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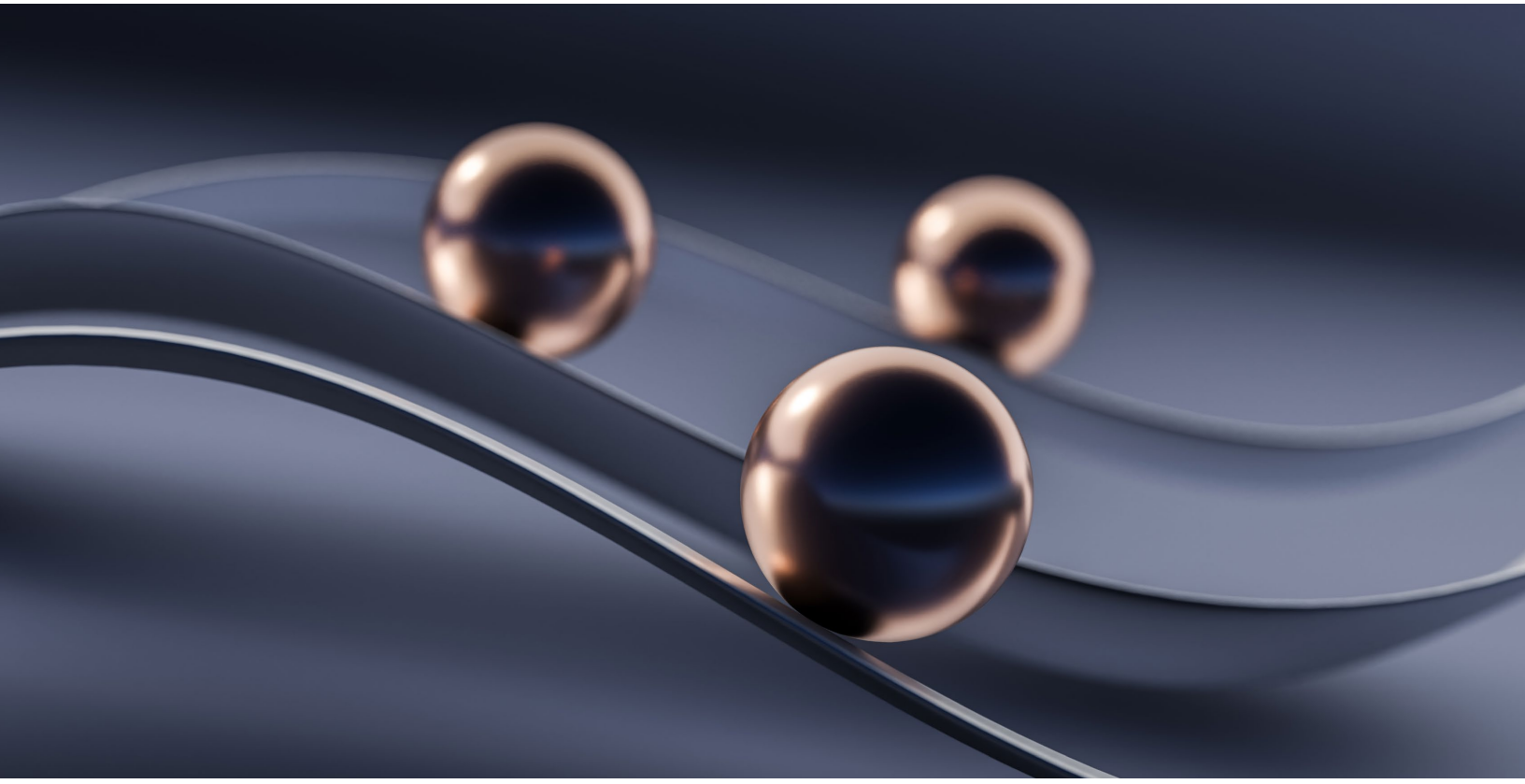
McKinsey Center for Future Mobility

Spotlight on mobility trends

It was another year of big changes for the mobility sector as regulation, investment patterns, consumer preferences, and technology continued to evolve.

by Kersten Heineke, Philipp Kampshoff, and Timo Möller



March 2024

In a decade that has witnessed remarkable mobility developments, 2023 still manages to stand out. The long list of accomplishments includes some familiar topics, such as the continued growth of micromobility, steady progress with vehicle electrification, and continued investment in autonomous vehicles (AVs). Mobility stakeholders also ventured deeper into relatively new technologies and began seriously exploring the potential of generative AI to transform everything from automotive marketing and sales to R&D.

Despite mobility's steady progress in 2023, the challenges facing the industry tended to overshadow the good news. Electric-vehicle (EV) sales slowed in some regions, technological issues and lack of public acceptance derailed some AV pilots, and concerns about battery range persisted. What's more, 2023 provided more evidence that the global automotive market is in the midst of major disruptions. The industry's future is clearly becoming more electric despite some regional sales dips, and Chinese EV OEMs, which hold a strong position in their home market, are now preparing to pursue global opportunities. Meanwhile, OEMs in China, Europe, and the United States continue to roll out increasingly innovative AVs, including some with advanced L3 driving technology.

Here's a closer look at the trends that defined 2023 and will continue to shape mobility in 2024.

A consumer shift from private vehicles to more sustainable options

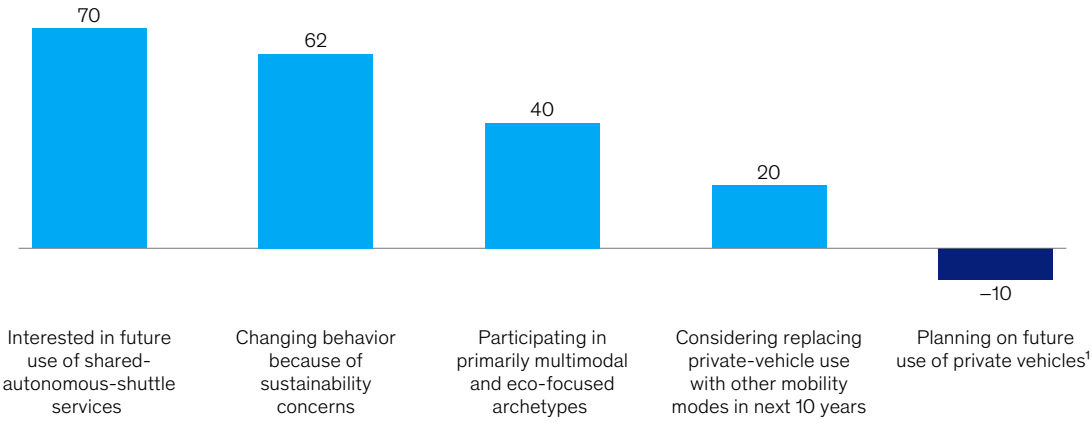
Mobility is first and foremost about consumer choices, and the McKinsey Mobility Consumer Pulse Survey shows that preferences are indeed shifting.[1] While private cars still dominate the road, 40 percent of survey respondents now use multiple mobility modes, including eco-friendly options such as e-bikes, and 62 percent are beginning to change their transportation habits because of sustainability concerns. In a development that could affect vehicle sales, 20 percent of respondents say they would consider replacing their private vehicles with other mobility options over the next ten years, and many are open to using autonomous shuttles if they become available.

[1] The McKinsey Consumer Pulse Survey, conducted in December 2022, included 27,869 respondents from Brazil, China, France, Italy, Japan, Norway, South Africa, and the United States.

Exhibit 1

Consumers are increasingly interested in sustainable transportation options.

General transportation consumer preferences, % of respondents



[1]Net figure. 30% of respondents say they plan to decrease use of private vehicles, and 10% say they plan to increase use.
Source: McKinsey Mobility Consumer Pulse Survey, 27,869 participants from Brazil, China, France, Italy, Japan, Norway, South Africa, and US, Dec 2022

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New vehicle preferences for everything from electrification to connectivity

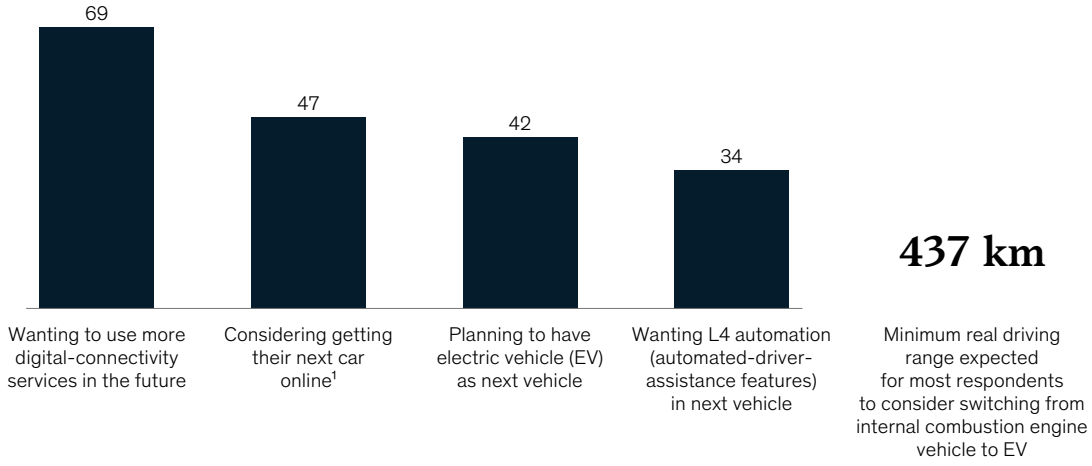
EVs have been soaring in popularity for years and remain in high demand, despite some recent sales declines in certain regions. The McKinsey Consumer Pulse Mobility Survey provides more evidence for this trend, with 42 percent of respondents stating that they want their next car to be an EV. To be willing to switch from an internal combustion engine (ICE) vehicle to an EV, respondents say their vehicles should be able to travel an average of 437 kilometers on a full charge. In another shift, 47 percent of prospective EV buyers surveyed say they are willing to purchase their vehicles online, showing that the sales process is also evolving.

Both digital connectivity and assistance features, such as automatic braking, are increasingly important purchase considerations. For their next vehicle purchase, 69 percent of survey respondents want more car connectivity services and 34 percent want L4 assistance features.

Exhibit 2

Many respondents are interested in electric vehicles—and want sophisticated vehicle features.

Preference for vehicle features, % of respondents



[1]For EV buyers.
Source: McKinsey Mobility Consumer Pulse Survey, 27,869 participants from Brazil, China, France, Italy, Japan, Norway, South Africa, and US, Dec 2022

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Growing EV demand—with China as the hot spot

McKinsey projects that worldwide demand for passenger cars in the battery electric vehicle (BEV) segment will grow sixfold from 2021 through 2030, with annual unit sales increasing to roughly 40.0 million, from 6.5 million, over that period. China retained its position as the world's e-mobility hot spot in 2023, with the highest penetration rates: one out of every four cars in China in 2023 was a BEV.

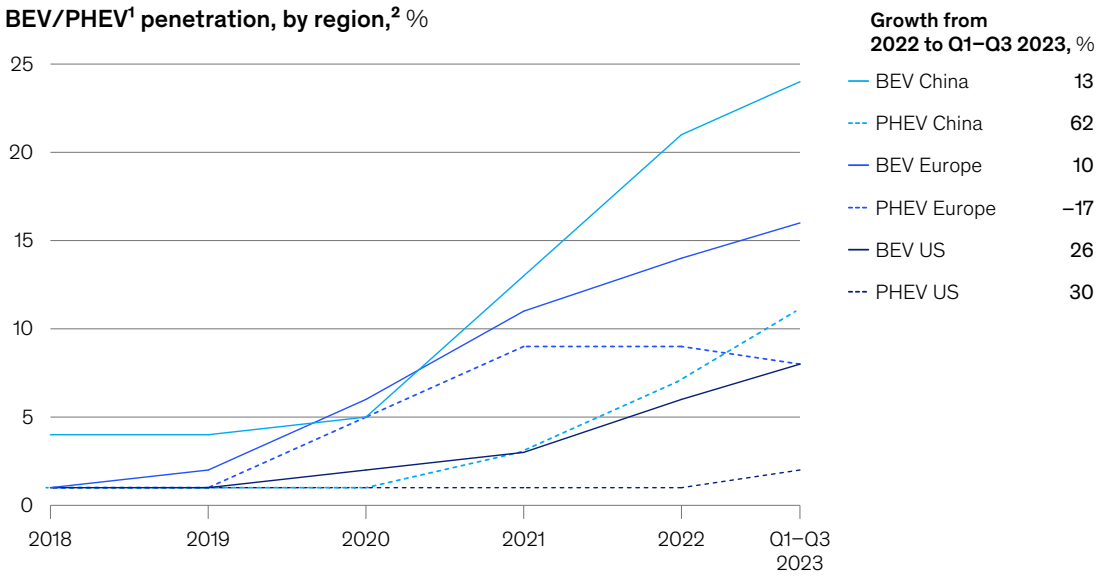
BEV growth remained positive across major regions, but it was slower than in past years for several reasons, including lower consumer demand stemming from a more pessimistic macroeconomic outlook and a lack

of new attractive BEV model launches globally. In Europe, BEV cash subsidies declined or ended, which further dampened demand. Plug-in hybrid electric vehicle (PHEV) sales grew in all regions except Europe.

China also hosts many local EV companies that are seeing strong domestic sales and have ambitious plans to export their vehicles. One essential factor to the country's success: an integrated value chain that provides local companies with easy access to everything from raw materials to batteries to digital services.

Exhibit 3

China retained its position as the world's e-mobility hotspot in 2023.



[1]Battery electric vehicle/plug-in hybrid electric vehicle.
[2]Share of BEV or PHEV in percentage of total passenger car sales.
[3]EU, European Free Trade Association, and UK.
Source: EV Data Center, EV-volumes.com, accessed on December 7, 2023; Light Vehicle Sales Forecast, S&P Global, accessed on December 7, 2023; McKinsey analysis

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Chinese EV OEMs—high market share, lower prices

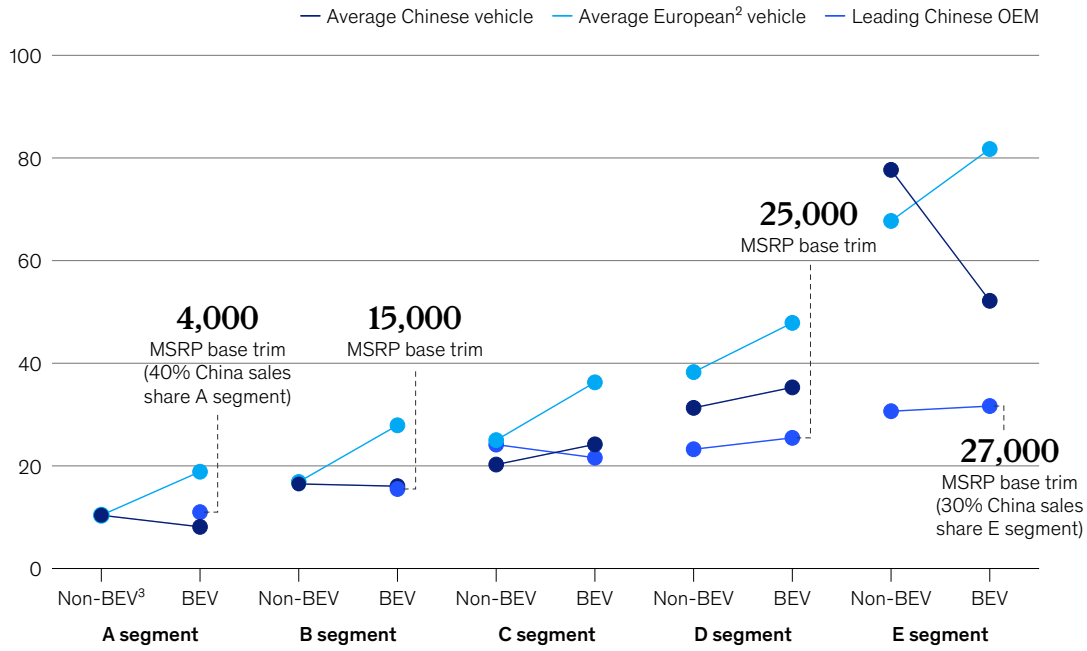
Beyond the quality of their EVs, Chinese OEMs may have an advantage in the global market for one simple reason: their vehicles are less expensive than those from European OEMs across all vehicle segments. In fact, one leading Chinese OEM now offers its vehicles at prices that are lower than or on par with those for comparable ICE vehicles.

China's integrated value chain contributes to the low prices for domestic OEMs. Other countries may want to consider developing similar value chains as the transition to EVs continues, since lower prices may accelerate the shift.

Exhibit 4

Chinese OEMs offer lower prices than European OEMs across all electric-vehicle segments.

Volume-weighted average estimated MSRP,[1] by segment and powertrain, in April 2023, € thousand



[1]Manufacturer's suggested retail price. Excludes value-added tax, other taxes, and add-on equipment (eg, leather seats, color options).
[2]EU, European Free Trade Association, and UK; MSRP calculated as average of Germany and UK.
[3]Non–battery electric vehicle. Includes full hybrid electric vehicles (EVs), fuel-cell EVs, internal-combustion-engine vehicles, mild hybrid EVs, plug-in hybrid EVs, and range-extended EVs.
Source: McKinsey analysis

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A growing need for batteries

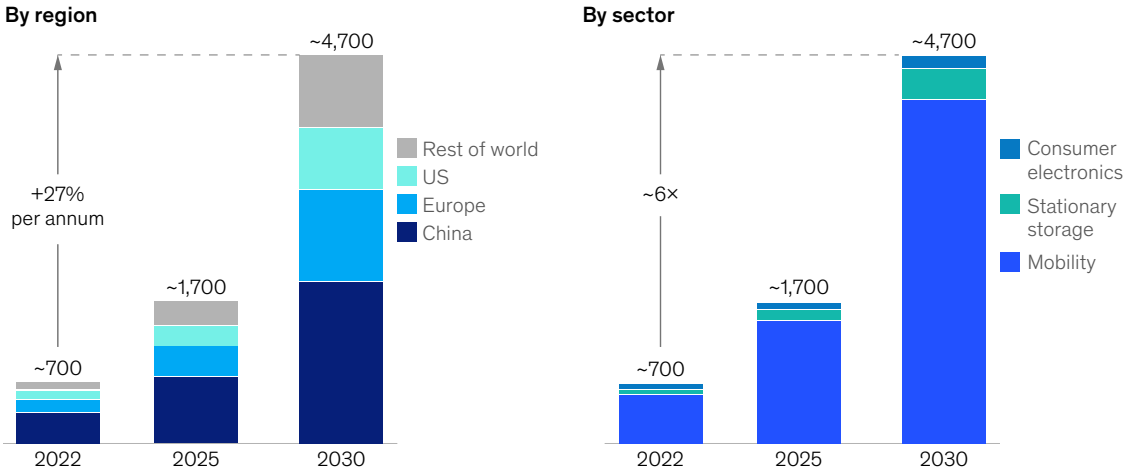
The McKinsey Battery Insights team projects that the entire lithium-ion (Li-ion) battery chain, from mining through recycling, could grow by 27 percent annually from 2022 to 2030, when it would reach a value of more than $400 billion and a market size of about 4,700 gigawatt-hours (GWh).[2] Batteries for mobility applications, such as EVs, will account for the vast bulk of demand in 2030—about 4,300 GWh, McKinsey estimates. The next two sources of demand—stationary storage and consumer electronics—will account for a much lower percentage of required GWh.

[2] "Battery 2030: Resilient, sustainable, and circular," McKinsey, January 16, 2023.

Exhibit 5

Lithium-ion battery demand is expected to reach around 4,700 GWh by 2030.

Global Li-ion battery cell demand, GWh, Base case



[1]Including 2 and 3 wheelers, aviation, commercial vehicles, passenger cars, and off-highway vehicles.
Source: McKinsey analysis

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A new go-to-market model for the EV age

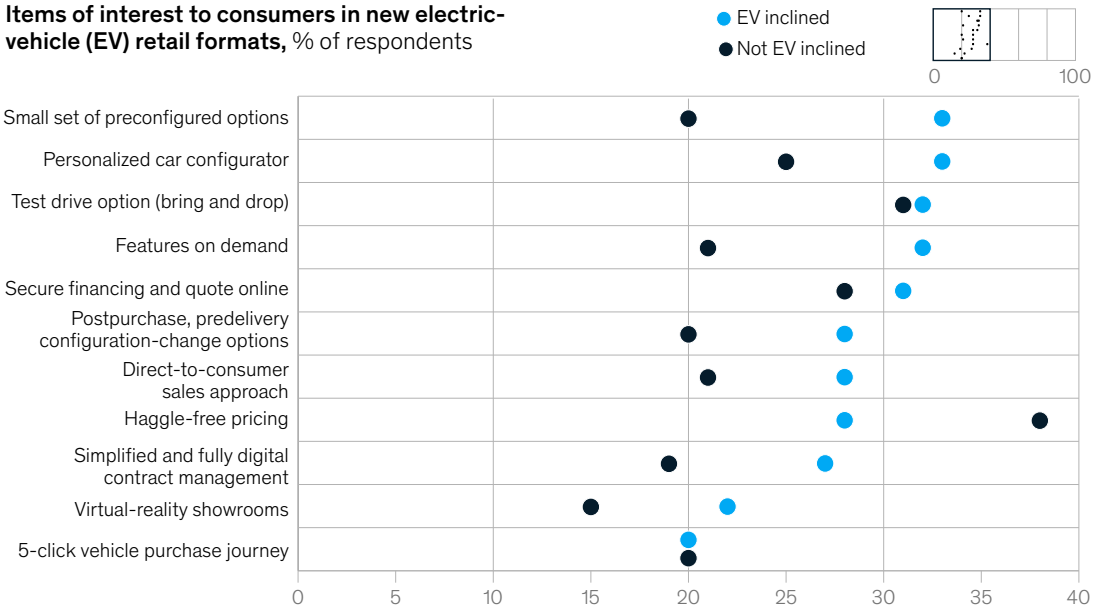
EV buyers value innovation, and that preference extends beyond the car to the buying process itself. McKinsey's latest Future of Auto Retail Consumer Survey reveals that respondents who are inclined to purchase an EV are more likely to say that they want more personalization than traditional car buyers.[3] They want a smaller set of preconfigured options, for instance, and the opportunity to change configuration after purchase and before delivery. Potential EV buyers also want more simplicity, convenience, and price transparency, including the ability to prebook test drives and secure financing online. OEMs that want to create an innovative and desirable brand impression could consider heeding these preferences as electrification accelerates.

[3] Future of Auto Retail Consumer Survey, McKinsey, August 2022. Consumers were interviewed in China, Germany, the United Kingdom, and the United States (n = 4,708).

These insights were developed by the McKinsey Center for Future Mobility (MCFM). Since 2011, the MCFM has worked with stakeholders across the mobility ecosystem by providing independent and integrated evidence about possible future-mobility scenarios. With our unique, bottom-up modeling approach, our insights enable an end-to-end analytics journey through the future of mobility—from consumer needs to a modal mix across urban/rural areas, sales, value pools, and life cycle sustainability. Contact us if you are interested in getting full access to our market insights via the McKinsey Mobility Insights Portal.

Exhibit 6

Electric-vehicle buyers want greater personalization, convenience, and flexibility when making a purchase.



Source: McKinsey Future of Auto Retail Consumer Survey, 4,078 participants from China, Germany, UK, and US, Aug 2022

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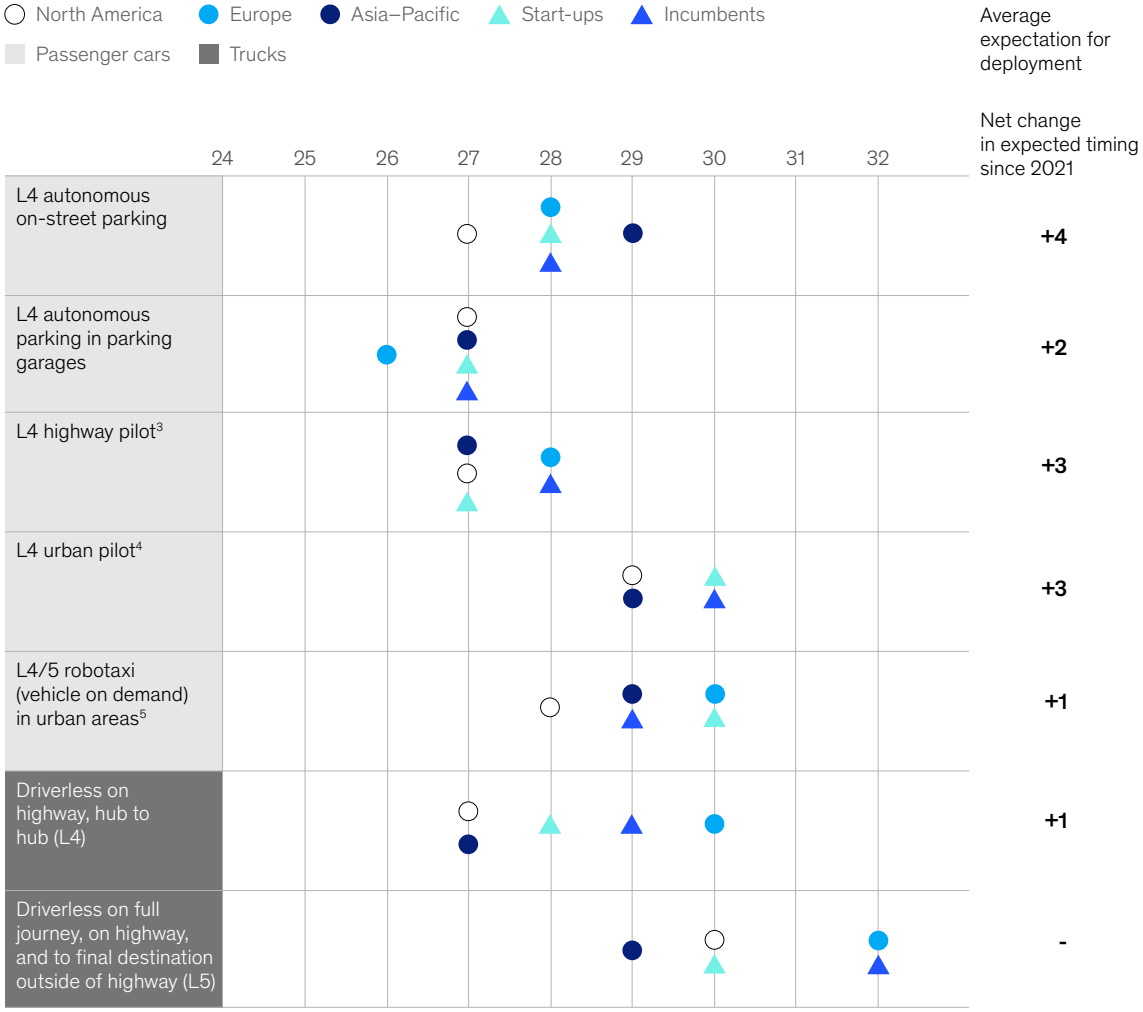
A few bumps in the road for autonomous driving but continued progress

OEMs and tech companies alike made important advances in autonomous driving in 2023, but these were balanced by some setbacks. One tech company, for example, successfully piloted robotaxis in the United States, but another was forced to discontinue its pilot after several accidents. We now estimate that adoption of vehicles with some L4 capabilities will occur at scale around 2026, with the first applications likely involving autonomous parking, followed by highway driving. More complex applications, such as driving in an urban environment, will require longer timelines for at-scale deployment. Reflecting the technological complexities of autonomous driving, the anticipated timelines for the emergence of L4 capabilities are now longer than they were in 2021.

Exhibit 7

Timelines for Level 4 and Level 5 autonomous-vehicle use cases have extended by two to three years on average.

Respondents' expectations for emergence of Level 4 (L4) and Level 5 (L5)[1] use cases,[2] weighted average across regions and by company types



[1]L4 vehicles are fully autonomous within controlled environments, such as robotaxis restricted to use within a city. L5 vehicles are autonomous under all conditions.
[2]Question: In your estimation, what is the rollout (ie, commercial availability of vehicles or service) timeline for autonomous driving across use cases in your region?
[3]Driver can use time on highways for work or leisure activities using in-car or own solutions but needs to take over at highway exits.
[4]Driver can use time on highways in urban environments for work or leisure activities using in-car or own solutions, but there might be certain situations in which the driver needs to take over.
[5]Robotaxis are driving everywhere in fully automated mode with no driver and are accepting and conducting transportation requests (goods, passengers). Passenger can use the travel time for work or leisure activities.
Source: McKinsey Center for Future Mobility Survey of global decision makers, 2023 (n = 86, 40 from North America, 37 from EU, 3 from China, 6 from other) and 2021 (n = 75, 31 from North America, 33 from EU, 11 from Asia–Pacific)

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A complex investment picture—with some signs for optimism

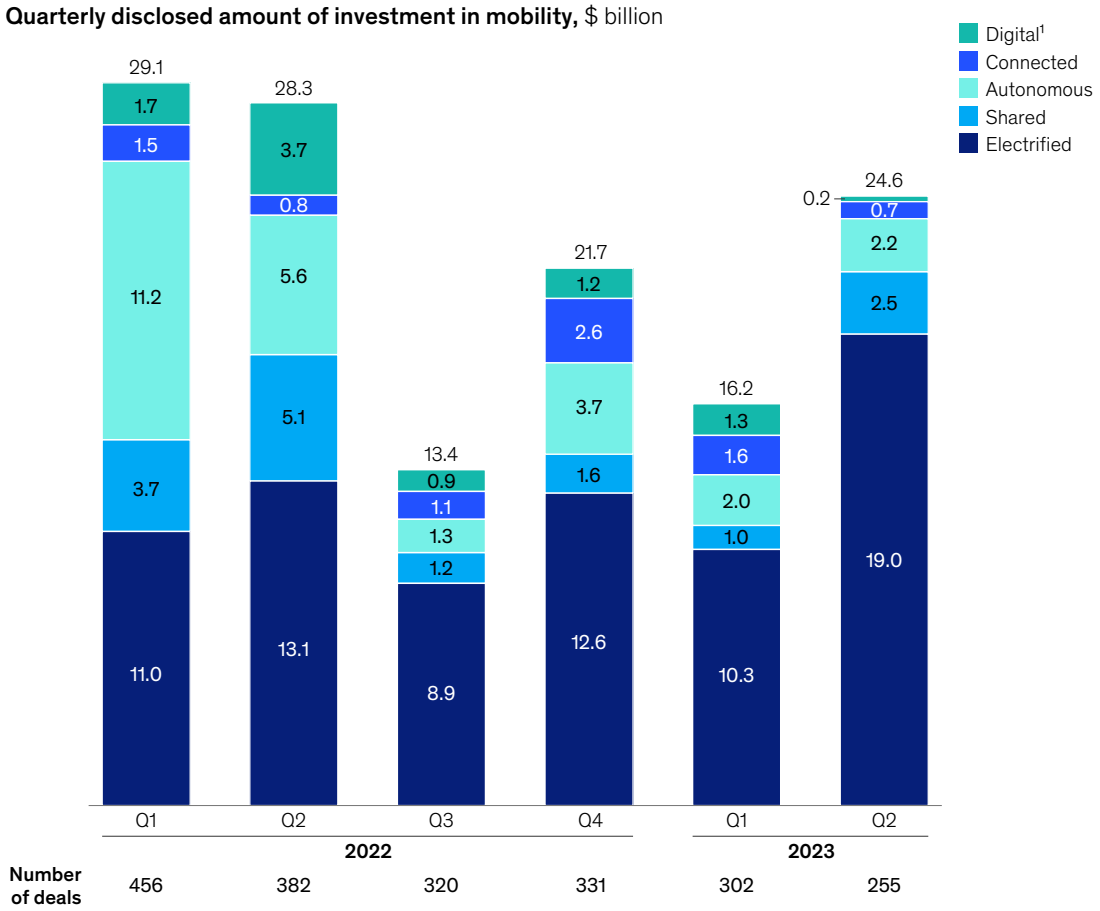
Innovation does not happen overnight after an inventor has a eureka moment. Within mobility, think of the complications involved in reconfiguring the automotive value chain to support EV production or the intense testing and reworking required to build the software stack for autonomous driving. These efforts require major funding from external investors, and the early part of 2023 showed signs that they were pulling back. Funding was down by 44 percent in the first quarter of 2023, compared with the same period last year, and 13 percent lower in the second quarter. In late 2023, mobility investment showed more positive momentum, and we expect this to continue in 2024. Companies that specialize in electrification, especially batteries, are attracting the most investment, followed by those that focus on AVs.

Private-market funding and corporate investment efforts for mobility initiatives continue to be significantly more selective; however, some strongly sought-after technology clusters like EVs still show momentum.

Exhibit 8

Investment in mobility declined in the first quarter of 2023 but was trending upward in the second quarter.

Quarterly disclosed amount of investment in mobility, $ billion



[1]Includes activities such as online leasing and subscriptions.
Source: PitchBook; McKinsey analysis

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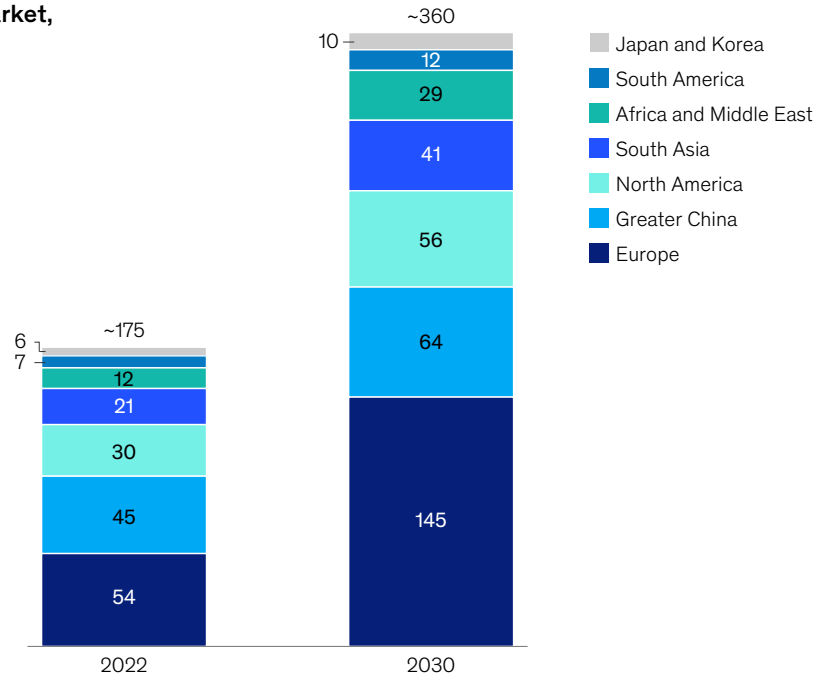
Micromobility options grew, suggesting big changes are ahead for the private-vehicle market

Micromobility—e-scooters, bikes, mopeds—is here to stay. In the recent McKinsey ACES Consumer Survey, almost one-third of respondents say they plan to increase their use of micromobility and nearly half are planning to replace their private vehicles with other modes of transport. McKinsey estimates that the global micromobility market will reach about $360 billion by 2030, up from about $175 billion in 2022—mainly driven by e-bike sales. Europe will represent the highest share of that value.

Exhibit 9

The global micromobility market is expected to reach a value of about $360 billion by 2030.

Value of micromobility market, by region, $ billion



Note: Figures may not sum to 100%, because of rounding.
Source: McKinsey analysis

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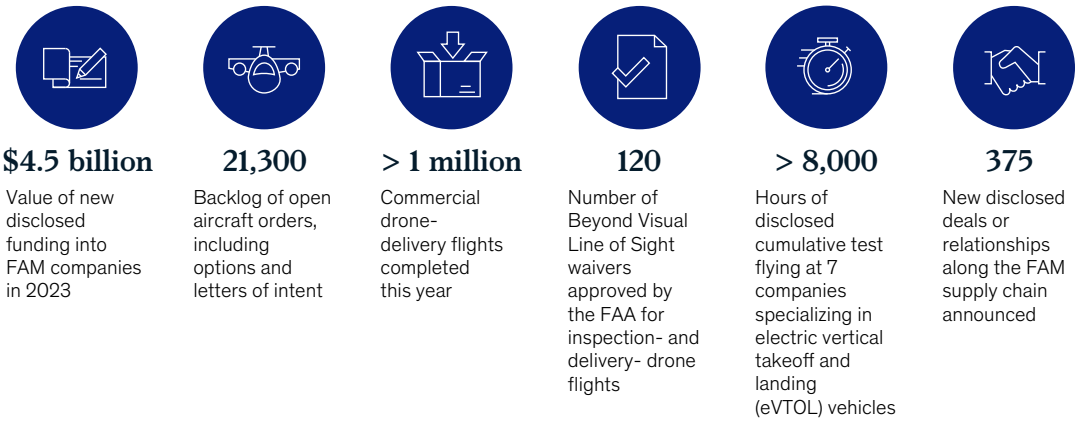
Future air mobility made progress, but funding slowed

The future air mobility sector had a mixed year in 2023. Disclosed investment totaled $4.5 billion for the year. Although this was lower than the $4.9 billion raised in 2022, the number of deals more than doubled to 151. New aircraft orders totaled $22 billion, and the backlog of open aircraft orders, including options and letters of intent, increased to 21,300.[4]

At the seven leading companies specializing in electric vertical takeoff and landing (eVTOL) vehicles, the number of cumulative disclosed test flight hours now totals over 8,000. The future air mobility sector also saw an increase in the number of deals or relationships along the supply chain in 2023, as well as more commercial-drone flights and new regulatory approvals for drone flights beyond the visual line of sight.

Exhibit 10

Future air mobility demonstrated steady progress in 2023.



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Applied AI still has a lead over generative AI within mobility

Mobility actors are still heavily investing in both new and existing technologies. A McKinsey analysis of 3,500 mobility start-ups that specialize in digitization or the so-called ACES trends—autonomous driving, connectivity, electrification, and shared mobility—shows that they are more likely to invest in applied AI applications compared with other leading-edge solutions.[5] Applied AI has a firm lead over generative AI within mobility because it enhances so many processes and addresses long-standing pain points, including those related to engineering, R&D, procurement, manufacturing, marketing and sales, and life cycle services. Companies, for instance, can use AI to identify customers who are at risk of being lost to a competitor and then create incentives to increase their satisfaction, potentially reducing churn and decreasing costs. Since many mobility stakeholders just began seriously exploring generative AI in 2023, it might soon gain more traction.

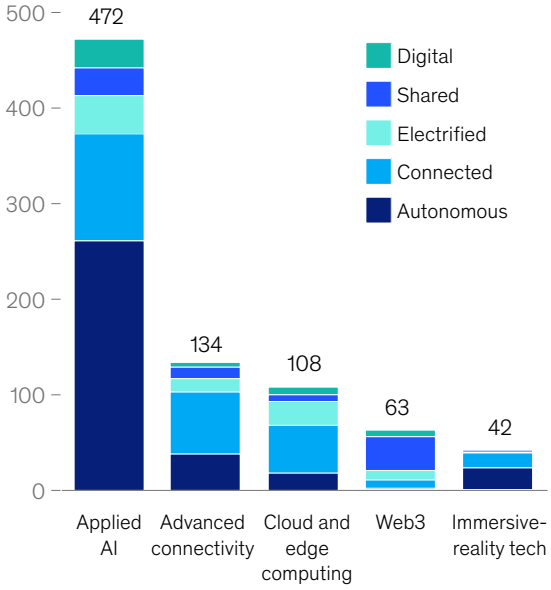
[4] *Future Air Mobility Blog,* "Clouds or clear skies? Prospects for future air mobility," blog entry by Axel Esqué, Tore Johnston, and Robin Riedel, McKinsey, January 23, 2024.

[5] This 2023 analysis involved reviewing keywords in corporate public filings to determine their technology focus.

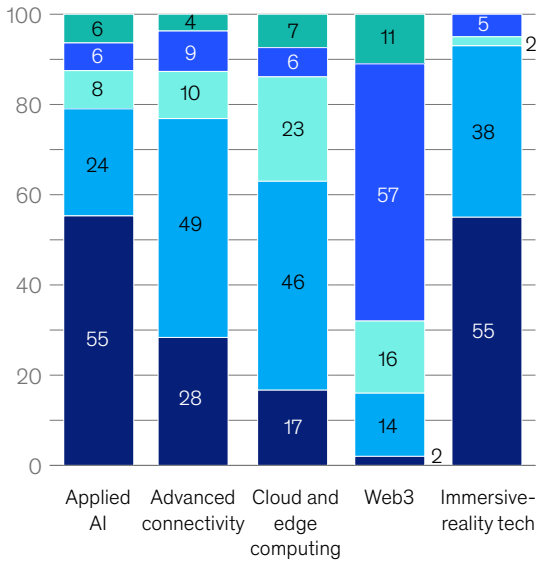
Exhibit 11

Companies in our sample are more likely to invest in applied AI than in other leading-edge technologies.

Top 5 tech trends of companies,[1] number of companies



Top 5 tech trends of companies,[1] % of companies working in each trend



Note: Figures may not sum to 100%, because of rounding.
[1]Corporate public filings of 3,500 companies worldwide were scanned for any mention of ~600 keywords linked to trends. Companies were working on autonomous driving, connectivity, electrification, and shared mobility tech or digital solutions, such as online leasing. Some companies were simultaneously working on products and services related to >1 trend.
Source: PitchBook; McKinsey analysis

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In retrospect, 2023 was a year of "getting things done" in mobility. Despite some setbacks, mobility stakeholders kept moving toward some of the industry's most important goals, including increasing battery life, developing more sophisticated EVs, overcoming the hurdles to L3 and L4 automation, and continuing the transformation to a less car-centric world. While external funding was down in the first quarter, it began trending upward later in the year, and select areas still generate high interest from investors. That bodes well for the entire sector, including niche areas such as future air mobility. As we move into 2024, the mobility sector is likely to experience both consolidation and scaling. As always, stakeholders will pursue innovation, but the increased attention to profitability will also persist. The resilience and persistence that they demonstrated in 2023 should also serve them well as the new year opens.

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