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The future of mobility

Mobility is entering a new age of innovation. We examined regional trends across the world to explore the complex changes that could transform the sector by 2035.

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Illustration by Peter Tarka

Mobility is one of the hottest sectors, with start-ups and traditional OEMs constantly developing new technologies and transportation options. The influx of innovative solutions has yet to solve the problem of congested roads, however, and almost every country is feeling the effects. Drivers in Munich waste an average of 87 hours in traffic every year; in Los Angeles, wasted time in traffic hit 119 hours before the pandemic, when roads were more crowded.¹

Worldwide, 1.3 billion vehicles are now in use, and many of these are privately owned. There are 868 vehicles per 1,000 capita in the United States, 635 in Norway, and 391 in Mexico. China, by comparison, has only 219 per 1,000 capita, but that still accounts for more than 300 million vehicles on the road. Private vehicles contribute to road congestion because they typically accommodate fewer passengers than public transportation or other shared options. The appeal of private ownership remains strong in many countries despite the recent rise of ride-sharing services. McKinsey analysis shows that private cars are used in 45 percent of all trips, outpacing public transport, micromobility (consisting of scooters and bikes—some electric—and other small vehicles), ride-sharing, ride hailing, and walking (exhibit).²

This legacy of private-car congestion does more than frustrate people. It also encourages developers to build garages and public officials to install more parking spaces, gobbling up scarce, valuable urban land that could otherwise be devoted to parks or other amenities. The United States, one of the world’s most car-dependent countries, now has eight available parking spots for every car.³ Additionally, the expansion of roadways and related infrastructure to ease congestion forces governments to spend more on maintenance and operations.⁴ And most critically, the high rates of private-car ownership are contributing to increased carbon emissions.

Within the next decade, however, the mobility ecosystem will most likely undergo a transformation not seen since the early days of the automobile—and one main shift will be the decline of private-car use. Governments are already enacting regulations to reduce the number of vehicles on the road to ease congestion and reduce emissions, and consumers are also voicing preferences for more efficient, green, and convenient transportation options. As technology advances, even more innovative mobility options could emerge, including roboshuttles (shared autonomous minibuses with four to eight seats) or urban air taxis.

The result of all these changes? A mobility ecosystem that is more intelligent, seamless, and environmentally friendly.

Exhibit

Private cars are still the most popular mobility mode.

Mobility split by mode of transportation, worldwide, 2022, %



Note: Figures do not sum to 100%, because of rounding.
Source: McKinsey Center for Future Mobility

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¹ Jörg Heinrich, "Major urban mobility trends of the future," ISPO, August 26, 2022; Jennifer Liu, "Commuters in this city spend 119 hours a year stuck in traffic," CNBC, September 4, 2019.

² Throughout this article, data on mobility usage were computed using a model from the McKinsey Center for Future Mobility that estimates the share of vehicle miles traveled by transportation mode.

³ Kaley Overstreet, "When 5% of the United States is covered by parking lots, how do we redesign our cities?," ArchDaily, February 1, 2022.

⁴ Across the United States, state and local governments spent \$617 per capita on highways and roads in 2019; "State and Local Backgrounders: Highway and road expenditures," Urban Institute, last updated March 2, 2023.

Disruptive trends and technologies: The forces transforming mobility

Here's a look at the disruptive trends and technologies that will shape the future of mobility and the impact that they will have worldwide.

Consumers are excited about the new options

The McKinsey Center for Future Mobility conducts an annual consumer survey that looks at four major trends: autonomous driving, electrification, connectivity, and shared mobility. Many respondents to the 2022 survey say they are open to shifting their transportation habits. Consider a few findings⁵:

- *Almost one-third of respondents* (30 percent) plan to increase their use of micromobility (for instance, e-bikes and e-scooters) or shared mobility over the next decade.
- *Nearly one-half of respondents* (46 percent) are open to replacing their private vehicles with other modes of transport in the coming decade.
- *Most respondents* (70 percent) are willing to use a shared autonomous shuttle with up to three other travelers; 42 percent of those trips would otherwise be taken by private vehicle.

The desire for a more enjoyable mobility experience is behind many of these shifts. A quick trip on the subway while reading a book often beats an hour behind the wheel in traffic, and cities that can offer that convenience might increase metro ridership. Sustainability concerns are also critical. The survey results show that 46 percent of respondents have already switched to more sustainable brands or products, and another 16 percent plan to make considerable changes to promote sustainability.

New trends and technologies are emerging

Some new mobility trends and automotive technologies, especially leading-edge electric-vehicle (EV) batteries, frequently make the headlines. Others are emerging more quietly but could have an

equally significant effect on future mobility, although some may not exert their full impact for several years.

Autonomous vehicles (AVs): Passenger vehicles in Europe and North America will have an increased amount of level-three and level-four automation features, which will make them highly automated or capable of self-driving on highways by 2025.⁶ Major urban areas, such as Beijing, London, and New York, could become top markets for shared autonomous vehicles, given the large pool of potential customers in these locations.⁷

Rise of micromobility: The global micromobility market is worth about \$180 billion today. McKinsey analysis shows that the value could more than double by 2030 to reach about \$440 billion.

Development of intermodal applications: Intermodal journeys involve more than one type of transportation. Platforms that integrate all possible mobility combinations for a particular route are already starting to emerge, allowing travelers to plan their journeys more easily. Jelbi, for instance, shows possible routes involving various mobility modes, as well as their time and cost.⁸

Transition towards shared or pooled zero-emission vehicles: Shared mobility (including ride hailing) is on the rise, as consumers look for transportation options that are convenient, cost-effective, and sustainable. This segment could generate up to \$1 trillion in revenues by 2030.⁹

Regulations are driving awareness and sustainability

In 2020, the transportation sector accounted for about 20 percent¹⁰ of global greenhouse-gas emissions, with more than 40 percent¹¹ of the total coming from private cars. To promote greener transport, over 150 cities have implemented measures to curb private-vehicle use, which include efforts to increase awareness about emissions from private cars, limit the number of private cars in cities, or provide financial incentives to use more environmentally friendly mobility modes. Some regional and national governments are enacting similar regulations. The following pages provide examples of some recent initiatives.

⁵ McKinsey ACES consumer survey, December 2022 (n = 27,036).

⁶ "Autonomous driving's future: Convenient and connected", McKinsey, January 6, 2023.

⁷ "Where does shared autonomous mobility go next?," McKinsey, January 3, 2023.

⁸ "Jelbi," Berliner Verkehrsbetriebe, accessed April 18, 2023.

⁹ "Shared mobility: Sustainable cities, shared destinies," McKinsey, January 5, 2023.

¹⁰ "Global carbon dioxide emissions from 1970 to 2021, by sector," Statista, February 6, 2023.

¹¹ "Distribution of carbon dioxide emissions produced by the transportation sector worldwide in 2020, by subsector," Statista, February 6, 2023.

Many cities and countries have enacted regulations to promote sustainability



China

- As part of the Comprehensive Beijing Rail Transit Network Plan, Beijing is expanding its subway system to reach a total length of 1,625 kilometers by 2035. The city is taking steps to ensure that rail transit accounts for at least 27 percent of all its public transit.
- Chengdu has started to build the biggest urban cycle lane network in the world, aiming for a total length of 1,920 kilometers by 2025 and 17,000 kilometers by 2040.



France

- France was the first country to ban short-haul flights if alternative modes of transport lasting two and a half hours or less are available.
- The mayor of Paris, Anne Hidalgo, announced plans to create a “15-minute city”—one in which city residents can perform six essential functions (living, work, commerce, health, education, and entertainment) within a 15-minute walk or bike ride from their homes.



Germany

- To reduce private-car usage, Heidelberg started a pilot program to create bicycle lanes and provide free public-transport tickets, valid for a year, to residents who sell their vehicles.
- German states and the federal government plan to begin offering a nationwide €49 ticket for local and regional public transit in May 2023; Munich has announced that it will provide the ticket to its employees free of charge.
- Potsdam is increasing its parking fees by up to 100 percent, except for car-sharing vehicles; if a shared vehicle is electric, it is exempt from any fees until 2026.



Norway

- Oslo has removed many of its city center's on-street parking spots to provide more space for bike lanes, parks, and pedestrian roads.
- Norway's Climate Change Act has established an emission-reduction target of at least 50 to 55 percent by 2030 and a 2050 target to become a low-emission society.



United Kingdom

- The United Kingdom has invested £2 billion in initiatives to help increase cycling and walking (for instance, creating wider pavements and pop-up bike lanes); it will also encourage commuters to walk or bike rather than take public transit.
- The UK Department of Transportation plans to invest an additional £44 billion from 2024 to 2029 to operate, maintain, and expand the UK rail system.



United States

- San Francisco has eliminated minimum parking requirements because such guidelines have been shown to increase traffic and emissions. City leaders may also dedicate certain lanes to ride-sharing vehicles to help promote that mobility option.
- The United States' 2022 Bipartisan Infrastructure Law specifies an annual contribution of \$1.44 billion to the Transportation Alternatives Set-Aside (a fund designed to help state and local projects for pedestrian and bicycle infrastructure, among other improvements) through 2026—almost double the \$850 million annual investment made from 2018 through 2020.



From Shanghai to Los Angeles:

What mobility will look like in 2035

While mobility will transform around the globe over the next decade, the changes will vary widely according to differing regional consumer preferences and regulations. Put simply, the way that people navigate, say, downtown Beijing is different from the way that they move around Berlin or Mumbai. Even within a country, big differences may exist. The efficient public-transit system in one urban population may be an anomaly in a rural area just a few hours away.

In the following pages, we try to capture such differences by considering the future mobility trends of four countries that will account for more than 70 percent of global GDP and 50 percent of passenger miles traveled (PMT) by 2035: China, Germany, India, and the United

States. For these countries, we have created five illustrative scenarios to depict how certain consumers might use mobility in 2035. There are two scenarios for the United States to illustrate regional variations.

We also developed models to predict broader mobility changes in some general categories, such as tier-one cities in China. For each category, we determined how the modal mix—the PMT by each mobility option—might shift based on the current commitments to curbing emissions that cities and countries have made. It's important to note that these commitments are ambitious; some initiatives may fall short of their goals. We also considered the impact of technological advances and consumer willingness to change.

Shanghai

The Liu family

Yu and Wang and their two children live in Shanghai. They don't own any bikes, scooters, or cars. Yu commutes to work by taking a shared bike and then walking. Wang takes the metro in the morning, since his commute is longer, then transfers to a shared bike. He uses robo-shuttles on busy mornings or if he's working late. Yu's parents usually take the children to daycare and extra-curricular activities via metro but opt for robo-shuttles when traffic or prices are low. For weekend activities, the family usually takes robo-shuttles but sometimes prefers advanced urban air mobility for longer trips.

Future mobility patterns in tier-one cities in China

The Liu family's transport options—with the notable exceptions of advanced air mobility and robo-shuttles—are all common in Shanghai today. A big shift is occurring in preferred mobility modes because of changing consumer behavior and government regulations, including those that limit the sales and use of private vehicles. For instance, Beijing and Shanghai have already introduced bidding processes and lotteries to award license plates to vehicle owners.

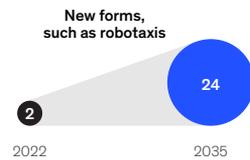
As GDP per capita and urbanization continue to rise, China will likely expand its mass-transit systems to satisfy an increasing demand for mobility and to limit the need for private vehicles. Shanghai, for instance, recently announced that it plans to add nine more metro and urban railway lines. Chinese megacities

may also start implementing robo-shuttle services.

Given these dynamics, the share of PMT traveled via private vehicles in tier-one cities in China is expected to decline by about 18 percent by 2035. Public transportation is expected to retain its 48 percent PMT share and remain dominant. New types of mobility will see the greatest uptake, with their share increasing to 24 percent, from 2 percent.

The Lius often use new mobility modes; these options could have a 24 percent mobility share in tier-one Chinese cities in 2035.

Share of mobility in tier-I Chinese cities, %



Source: McKinsey Center for Future Mobility

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Munich

The Mueller family

Manuel and Anne live with their three children in Munich and work nearby. Manuel commutes via the metro, typically using an e-bike or e-scooter for the first and last miles, but he occasionally takes a robo-shuttle. Anne usually relies on a cargo bike but takes a bus or robo-shuttle in bad weather. The children take the metro to school. For extracurricular activities, the older two children bike, and the youngest is transported by her parents on a standard bike or cargo bike or by bus or metro. On weekends, the Muellers use cargo bikes, standard bikes, or robo-shuttles within Munich and carsharing services for longer trips.

Changes in European cities with a good assortment of mobility options

The number of trips taken by private vehicles will decrease in many European cities by 2035, partly because of regulations that are already going into effect. For instance, some cities, such as Munich, now prevent high-emission vehicles from driving into their city centers. If urban centers in multimodal cities limit traffic or become car free, commuting from surrounding suburbs could become more complicated. Governments may also consider offering financial incentives to discourage private-car use and increase the uptake of greener options.

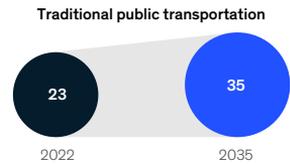
Many European cities will likely see increased use of e-bikes and bike-sharing services (standard and electric), especially as leaders create safer bike paths and improve the infrastructure.

Residents may also bike more as knowledge about cycling's health benefits increases.

Although many European cities already have extensive public-transportation systems, people underutilize them. To gain ridership, numerous local authorities are adding routes, building infrastructure, and introducing express lines from suburbs to city centers. As a result, the share of PMT for mass transit is expected to increase by 2035. New transportation modes, such as carsharing and robo-shuttles, could account for almost 20 percent of the total PMTs of some European cities.

The Muellers primarily use traditional public transit. In many European cities, this mode could represent 35 percent of total mobility share in 2035.

Share of mobility in large European cities, %



Source: McKinsey Center for Future Mobility

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Mumbai region

Aadhya

Aadhya lives in Thane, a city near Mumbai. She begins her commute to Mumbai by metro and then transitions to an e-scooter or uses a ride-hailing service that offers two-wheelers for the last mile. She occasionally takes the EV that she shares with five other Thane residents through a joint-vehicle-subscription service. Her choice depends on the EV's availability, traffic, and her desire for privacy and convenience. When meeting up with friends, Aadhya often takes her own e-scooter or uses a ridesharing service. For longer trips, including those outside Thane, she takes either the metro or her shared EV.

Future mobility patterns in transit-reliant megacities in Asia

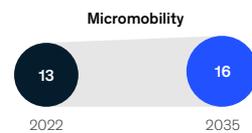
Rapid population growth and growing economies could prompt many mobility changes in some megacities in Asia. Many local governments are making significant investments in transportation upgrades, and they are particularly interested in increasing the capacity of mass transit because roads are already congested and there is little room to build more. Consider the city of Jakarta. About 85 percent of its residents live within 500 meters of public transport, and officials hope that expansions will bring the number to 95 percent.

Public transport will have a smaller share in the overall mobility mix as alternative

options (such as micromobility and shared services) gain ground. City centers will have mobility hubs that will allow people to switch from conventional cars to zero-emission transportation options, such as e-bikes and e-scooters (some shared). As income levels continue to rise and technology to evolve, other mobility options, such as autonomous robo-shuttles, will also emerge in Asian megacities.

Aadhya often uses e-scooters. Micromobility is popular in Asian megacities and its share of total mobility has grown since 2022.

Share of mobility in Asian megacities, %



Source: McKinsey Center for Future Mobility

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Los Angeles

Steven and Roger

Steven and Roger, a retired couple, own a condominium in Los Angeles; both prefer to own private vehicles. Steven uses his private AV when going to the gym, grocery shopping, getting coffee, or volunteering. If Steven thinks parking will be difficult, he often uses premium robo-taxis that he doesn't have to share with other passengers; less rarely, he uses advanced air mobility. Roger often goes to the gym or volunteer activities with Steven in the AV. When Roger travels alone, he uses his own standard battery-powered EV because he prefers driver-controlled vehicles with advanced-driver-assistance features.

Changes in mobility behavior in car-reliant metropolises in the United States

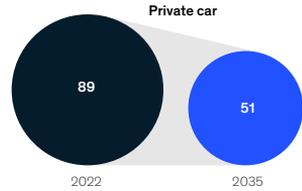
Steven and Roger's 2035 mobility mix will be somewhat atypical for most Los Angeles residents, who will be more likely to use options such as public transport and micro-mobility, although some people may still prefer to own their own vehicles. However, car-reliant metropolises in the United States are trying to increase access to cleaner forms of transportation, such as micromobility, shared-vehicle-rental services, mass transit, and bike rentals. For instance, Los Angeles has implemented the Sustainable Transportation Equity Project to decrease car dependency. We expect such initiatives to be successful, allowing public transit and micromobility to

claim an increased share of total mobility by 2035 in large US cities.

The introduction of new mobility modes, especially robo-shuttles, will account for about 29 percent of PMT in car-dependent US metropolises in 2035, and their rise will reduce the number of private-car trips. Private vehicles will continue to dominate, however, and will still account for more than 50 percent of PMT.

Although Steven and Roger enjoy driving, private-vehicle use is likely to drop greatly in Los Angeles by 2035.

Share of mobility in car-reliant metropolises in the US, %



Source: McKinsey Center for Future Mobility

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The rural United States

The Johnsons

James and Christine have two children and live in Frankton, Indiana, a small, rural town. With few public-transportation or shared-mobility options nearby, car ownership is essential. Both parents commute about 25 miles in one of the two AVs that they own. Their teenage children usually take the school bus or bike in the mornings, but their parents occasionally send one of the AVs home after their commute for the children to use for school transport. On weekends, the family uses the AVs to go to activities in Indianapolis, a large city, and then they get around via robo-shuttles, e-bikes, or e-scooters.

Mobility in car-reliant rural areas of the United States

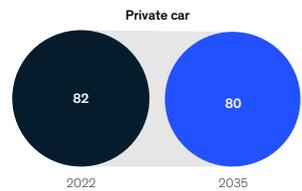
Although the US government is attempting to expand the country's public-transportation systems, people in many rural areas will still rely on private cars for more than 80 percent of PMTs in 2035. The big shift is that some of these vehicles will be electrified and autonomous.

Fleet operators may face an uphill battle when trying to establish robo-shuttle operations in remote areas, given the lower population density and thus less favorable economics. Therefore, the operators will likely focus initially on cities and suburbs. While other mobility solutions will eventually emerge in rural areas in the United States, wide-scale rollout may not be under way by 2035.

Micromobility usage and walking in rural US areas will increase slightly by 2035, as consumers increasingly perceive the related health benefits, but these changes will not have a significant effect on the total modal split.

People who live in rural areas of the United States, such as James and Christine, will still depend on private vehicles in 2035.

Share of mobility in car-reliant rural areas in the US, %



Source: McKinsey Center for Future Mobility

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Global implications:

The short- and long-term shifts

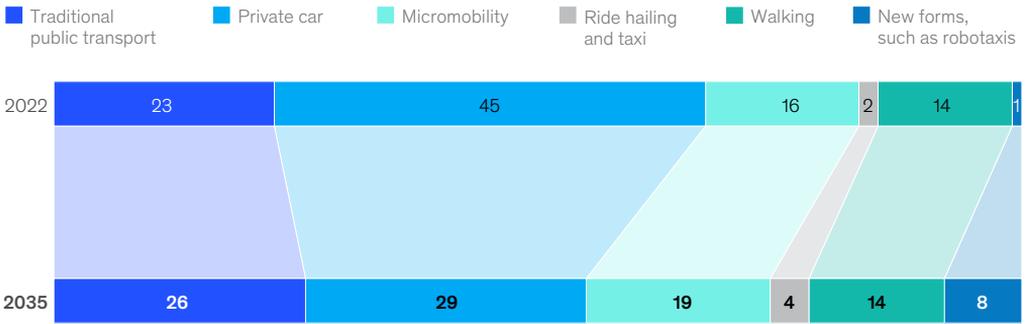
While mobility changes will vary by geography, our scenarios allowed us to identify some global trends—and one of the greatest relates to private vehicles. By 2035, the share of passenger miles traveled (PMT) in private cars will drop by about 15 percentage points (Exhibit 1). Over the same time, new modes of travel that are barely on the radar now, such as autonomous roboshuttles, will increase their PMT share from 1 percent today to 8 percent. Public transportation, e-scooters, e-bikes, and minimobility—very small three- or four-wheeled cars—could become preferred

transport modes, rather than a last resort for people who cannot afford cars. And apps that link different forms of transportation, such as roboshuttles and urban air mobility, could make intermodal journeys more common, since passengers will no longer have to scramble to put a trip together.

The shifts could come slowly, even in those areas where the change will be dramatic. Over the next few years, most people are likely to continue their usual travel patterns and behavior. The most significant disruptions will likely kick in after that. Urban dwellers in cities such as Los Angeles, Munich, and Shanghai will spur most of the change. Residents of other areas, including rural zones, are less likely to have access to new forms of transportation. The big changes in mobility infrastructure—more bicycle-friendly streets, vertiports for urban air mobility—are also most likely to occur in cities, at least initially. As greener transportation becomes more common, the world may finally begin to see significant drops in emissions.

Although private cars will remain the most popular transportation option, their share of total mobility will decline.

Mobility split by mode of transportation, worldwide, %



Note: Figures may not sum to 100%, because of rounding.
Source: McKinsey Center for Future Mobility

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The changes in mobility will affect everyone from OEMs to ride-share providers. One of the greatest changes will be in the number of private-car sales. Car sales¹ will likely rise globally over the next few years and peak by the end of this decade. They could then fall to 84 million units by 2035, down from the 85 million units sold in 2015.

Some regions will likely see bigger drops in car sales than others, which could alter supply chains, sales strategies, and other aspects of the OEM business model. In 2035, for example, car sales in the European Union are forecasted to be almost 20 percent lower than 2015 levels, and the United States could experience an even greater drop of 30 percent. The decrease in cars will have a much more profound impact in the United States than in Europe, which already offers better access to other mobility modes, including public transport. The United States will have to create new infrastructure and increase support for alternative mobility options as private-car ownership drops (Exhibit 2).

China, which is now an important market for cars, will also likely experience declining sales, although not to the same extent as Europe and the United States. The

26 million units projected to be sold in 2035 will be lower than the historical peak of almost 27 million in 2019, but it will still be above the 2015 level of 24 million.

Some markets, such as India and other parts of South Asia, will partially compensate for the drop in other regions, with car sales expected to continue on an upward trajectory beyond 2035. Total sales in countries other than China, Europe, and the United States, termed the rest of world, are projected to amount to 33 million in 2035. This is up from the 29 million reported in 2015 and slightly above the historic high of 31 million units reported in 2018.

While private customers may show less appetite for new vehicles, technology advances might allow robotaxi and roboshuttle providers to emerge. If so, they might attempt to build their vehicle fleets to capture a greater share of the growing market.

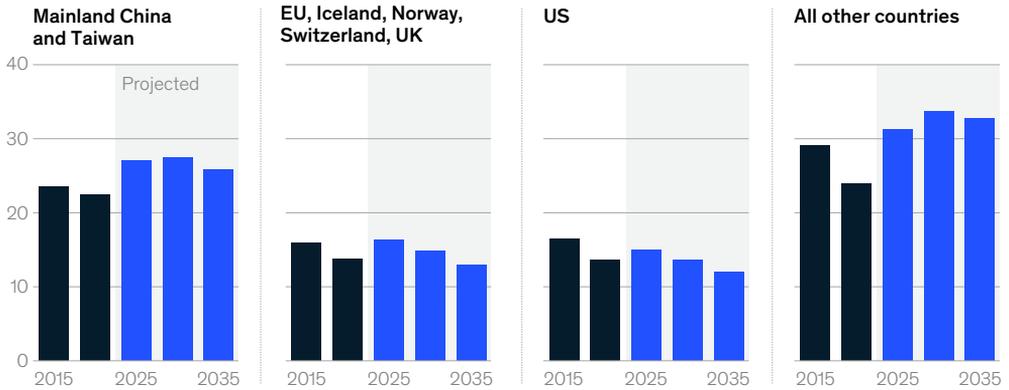
Although car sales may be declining, other value pools are expected to emerge along the entire value chain, potentially disrupting traditional business models. Given the value at stake, as well as the increasing risk

¹Total light vehicle sales (gross vehicle weight < 3.5 metric tons).

Exhibit 2

Some regions will see bigger drops in car sales than others, which could alter supply chains, sales strategies, and other aspects of the OEM business model.

Light vehicle sales, by region, million



Source: IHS Markit; McKinsey Center for Future Mobility

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of business failure, mobility players should develop a strong future strategy—possibly one that diverges from long-term tactics—to thrive. The question is whether OEMs and others can pivot and scale their operations fast enough.

While new technologies and regulations will account for many shifts, the power of customer preferences—the desire for more convenient and sustainable mobility choices—is equally, if not more, important. For this mobility revolution, the consumer is in the driver's seat. [Q](#)

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