach critical mass, rideshare companies also provide users with the optimal mix of AV and human driver availability, and minimize pickup times and maximize coverage area.

For further reading, see: **Internet: Approaching an Autonomous Inflection Point.**

Implications for the Europe Market

By Javier Martinez de Olcoz Cerdan/Matias Rodriguez Florez-Estrada

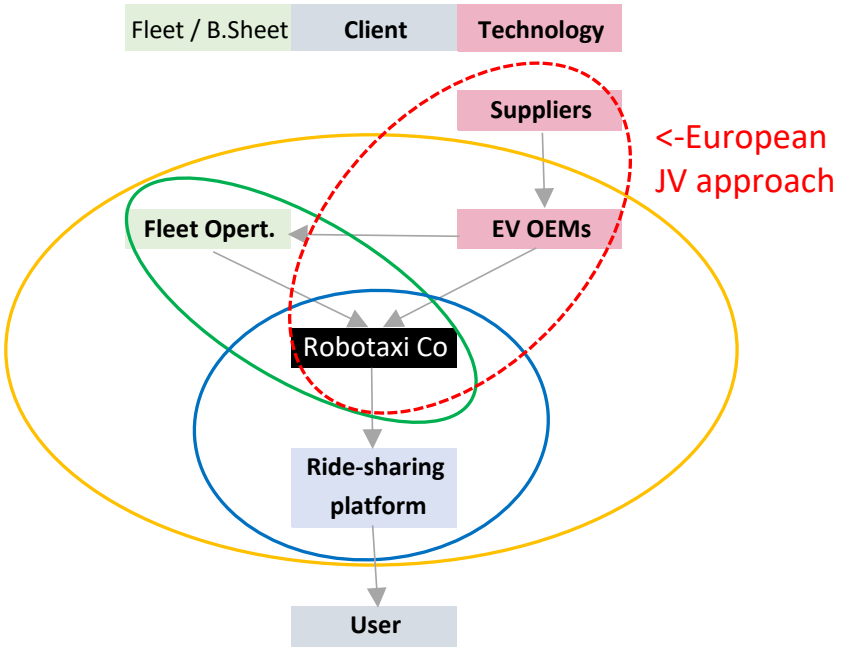
L4+ robotaxi rollout in Europe

Europe seems to be lagging behind. The European market is evolving more cautiously than the US or China so far, with just an embryonic operation in Croatia using BAIC cars and Waymo planning to start in London this year. Outside Europe, Mercedes has launched a robotaxi pilot in Abu Dhabi in a JV with Momenta (Chinese advanced driver-assistance player) and Lumo (local partner), using S-Class test vehicles and the idea is to scale the offering to other regions after validation.

Partnership seems to be the approach in Europe. Most European OEMs are not willing to independently fund full-stack robotaxi programmes at significant costs, given an already challenging FCF backdrop, and instead increasingly rely on partnerships with specialist autonomy companies and compute-platform providers. The European model is also skewing more toward autonomous shuttles, fixed-route urban mobility and geofenced operations rather than unrestricted citywide robotaxi services. This reflects both Europe's stricter regulatory environment and the greater complexity of scaling across fragmented national jurisdictions.

European OEMs are gradually increasing investment into autonomous driving and robotaxis. Volkswagen and Renault are making operational advancements in Europe: Volkswagen, through MOIA and Mobileye, is building a vertically integrated robotaxi platform centered on an autonomous ID. Buzz, while Renault has focused on autonomous public transport and shuttle deployment through WeRide, and Stellantis teaming up with Bolt. Mercedes-Benz is taking more of a luxury angle, positioning autonomous S-Class vehicles as high-end robotaxis supported by partners such as NVIDIA and Momenta. Stellantis is also pursuing a partnership approach, collaborating with external autonomy specialists including Pony.ai, NVIDIA and Uber to accelerate Level 4 capabilities without bearing the full development burden internally. By contrast, BMW and Porsche remain focused primarily on consumer ADAS and Level 2/Level 3 driving assistance for privately owned vehicles rather than commercial robotaxi fleets.

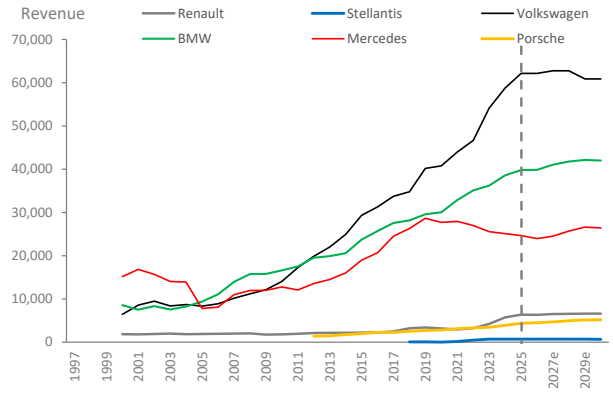
Exhibit 33: European OEMs approach to Robotaxi strategic options defined by balance sheets, brand positioning, ADAS technology and long-term optionality



Source: Morgan Stanley Research.

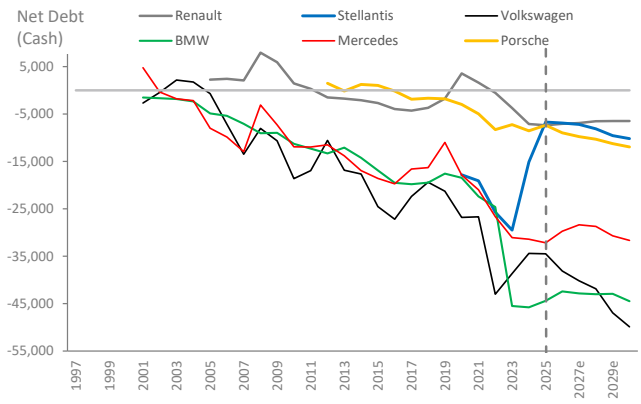
Short-term business opportunities but also long-term strategic optionalities. Several moving parts define each OEM option into this business (Exhibit 51): all European OEMs have a FS business, a good starting point to operate a fleet, but the scale of FS differs by OEM (Exhibit 34), and not all the companies have the balance sheet to invest in a fleet (Exhibit 35) and related to that, different cost of funding. ADAS technology is still a differentiating factor, in our view. German OEMs are a step in front of French peers, as well as brand positioning. Thinking medium term, this could be a new business line, capturing share as Robotaxis gain scale; longer term, it could bring optionality once the progress of autonomous technology reduces the size of the global fleet.

Exhibit 34: European OEMs Financial Services revenue (EUR mn)



Source: Morgan Stanley Research estimates.

Exhibit 35: European OEMs Industrial net Debt (Cash) position



Source: Companies, Morgan Stanley Research estimates.

Regulation fragmented across the region. Europe has a legal framework in place for L4 autonomous vehicles, but it remains relatively cautious and fragmented. At the EU level, regulation allows fully automated vehicles to operate within defined operational domains,

enabling passenger and goods transport under controlled conditions. In practice, deployment authority still sits largely with national regulators and local governments, meaning commercial rollout depends on country-specific rules around liability, remote supervision, insurance and geofenced operating permits. Germany is one of the most advanced major EU markets, with legislation already allowing driverless vehicles on public roads in approved operating areas under remote technical supervision. France is also relatively progressive, particularly for autonomous shuttles and public-transport use cases, and has already permitted Level 4 driverless shuttle operations. The UK, operating outside the EU framework, is building an independent regime under the Automated Vehicles Act 2024 and is becoming a major early testing ground for Waymo, Wayve and Uber. Overall, Europe's regulatory environment increasingly allows robotaxi deployment, but scaling remains slower and more operationally constrained than in the US or China because approvals remain highly localised and operationally restricted.

Stock implications

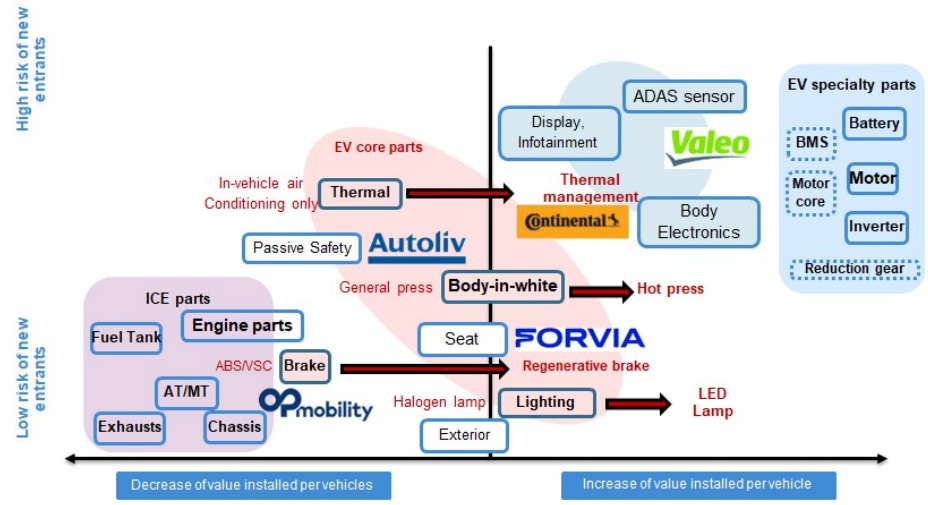
Robotaxis presents a new risk to legacy OEMs. European OEMs face numerous challenges currently, US tariffs, declining market share in China, a tough macroeconomic and geopolitical backdrop, and the pressure of Chinese OEMs expanding into their home markets. With Robotaxis, they now also face technology specialists such as Waymo and Wayve. We think the robotaxi wave is likely to have a gradual but strategically important impact on European legacy OEMs. Near-term volume effects should be limited because robotaxis will initially scale only in dense urban, geofenced areas, and taxi demand represents only a small share of total European car registrations. However, the longer-term risk is that Robotaxis present another shift in the value chain, away from legacy vehicle manufacturing and toward autonomy software, fleet operations and mobility platforms, where US and Chinese players currently lead. Volkswagen and Mercedes appear to be positioned better than peers for now, with a focus on creating their own autonomous offerings.

Suppliers with ADAS exposure to benefit from Robotaxi expansion, but will face increasing competition from China: European Auto Parts players exposed to ADAS, sensors, domain controllers and thermal management, such as Valeo, are positioned well to benefit from expanding robotaxi fleets, but will face intensifying competition from Chinese peers scaling rapidly in these high-CPV categories – putting pricing power under increasing pressure. Principally, the fact that European OEMs (long-term partners of EU suppliers) are significantly behind in the race towards capturing the robotaxi opportunity, puts EU suppliers at a disadvantage, or even-playing field at best, versus Chinese peers in winning incremental ADAS share and securing partnerships with new AV leaders.

Those with higher powertrain exposure and little to no ADAS participation are even worse off in the competitive landscape, as robotaxi fleets will primarily be comprised of autonomous BEVs. With increasing BEV and AV penetration over the next decades, the TAM for ICE powertrain focused suppliers will decline gradually, raising the long term of risk of obsolescence. Suppliers exposed to lighting and sensors, such as Forvia and Valeo, could participate in LiDAR technologies for robotaxis, but again face significant competition from Chinese suppliers already working with Chinese AV players. Overall, there is an opportunity for EU suppliers to capture share of the robotaxi TAM, although it will be an steep uphill battle as they grapple with heightened competition, pricing

pressure, and BEV penetration trends.

Exhibit 36: European Auto Parts players product positioning



Source: Morgan Stanley Research.

Implications for the Japan Market

By Hiroto Segawa/Shinji Kakiuchi

L4+ robotaxi rollout in Japan

Current status of robotaxis and pilot initiatives in Japan: Commercial robotaxi operations have not yet commenced in Japan. However, Nissan announced in March 2026 that it plans to launch pilot robotaxi services in Tokyo in 2H26 in collaboration with Wayve and Uber Technologies. Under this framework, Nissan aims to integrate Wayve's end-to-end AI autonomous driving system into Nissan vehicles and connect them to Uber's ride-hailing platform, linking robotaxis directly with users. In addition, Waymo, a subsidiary of Alphabet, began public-road testing in Tokyo in April 2025 and is currently collecting mapping data to support future robotaxi services in Japan.

Medium- to long-term significance of robotaxis from a social perspective: While Japan's robotaxi initiatives currently lag those of China and the US, they offer meaningful long-term potential in addressing social challenges. The total number of taxi drivers in Japan stands at just over 200,000, representing a decline of approximately 30% over the past decade. In particular, securing mobility options for elderly residents and transportation-disadvantaged populations in rural areas has become an increasingly important issue. Against this backdrop, robotaxis could play a growing role in Japan over the medium to long term.

Safety-oriented policy environment and constraints on adoption scenarios: That said, Japan frequently sets "zero traffic fatalities" as a policy objective. Even if robotaxis reduce accident rates relative to human drivers, widespread adoption of end-to-end AI-based robotaxis (Level 4 autonomy) could still face resistance. As a result, a scenario in which Level 2++ autonomous driving systems – such as navigation-on-autopilot functionality capable of operating on both highways and local roads – become the mainstream solution in the near term appears more plausible than large-scale robotaxi deployment.

Greater near-term adoption potential in commercial applications: As discussed above, we do not expect rapid near-term expansion of robotaxis in the passenger vehicle market. In contrast, the commercial vehicle segment appears better positioned for earlier adoption of autonomous driving. By 2030, truck transport capacity is projected to face a shortfall of approximately 35%, while the number of bus drivers could decline by nearly 30%, increasing the urgency of labor-saving solutions. Isuzu plans to introduce Level 4 autonomous driving for large trucks on its spare-parts logistics routes starting in FY2027 and also plans pilot operations for route buses on selected sections in Hiratsuka City from the same fiscal year. Given the technical challenges associated with deploying Level 4 autonomy in passenger vehicles and Japan's strong policy focus on traffic safety, we believe Level 4 autonomous driving is more likely to gain traction first in commercial vehicles than in passenger cars.

Stock implications

Toyota: Toyota entered into a strategic partnership with Waymo in April 2025. While details remain limited, the two companies aim to jointly explore enhancements to

autonomous driving technologies for Toyota's future production vehicles. Toyota also began supplying vehicles to Pony.ai for robotaxi deployment in February 2026, with further expansion expected. In addition, Toyota targets the introduction of Level 4 autonomous driving for its 17-seat e-Palette, designed for shuttle-bus and mobile-retail applications, in FY2027.

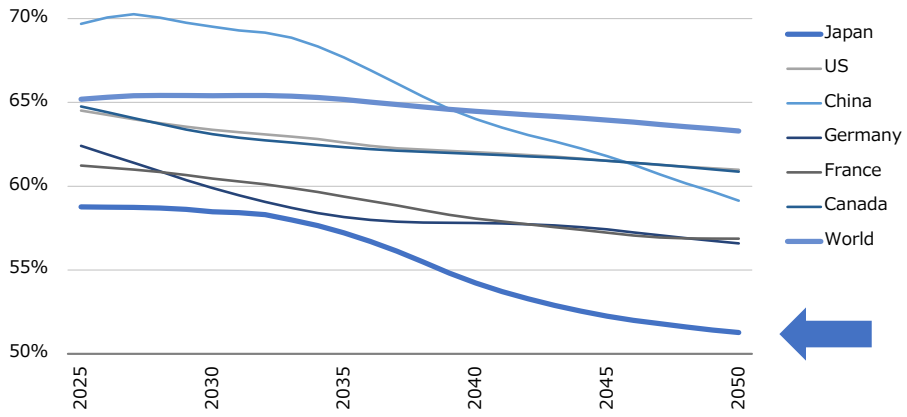
Honda: Honda aims to obtain regulatory approval for Level 4 autonomous driving in FY2027, with commercialization targeted around 2030. Meanwhile, the company expects to introduce additional Level 2 autonomous driving systems from 2028 onward.

Nissan: Nissan plans to begin pilot robotaxi operations in 2H26. Separately, the company intends to equip its Elgrand minivan with Level 2 autonomous driving capabilities by the end of FY2027.

Isuzu: Isuzu plans to deploy Level 4 autonomous driving for large trucks on its internal spare-parts logistics routes beginning in FY2027 and is also preparing pilot and deployment initiatives for route buses in Hiratsuka City.

Level 4 deployments by local governments likely to increase to address social challenges, including driver shortages and access to transportation: As aging and depopulation continue in Japan, access to healthcare and shopping for mobility-constrained residents, particularly the elderly, is becoming a significant social challenge. Many bus operators have already reduced routes or are considering doing so, while shortages of route-bus drivers remain a key constraint. Against this backdrop, we believe expectations are rising for autonomous buses in Japan – particularly Level 4 services that can operate without a driver.

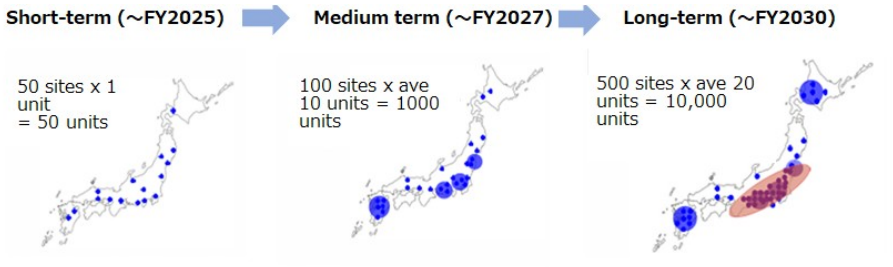
Exhibit 37: Productive population ratio forecast by country



Source: United Nations "Population Division, Department of Economic and Social Affairs", Population Division (2024). World Population Prospects 2024, Online Edition.

Cabinet-approved target to deploy 10,000 autonomous service vehicles by F3/31 (January 2026): On January 16, 2026, MLIT and the National Police Agency released the Cabinet-approved 3rd Basic Plan on Transport Policy. The plan outlines four pillars: (1) sustainability of local communities, (2) realization of a growth-oriented economy, (3) resilient transport infrastructure, and (4) adoption of digital and new technologies. For autonomous driving, the government targets an increase in autonomous service vehicles from 10 as of F3/26 to approximately 1,000 by F3/28 and 10,000 by F3/31.

Exhibit 38: Roadmap for expanding autonomous service vehicles (buses) by municipalities in Japan



Source: Ministry of Internal Affairs and Communications, "Study Group on 'Next-Generation ITS Communications in the Era of Autonomous Driving' (Phase III)," p.28, "Progress in Initiatives Related to Autonomous Driving,", Morgan Stanley Research.

Denso and Koito develop LiDAR technology: Denso is advancing both internal LiDAR development and joint development efforts with partners such as Aeva. The company focuses not only on standalone sensors but also on integrated sensing systems that incorporate ECUs. Koito Manufacturing began a joint LiDAR development program with Cepton in 2018 and acquired the company in 2025. However, development costs have increased after revisions to a customer's vehicle development plans resulted in the cancellation of deployment in certain mass-market passenger vehicle programs. As a result, Koito is likely to focus on opportunities in commercial vehicle and infrastructure-related LiDAR applications. For Denso, we present these developments as factual observations rather than investment implications.



Implications for the Korea Market

By Young Suk Shin/Chan Park

L4+ robotaxi rollout in Korea

From pilot-driven to ecosystem-building phase: Korea's robotaxi industry is transitioning from a pilot-driven phase to an ecosystem-building phase. For much of the past decade, efforts focused on demonstrating autonomous driving technology in limited environments such as Pangyo, Sangam, and parts of Seoul. The government's current objective is more ambitious: achieving commercial Level 4 autonomous driving by 2027 while building a competitive domestic autonomous mobility industry.

The government's approach has evolved from supporting isolated pilot projects to creating conditions for large-scale deployment. Earlier autonomous driving initiatives focused on proving technological feasibility within tightly defined operating zones. More recently, policy has shifted toward expanding operating domains, simplifying testing frameworks, and encouraging collaboration among industry participants.

The centerpiece of this effort is Gwangju, Korea's first citywide autonomous driving pilot zone. The objective is not simply to test autonomous vehicles but to create a realistic urban environment where companies can accumulate operational experience, generate driving data, and validate commercial service models. More broadly, policymakers view autonomous driving as a strategic industry that will influence Korea's competitiveness in the future automotive sector, much as batteries and semiconductors have done today.

Team Korea approach: Unlike the US model, where Tesla and Waymo are emerging as the two leading robotaxi operators, or the Chinese model, where several large players are deploying fleets at scale, Korea is pursuing a collaborative ecosystem approach. A layered ecosystem is emerging, with different participants specializing in distinct parts of the value chain. Vehicle manufacturers provide the platform, autonomous driving companies supply software, fleet operators manage vehicles, and mobility platforms such as Kakao connect services with customers.

This structure reflects Korea's broader industrial model, where large corporations, technology specialists, and government institutions often collaborate to develop strategic industries. Rather than producing a single Korean equivalent of Waymo, Korea appears to be building an interconnected ecosystem designed to accelerate commercialization while spreading risk across multiple participants.

Key players and their strategies:

- **Hyundai Motor Group** is the central industrial player. Through Hyundai, Kia, 42dot, and Motional, the group is building capabilities across vehicle manufacturing, software-defined vehicles, autonomous driving software, and mobility services. Hyundai's strategy is to remain relevant as value creation shifts from hardware toward software and autonomous mobility platforms. While its manufacturing scale provides a significant domestic advantage, its key challenge remains accumulating real-world operating experience comparable to global leaders such as Waymo.
- **Kakao Mobility** occupies a different but potentially powerful position. Through

Kakao T, it already operates one of Korea's largest transportation platforms and serves as the interface between mobility providers and consumers. Rather than developing autonomous driving technology itself, Kakao's strategy is to become the primary distribution and dispatch platform for future autonomous fleets. If robotaxi adoption accelerates, customer ownership may prove just as important as vehicle ownership.

- **Autonomous a2z** has emerged as one of Korea's leading independent autonomous driving software companies. Its strategy is to become a preferred supplier of autonomous driving technology rather than compete as a fleet operator. This allows it to partner with multiple vehicle manufacturers and service providers while focusing resources on perception, planning, and vehicle-control technologies.
- **RideFlux** is pursuing a broader commercialization strategy by combining passenger transportation with autonomous logistics services. This approach may enable the company to generate revenue earlier while continuing to develop its core autonomous driving capabilities. Its expansion into freight applications reflects a pragmatic view that logistics may commercialize faster than large-scale robotaxi deployment.

Key risks and barriers: Despite strong policy support, several challenges could slow commercialization.

- The most immediate issue is the continued reliance on safety drivers and remote supervision. Robotaxi economics improve significantly only when vehicles can operate with minimal human intervention. Until then, operating costs remain elevated and profitability remains uncertain.
- Scale is a second challenge. Autonomous driving systems improve through real-world data collection, and Korean fleets remain small relative to those operating in the US and China. This creates a risk that Korean firms fall further behind global leaders in both data accumulation and system performance.
- Commercial viability remains another open question. Even if autonomous vehicles operate safely, fleet economics must ultimately compete with traditional taxi services. High sensor costs, maintenance requirements, remote operations, and ongoing software development create significant cost burdens that remain largely unproven at scale.
- Finally, regulatory and liability issues remain unresolved. As vehicles move toward driverless operation, responsibility for accidents may shift among manufacturers, software providers, operators, and insurers. Establishing clear accountability frameworks will be essential before widespread deployment becomes possible.

Implications for TMT Players

By Gary Yu & Joanne Lau

Apollo Go (Baidu):

Apollo Go is Baidu's Level 4 autonomous ride-hailing platform and the company's largest real-world AI application, with more than 12 years of cumulative investment in the field. The platform operates under the Apollo Go brand in China and internationally and is widely recognized, alongside Waymo, as one of the world's leading robotaxi services.

Apollo Go's flagship vehicle is the RT6 – a purpose-built, mass-produced Level 4 autonomous vehicle. The fully electric vehicle carries up to three passengers and incorporates more than 30 sensors. Its steering wheel is designed to be removable to support fully driverless operation. At a production cost of less than US$30,000 per vehicle, the RT6 offers one of the most competitive cost structures in the industry.

Exhibit 39: Key development milestones

Date	Milestone	Geography
Nov-21	Apollo Go begins charging fees for autonomous ride-hailing in Beijing (with safety operator)	China
Jul-22	RT6 (6th-gen, steering wheel-free) unveiled; fully driverless commercial service launched in Wuhan & Chongqing	China
Aug-23	Fully driverless (no safety operator) fee-charging service launched in Beijing	China
Feb-25	Achieved 100% fully driverless operations in 10+ Chinese cities including Beijing, Shanghai, Shenzhen, Wuhan, Chengdu, Chongqing, Haikou, Sanya, etc.	China
Nov-24	First robotaxi testing permit in Hong Kong — first right-hand drive market entry	Intl
Jan-26	Fully autonomous commercial ride-hailing launched in Abu Dhabi; Apollo Go Park (first overseas hub) inaugurated in Dubai	Middle East
Apr-26	Fully driverless commercial ride-hailing launched in Dubai via Apollo Go app (first international app deployment); partnership with Dubai Taxi Company	Middle East
Jun-26	AmiGo (Apollo Go + PostBus) receives Level 4 regulatory approval from Switzerland's FEDRO; open-road trials began June 1, 2026 across ~80 km^2 in Eastern Switzerland	Europe

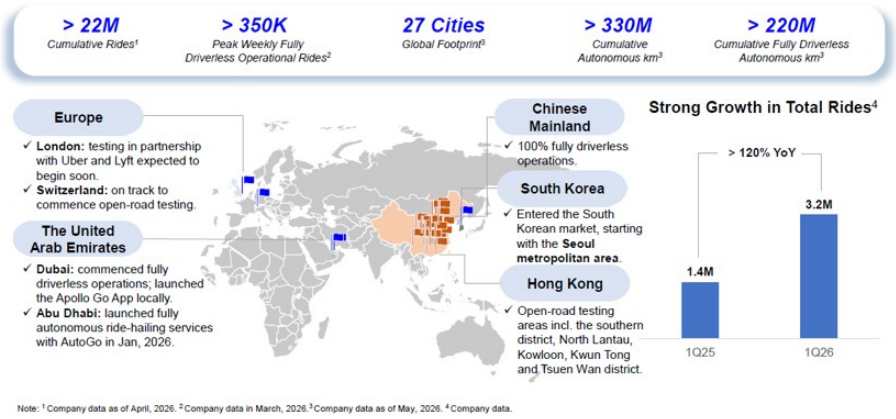
Source: Company data, Morgan Stanley Research

Operational highlights:

Apollo Go delivered 3.2 million fully driverless operational rides, with weekly rides peaking at over 350,000 in March. Total rides increased by over 120% year over year. As of April 2026, cumulative rides provided to the public by Apollo Go exceeded 22 million.

Apollo Go has been operating fully driverless in 10+ cities in China and expanding globally, now operating in 27 cities in total. The business model is evolving towards an asset-light approach, leveraging partnerships with platforms such as Uber (report) and Lyft to accelerate international expansion without significant capital investment. Apollo Go has achieved unit-level breakeven in Wuhan, its largest operating city, and management targets breakeven in additional cities during 2026.

Exhibit 40: Apollo Go development



Source: Company 1Q26 presentation, Morgan Stanley Research

Our view: Though we see encouraging progress in Apollo Go expansion, we expect the current financial contribution is still limited. We expect Baidu will focus on expanding overseas as there could be more pushback from local media/government over the negative impact on employment and safety considerations. Margin uplift will depend on mass roll-out of next generation robotaxis to further lower operational costs and to achieve sizable profitability.

Disclosure Section

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(as of June 30, 2026)

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	Coverage Universe		Investment Banking Clients (IBC)			Other Material Investment Services Clients (MISC)	
Stock Rating Category	Count	% of Total	Count	% of Total IBC	% of Rating Category	Count	% of Total Other MISC
Overweight/Buy	1544	42%	453	49%	29%	757	44%
Equal-weight/Hold	1577	43%	390	42%	25%	769	44%
Not-Rated/Hold	3	0%	1	0%	33%	1	0%
Underweight/Sell	544	15%	89	10%	16%	204	12%
Total	3,668		933			1731	

Data include common stock and ADRs currently assigned ratings. Investment Banking Clients are companies from whom Morgan Stanley received investment banking compensation in the last 12 months. Due to rounding off of decimals, the percentages provided in the "% of total" column may not add up to exactly 100 percent.

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COMPANY (TICKER)	RATING (AS OF)	PRICE* (07/03/2026)
Joey Xu, CFA		
Anhui Jianghuai Automobile (600418.SS)	E (08/19/2023)	Rmb26.19
BAIC Motor (1958.HK)	E (10/02/2025)	HK$0.84
Brilliance China Automotive (1114.HK)	E (03/31/2025)	HK$2.03
Chongqing Changan Automobile (000625.SZ)	E (03/03/2026)	Rmb7.24
Guangzhou Automobile Group (601238.SS)	U (10/23/2019)	Rmb5.25
Guangzhou Automobile Group (2238.HK)	O (05/05/2020)	HK$2.22
Huayu Automotive (600741.SS)	O (09/08/2020)	Rmb16.10
Jiangsu Changshu Automotive Trim Group (603035.SS)	E (08/14/2023)	Rmb11.43
Ningbo Huaxiang Electronic Co., Ltd. (002048.SZ)	E (05/05/2026)	Rmb26.22
SAIC Motor Corp. Ltd. (600104.SS)	O (11/25/2021)	Rmb10.11
Voyah Automotive Technology Co. Ltd, (7489.HK)	O (03/31/2026)	HK$3.30
Zhengzhou Yutong Bus Co (600066.SS)	E (09/22/2023)	Rmb28.90
Shelley Wang, CFA		

Beijing Jingwei Hirain Technologies (688326.SS)	U (09/27/2024)	Rmb72.20
Bethel Automotive Safety Systems Co Ltd (603596.SS)	O (12/11/2023)	Rmb27.65
Changzhou Xingyu Automotive Lighting Sys (601799.SS)	O (09/27/2024)	Rmb100.31
China MeiDong Auto Holdings Ltd (1268.HK)	E (01/08/2024)	HK$0.51
China Yongda Automobiles Services (3669.HK)	E (08/13/2024)	HK$0.74
Foryou Corporation (002906.SZ)	O (03/06/2024)	Rmb26.48
Fuyao Glass Industry Group (600660.SS)	E (12/01/2016)	Rmb50.93
Fuyao Glass Industry Group (3606.HK)	E (12/01/2016)	HK$51.75
Huizhou Desay SV Automotive Co Ltd (002920.SZ)	O (02/28/2025)	Rmb86.48
Keboda (603786.SS)	O (01/17/2024)	Rmb44.28
Minth Group Limited (0425.HK)	O (08/24/2015)	HK$28.66
NavInfo Co Ltd (002405.SZ)	U (03/06/2024)	Rmb6.56
Nexteer Automotive Group (1316.HK)	E (02/28/2025)	HK$4.13
Ningbo Joyson Electronic Corp (600699.SS)	E (03/11/2026)	Rmb23.45
Ningbo Tuopu Group Co Ltd (601689.SS)	E (11/12/2025)	Rmb62.43
Ningbo Xusheng Group Co Ltd (603305.SS)	E (06/18/2025)	Rmb13.03
Suzhou Recodeal Interconnect System (688800.SS)	O (07/02/2026)	Rmb83.00
TUHU Car Inc (9690.HK)	O (07/29/2024)	HK$13.08
Zhejiang Sanhua Intelligent Controls (002050.SZ)	E (11/12/2025)	Rmb48.99
Zhongsheng Group Holdings (0881.HK)	O (10/12/2021)	HK$5.06
Tim Hsiao		
BAIC BluePark New Energy (600733.SS)	U (08/07/2024)	Rmb4.87
BYD Company Limited (002594.SZ)	O (04/14/2025)	Rmb88.47
BYD Company Limited (1211.HK)	O (04/14/2025)	HK$84.10
EHang Holdings Ltd (EH.O)	O (03/13/2025)	US$6.31
Geely Automobile Holdings (0175.HK)	O (06/26/2024)	HK$18.30
Great Wall Motor Company Limited (601633.SS)	U (03/16/2022)	Rmb15.37
Great Wall Motor Company Limited (2333.HK)	E (01/08/2024)	HK$8.85
Hesai Group (HSAI.O)	O (07/28/2025)	US$17.19
Horizon Robotics (9660.HK)	O (12/02/2024)	HK$4.68
Li Auto Inc. (LI.O)	O (08/24/2020)	US$12.02
Li Auto Inc. (2015.HK)	O (11/16/2021)	HK$47.36
NIO Inc. (9866.HK)	O (10/03/2022)	HK$38.40
NIO Inc. (NIO.N)	O (08/26/2020)	US$4.79
WeRide Inc (WRD.O)	O (11/19/2024)	US$5.52
XPeng Inc. (9868.HK)	O (11/16/2021)	HK$51.70
XPeng Inc. (XPEV.N)	O (01/29/2021)	US$13.08

Stock Ratings are subject to change. Please see latest research for each company.
* Historical prices are not split adjusted.

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