

Center for Future Mobility Compendium 2020–21

# From no mobility to future mobility: Where COVID-19 has accelerated change

The COVID-19 pandemic has disrupted mobility, and its effects will linger well into next year. How will changing consumer preferences, technologies, and regulations shape the market in 2021?



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**COVID-19 swept across the globe** in a matter of months, jeopardizing lives, upending businesses, and setting off a worldwide economic slump. Consumers are intensely focused on health and have altered many long-standing habits and preferences to avoid infection. Within the mobility sector, this means that many passengers favor transport modes perceived as safer and more hygienic. Suddenly, private cars are in and shared rides seem to be out. Working from home is on the rise, again with the goal of preserving safety, while business travel and all the mobility services attached to it—flying, taxis, e-hailing—are in low demand. The best-laid plans of mobility players appear to be in tatters. It may seem that the acceleration of future mobility has come to a halt, but this first impression overlooks recent developments that will have a tremendous impact on mobility's future.

Consider some recent developments: cities have redefined car lanes to create more space for bikes and scooters as people began to avoid public transportation. Similarly, government incentives to help the automotive industry have encouraged the use of carbon-neutral solutions and stimulated the development of electric vehicles (EVs). In another shift arising from the pandemic, consumers are

increasingly turning to digital channels—from convenient food deliveries to streaming services—and they now expect mobility players to expand their online offerings.

Such fundamental changes, along with other recent developments, are prompting mobility leaders to reimagine the future of mobility. They had already been adjusting their strategies to the emergence of ACES—autonomous driving, connected cars, electrified vehicles, and shared mobility—and now they are going even further to account for the pandemic's impact on consumer behavior, policy making, and regional economies. The following shifts are likely to persist long after COVID-19 is controlled and thus deserve particular attention:

- *Customer preferences.* In addition to safety, consumers are becoming more focused on digital channels and sustainability issues. Access to micromobility options—lightweight vehicles such as bicycles, e-scooters, and mopeds—will be important, as will safety and health issues.
- *Technology.* The pace of change will continue to accelerate in all areas, including connectivity, autonomous driving, and urban transport.

**In addition to safety, consumers are becoming more focused on digital channels and sustainability issues. Access to micromobility options—lightweight vehicles such as bicycles, e-scooters, and mopeds—will be important.**

- *Regulations.* We expect regulators to become even more active within the mobility sphere. Many, for instance, are tightening CO<sub>2</sub> regulations for vehicles as they attempt to reduce climate change.

Exhibit 1 summarizes some of the most important shifts in these areas.

The articles in our compendium explore the major developments within mobility in 2020 and also look ahead to 2021, as approved vaccines will, it is to be hoped, limit the spread of COVID-19 and usher in the next normal. Here are a few of the topics we will explore.

### Consumer preferences

Many car dealerships closed in 2020, and car buying plummeted, especially early in the year. In February, sales were down 71 percent in China; in April, they decreased by 80 percent in Europe and 47 percent in the United States. Likewise, mobility behavior changed drastically during the pandemic, as many commuters worked from

home and others avoided public transportation because of health concerns. While consumers have traditionally focused on time to destination, cost, and convenience when selecting a transport mode, they now cite the ability to reduce the risk of infection as their major consideration (Exhibit 2).

In a related trend, transport modes that are considered safe have become more popular. With consumers focused on avoiding infection, mobility service providers quickly implemented a range of safety improvements (Exhibit 3). These changes will persist, and providers may soon add other safety measures that span the entire customer journey. Changing consumer preferences may give private-car use the greatest boost, but micromobility options and walking/biking are also expected to gain ground.

### Consumer preferences related to ACES

The articles in our compendium also examine how customers perceive ACES developments. In a recent survey, which examined consumer mobility preferences worldwide, we found that customers believe traditional automakers are well qualified

Exhibit 1

## Recent changes in mobility regulations will have lasting repercussions.

### Customer preferences

- New emphasis on safety and health: reducing risk of infection is now the top consideration when choosing transport; recent hygiene improvements in public transit and shared mobility are viewed as effective
- Micromobility: use of bicycles is expected to increase 5 percentage points, and shared micromobility is expected to increase 3 percentage points after the pandemic
- Digital sales experience: more than 80 percent of car buyers use online sources, and only a third of the 18–34-year-old customers would prefer to buy their next vehicle at the dealership rather than online

### Technology

- Renewed focus on partnerships and collaborations: the industry will continue to consolidate; more than 420 partnerships in ACES have been concluded in 2020 compared with 110 in 2015 (major OEMs only)
- Investments in innovation: investments in mobility start-ups have stabilized, with about \$45 billion invested in 2020
- Emerging technologies: urban-air mobility, 5G, and quantum computing could transform mobility; the software and electronics market is expected to double in size by 2030

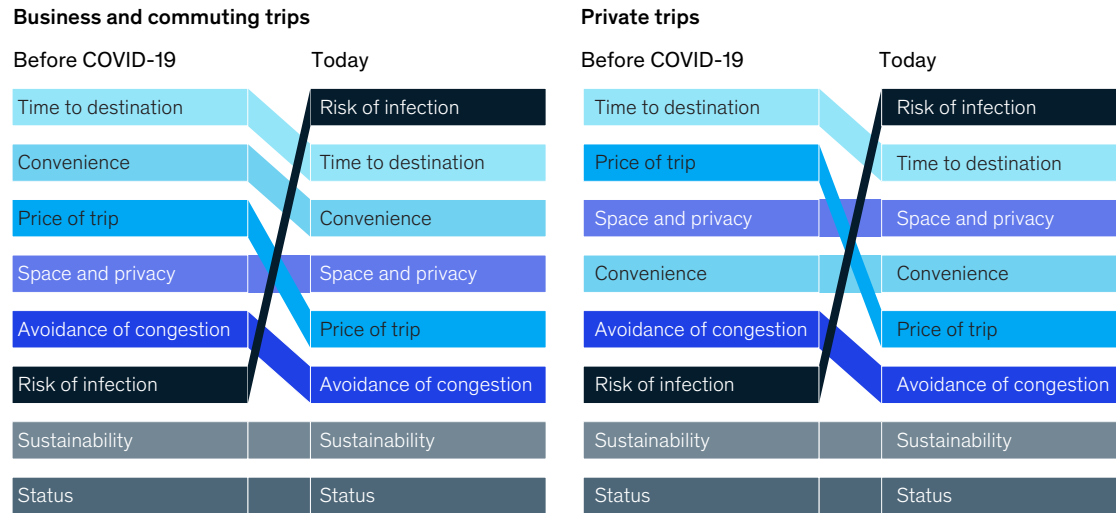
### Regulation

- City redesign for alternative transport modes: during the pandemic, many cities announced new mobility regulations, such as the creation of bike lanes; more than 150 cities globally have restricted access for private vehicles
- Electric-vehicle surge and development of the electric-grid infrastructure: the European Union has proposed raising CO<sub>2</sub> targets from the current 40 percent to 55 percent in 2030; California will ban the sale of new cars with internal combustion engines

Exhibit 2

**Reducing the risk of infection has become the primary reason for the choice of a mode of transportation.**

**Key reasons to choose a mode of transportation,<sup>1</sup> rank**

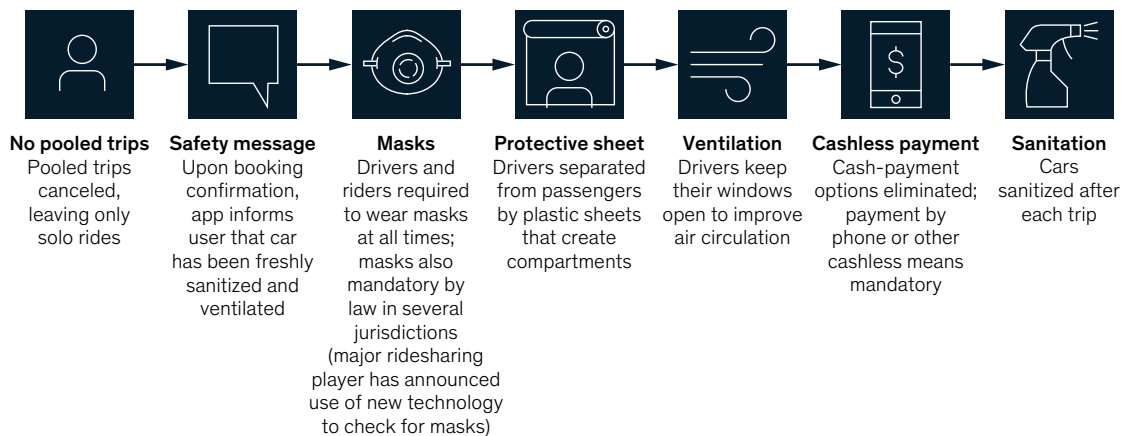


<sup>1</sup>Question: What were/are your key reasons to choose a mode of transportation? Aggregated results from China, France, Germany, Italy, Japan, UK, and US. Reasons ranked by number of respondents. Source: McKinsey Center for Future Mobility

Exhibit 3

**Mobility players have implemented measures to improve hygiene across the entire customer journey.**

**Examples of safety measures implemented in customer journey**



to drive ACES innovation. That finding marks a big departure from previous surveys, in which consumers stated that established OEMs lagged behind their Asian counterparts and start-ups in pursuing ACES trends.

Some of the greatest changes in consumer preferences relate to EVs. Insights from our EV consumer survey show that consideration of EVs has increased by an average of about 21 percent over the last three years, partly because buyers are now more aware of their benefits. Still, consumers have significant concerns about EVs, such as those regarding battery/charging, driving range, and higher costs compared with ICE (internal combustion engine) vehicles. These issues may explain why relatively few consumers move from EV consideration to purchase.

EV sales are not destined to remain low, however. As automakers recognize the growing interest in EVs, many have begun revising their go-to-market (GTM) models for this segment. A seven-step approach may help to increase their sales significantly (Exhibit 4).

**The growing importance of online channels**

In addition to exploring new products and mobility options, consumers are interested in new services. This shift is clearly apparent in automotive retailing, where a future beyond bricks

and mortar is emerging. Although consumers still rank dealership visits as the top factor influencing purchase decisions, digital channels are becoming more important. In a recent survey, more than 80 percent of respondents used online channels during the purchase-consideration period, and more than 60 percent said it would be appealing or very appealing to have digital channels for booking, paying, and reviewing additional services (Exhibit 5).

**New attitudes about auto financing and vehicle ownership**

Consumers are now open to financing their vehicles through digital channels: a survey of auto-financing executives showed that respondents expect online business-to-consumer sales for auto loans and leasing to reach a market share of approximately 20 to 25 percent by 2025 (Exhibit 6).

The same survey suggested that more consumers may be open to forgoing car ownership in favor of vehicle-subscription services. While such subscriptions are still niche products, they show strong promise. Demand may be particularly strong for fully flexible products, such as leasing models with nonbinding durations.

**Technology**

Although many mobility players focused on responding to COVID-19 in 2020, they continued

Exhibit 4

**Seven innovations will shape the electric-vehicle go-to-market model.**

**Innovations for 2020**

**Create your offering**

**1**

Reinvent brand positioning

**2**

Shape the charging ecosystem

**3**

Monetize the life cycle

**Master sales**

**4**

Perfect omni-channel approach

**5**

Massively reskill and refocus sales force

**Optimize aftersales services**

**6**

Upgrade aftersales customer-centricity and readiness

**Disrupt business model**

**7**

Transform business model to achieve profitability at scale



Exhibit 5

## Digital channels are becoming more important in the automotive-purchase experience.

Offline touch points still represent key parts of the car-buying journey ...

**No. 1**

Ranking of dealership visits as a factor influencing purchasing decisions

**~70%**

Car buyers who consider the dealership a major touch point for physically experiencing the car

**2–3**

Dealership visits per customer prior to purchase is still the norm

... while online touch points are increasingly shaping customer decisions and experiences

**>20%**

Use of online sources compared with offline sources during purchase-consideration period

**>80%**

Respondents who use online sources during the purchase-consideration period

**>60%**

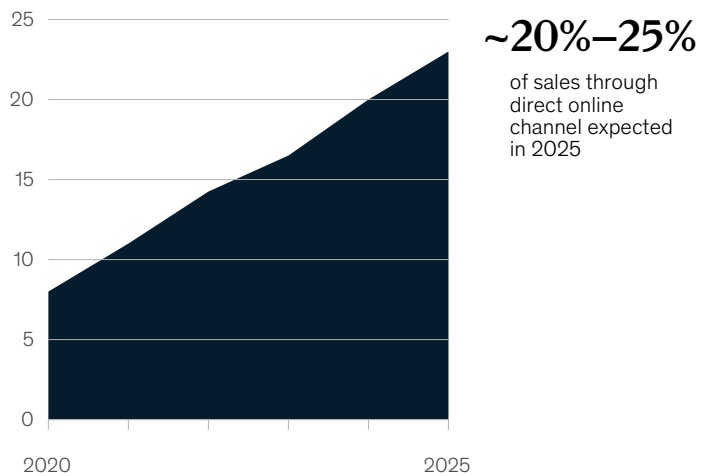
Buyers who perceive booking, paying, and reviewing additional services online as (very) appealing

Source: McKinsey Automotive Retail Consumer Survey (China, Germany, United States)

Exhibit 6

## Auto-financing executives expect online business-to-consumer sales for auto loans and leasing to reach a market share of around 20 to 25 percent by 2025.

Expected share of online B2C sales for auto loans and leasing until 2025, % estimated by respondents



Source: McKinsey European Auto Finance Survey 2020

to invest in ACES. Funding such innovations has always been challenging given the high costs, and the pandemic has exacerbated this issue

because traditional OEMs have undertaken cash-preserving measures and cost-cutting initiatives that leave little room for technology investments.

OEMs and suppliers may mitigate some funding issues by undertaking partnerships with other companies. Even before COVID-19 hit, many companies were investing in these ventures, with the number of ACES partnerships increasing 40-fold over the past decade (Exhibit 7). With COVID-19 putting budgets under pressure at OEMs and suppliers, these partnerships will become even more essential.

**Electric vehicles**

Technology advancements are arguably most apparent within electric mobility. As an article in our compendium explains, the automotive industry will introduce about 600 new battery-electric vehicles (BEVs) and plugin-hybrid EVs through 2025, increasing customer choice significantly. Over that same time frame, OEMs will devote more than \$120 billion in capital expenditures to BEVs—about 25 to 30 percent of the total (Exhibit 8).

Europe and China are currently in the lead with EVs, as measured by our yearly McKinsey

Electric Vehicle Index. The European market grew 44 percent between 2018 and 2019, even as growth slowed in many other countries. China saw slower growth than Europe during this period, but it remains the largest EV market. There are many established Chinese players and new entrants, all of which compete fiercely at the local and global levels. Our benchmark of ten leading Chinese BEV models shows the dominance of local companies. These players account for 85 percent of BEV sales within China and 57 percent globally.

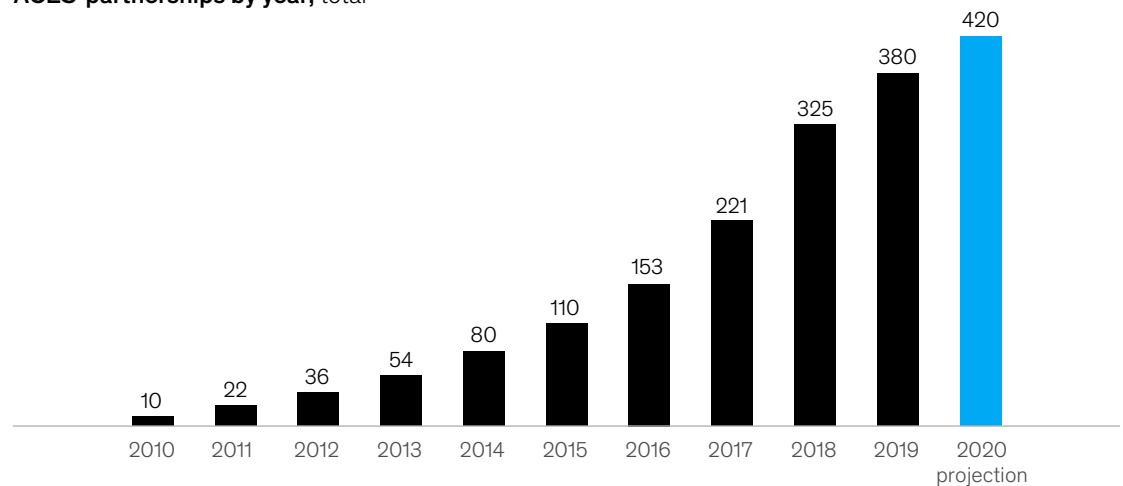
**Automotive electronics and software**

The role of automotive electronics and software continues to become more important, with both markets expected to see strong growth (Exhibit 9). Components that will be in strong demand include electronic control units (ECUs) and domain control units, which will account for an estimated \$156 billion in annual sales in 2030. Software—functions, operating systems, middleware—will account for \$50 billion in annual sales.

Exhibit 7

**The past decade has seen a 40-fold increase in the number of ACES partnerships, with a heavy focus on electrification and shared mobility.**

**ACES' partnerships by year, total**

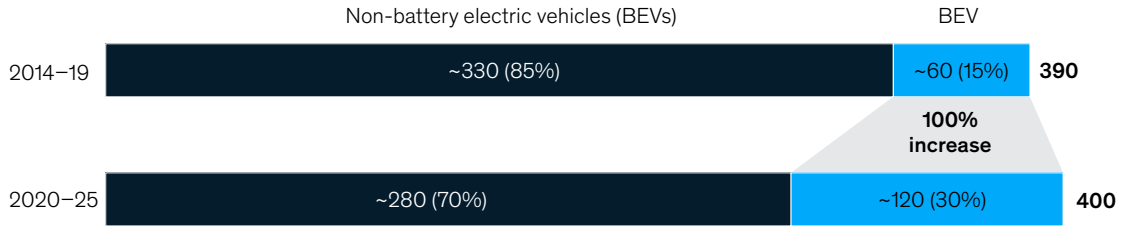


<sup>1</sup>Autonomous technologies, connectivity, electrification, and shared mobility. Source: McKinsey Moves Database; press search

Exhibit 8

**Capital expenditures for BEVs will probably double over the next five years, while investments in other vehicles decline.**

**Cumulative global model-related capital expenditures (capex), \$ billion**



**600 EV models**

will be launched in the next 5 years, and more than 450 will be BEVs

**~\$120 billion**

of global BEV-related capex through 2025

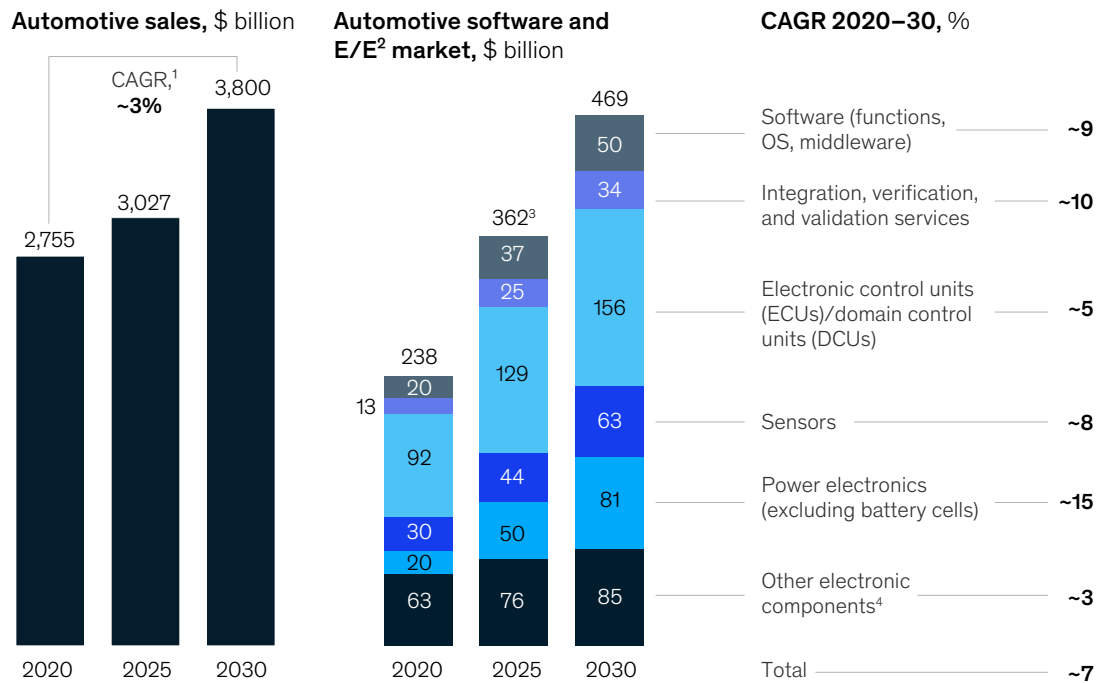
**25-30%**

of OEM capex will be BEV related

Questions: How has the coronavirus (COVID-19) situation affected your company's production (operation) capacity? How has the coronavirus (COVID-19) situation affected demand for your company's products/services?  
Source: McKinsey COVID-19 B2B Decision-Maker Pulse #2, April 20-27, 2020 (n = 607)

Exhibit 9

**The automotive electronic and software market will see strong growth through 2030, driven by power electronics, software, ECUs, and DCUs.**



<sup>1</sup>Compound annual growth rate.  
<sup>2</sup>Electrical and electronic components.  
<sup>3</sup>Figures may not sum because of rounding.  
<sup>4</sup>For example, harnesses, controls, switches, displays.  
Source: Revenue forecasts based on vehicle volumes from IHS Markit (Automotive), Light Vehicle Production Forecast, Oct 2018, pull completed on Nov 6, 2018; McKinsey analysis



### Automotive cybersecurity

At many OEMs, cybersecurity has become a top concern. Currently, only narrow standards and guidelines exist for specific technical procedures for securing hardware and software in vehicles, such as standards for hardware encryption or secure communication among ECUs. That will soon change, however. The World Forum for Harmonization of Vehicle Regulations (WP.29), under the UN Economic Commission for Europe, is planning to release new regulations on cybersecurity and over-the-air software updates.

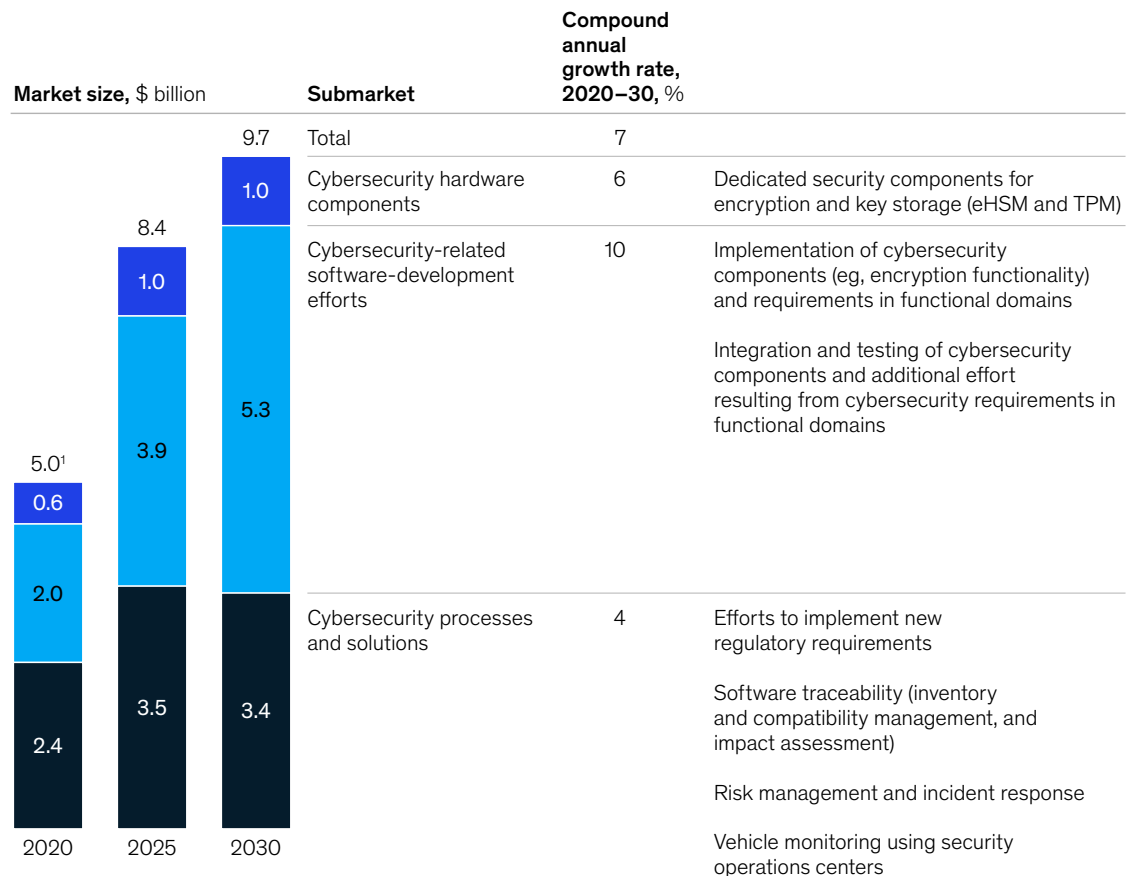
The cybersecurity market is expected to have a compound annual growth rate of 7 percent through 2030, when it will reach \$9.7 billion in value (Exhibit 10).

### Other technology developments

Many other technology developments are altering the mobility landscape, and innovation will continue to have a profound impact in 2021. Recent advances and potential future developments that our compendium explores include the following:

Exhibit 10

## The cybersecurity market will grow significantly for automotive in coming years.



<sup>1</sup>Figures may not sum because of rounding.

Source: Analysis based on data from Ondrej Burkacky, Johannes Deichmann, and Jan Paul Stein, *Automotive software and electronics 2030: Mapping the sector's future landscape*, July 2019, McKinsey.com

- With software and high tech becoming more important to vehicles, automakers are increasingly looking for new pools of talent and an innovative R&D model.
- 5G technology, with its superior speed, latency, reliability, and power consumption for handsets and Internet of Things (IoT) devices, has recently become mainstream in many sectors, and there are interesting use cases related to mobility.
- Quantum computing could assist with many steps across the automotive value chain as suppliers, OEMs, dealerships, and others take advantage of its power.
- Urban air mobility is becoming more cost-competitive and could offer new mobility options, provided that sufficient pilots are available.

## Regulation

The automotive and mobility industries have always been tightly regulated, but governments around the globe are now playing an ever bigger role by instituting travel restrictions and other guidelines to limit the spread of COVID-19. Even after the pandemic abates, we expect that policy makers will increasingly shape mobility's future through new guidelines and regulations.

### New guidelines to limit emissions

To encourage car sales and stimulate the economy, some governments have created policies favoring low-emission vehicles and alternative forms of transportation. The new regulations can vary greatly by region, however. In Germany, for example, purchase-price subsidies for new EVs can amount to more than \$10,000 per vehicle. In China, the purchase-price subsidy currently ranges from 16,200 to 22,500 renminbi (approximately \$2,350 to \$3,265) per car, depending on its range.

The regulatory variations, combined with macroeconomic changes, infrastructure, and other factors, will influence how quickly the EV market recovers in different countries (Exhibit 11). The EV market is much more likely to see a quick recovery

and strong growth in China and Europe than in the United States, where the government is not providing EV subsidies. Over the long term, EV market share is also more likely to increase in China and Europe.

In addition to EV subsidies, some governments provide financial assistance to encourage the use of low-carbon transportation alternatives. The Italian government offers its citizens a €500 bonus for buying a bike, and the policy has been so successful that many bicycle shops are out of stock.

### Impact of regulations on infrastructure

Government planners are constantly making mobility decisions, since they must design car lanes, pedestrian walkways, EV-charging infrastructure, and much more. Since the pandemic, city leaders have been especially active in making infrastructure changes that affect mobility. Consider a few recent examples:

- Milan announced it will transform 35 km (about 22 miles) of streets previously used by cars to walking and cycling lanes.
- Paris will devote 50 km (30 miles) of lanes usually reserved for cars to bicycles; it also plans to invest \$325 million to update its bicycle network.
- Seattle permanently closed 30 km (20 miles) of streets to most vehicles at the end of May 2020, providing more space for people to walk and bike after the lockdown.
- Berlin repurposed some residential streets as “play streets” on Sundays during the lockdown and is also discussing the possibility of extending the program to other days of the week.

## The outlook for 2021 and beyond

Certainly, no one could have imagined how the world would change in 2020. Next year will also bring much uncertainty, but one thing is definite: mobility will continue to evolve in exciting ways. Here are the major developments we expect:

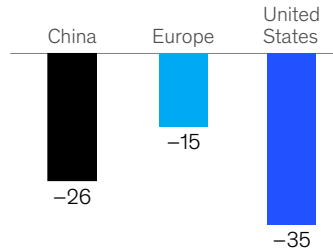
Exhibit 11

**Multiple forces will shape the future electric-vehicle market, but their impact will vary by region.**

**Key drivers by selected focus areas**

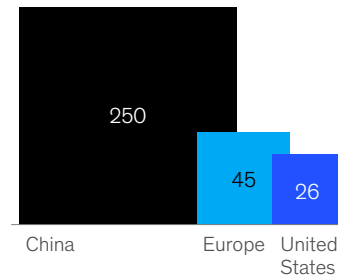
MACROECONOMICS

**Change in gas price as a result of per-barrel oil-price decrease from \$60 to \$30, %**

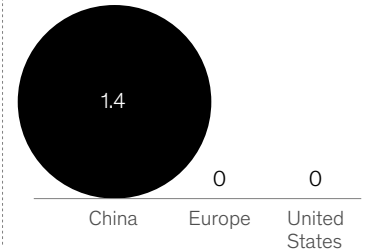


TECHNOLOGY AND INFRASTRUCTURE

**Additional public charging poles installed in 2019, thousands**

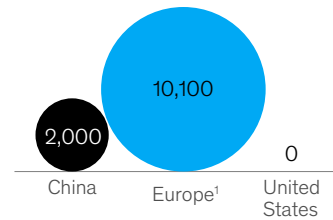


**Committed additional spending on charging stations in 2020, \$ billion**

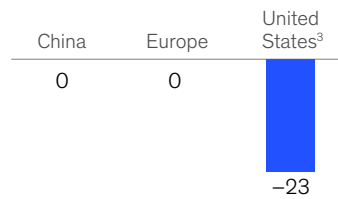


REGULATIONS AND POLICIES

**Purchasing incentives, as of June 2020, \$ per vehicle**

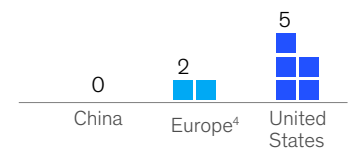


**Change in regulatory target<sup>2</sup> from pre-COVID-19 to April 2020, %**



SUPPLY

**Electric-vehicle models with delayed production since pandemic began, as of June 2020**



<sup>1</sup>Total purchasing incentives in Germany; similar incentives have been enacted or are under consideration in other European countries.

<sup>2</sup>Target of grams of CO<sub>2</sub>/kilometer.

<sup>3</sup>2025 US federal-fleet-consumption target.

<sup>4</sup>Both model launches by US-based OEMs.

Source: *Autozeitung*; Electrek; electrive.com; European Alternative Fuels Observatory; *Handelsblatt*; NBC Universal; Renewable Energy World; Statista; Vox Media; McKinsey analysis

**Expanded consumer preferences and a greater focus on sustainability**

When the COVID-19 pandemic is controlled—it's to be hoped at some point in 2021—consumers will be more willing to use public transport and other forms of shared mobility. We expect that sustainability will continue to be an important consideration, with more consumers opting for electric and micromobility solutions, especially in cities. Car sales may continue to decline from their 2019 peak, as more consumers consider alternatives to car ownership.

**Continued technology disruptions and widely available innovations**

Automotive technology will continue to evolve in 2021, and consumers will have greater access to innovations. For instance, 60 percent of premium OEMs plan to have some form of level 4 automation in their vehicles by 2025. Vehicle electrification will also continue, and innovations could drive EV costs down even further. (The total cost of ownership for BEVs has already reached parity with ICE vehicles in the C-segment.) For technology overall, we expect that software will increasingly become the key differentiator for vehicles.

**Regulation will continue to enable the mobility revolution**

Continuing the trend seen in 2020, many regulators will focus on environmental issues when enacting mobility guidelines. For instance, European officials are planning to create more stringent carbon-reduction targets to meet the Paris Agreement on climate change. Many governments are also creating new incentives to boost the sales of

carbon-free means of transport, and others are issuing guidelines with similar goals. Already, more than 150 cities in Europe restrict access to their centers to reduce pollution and carbon emissions.

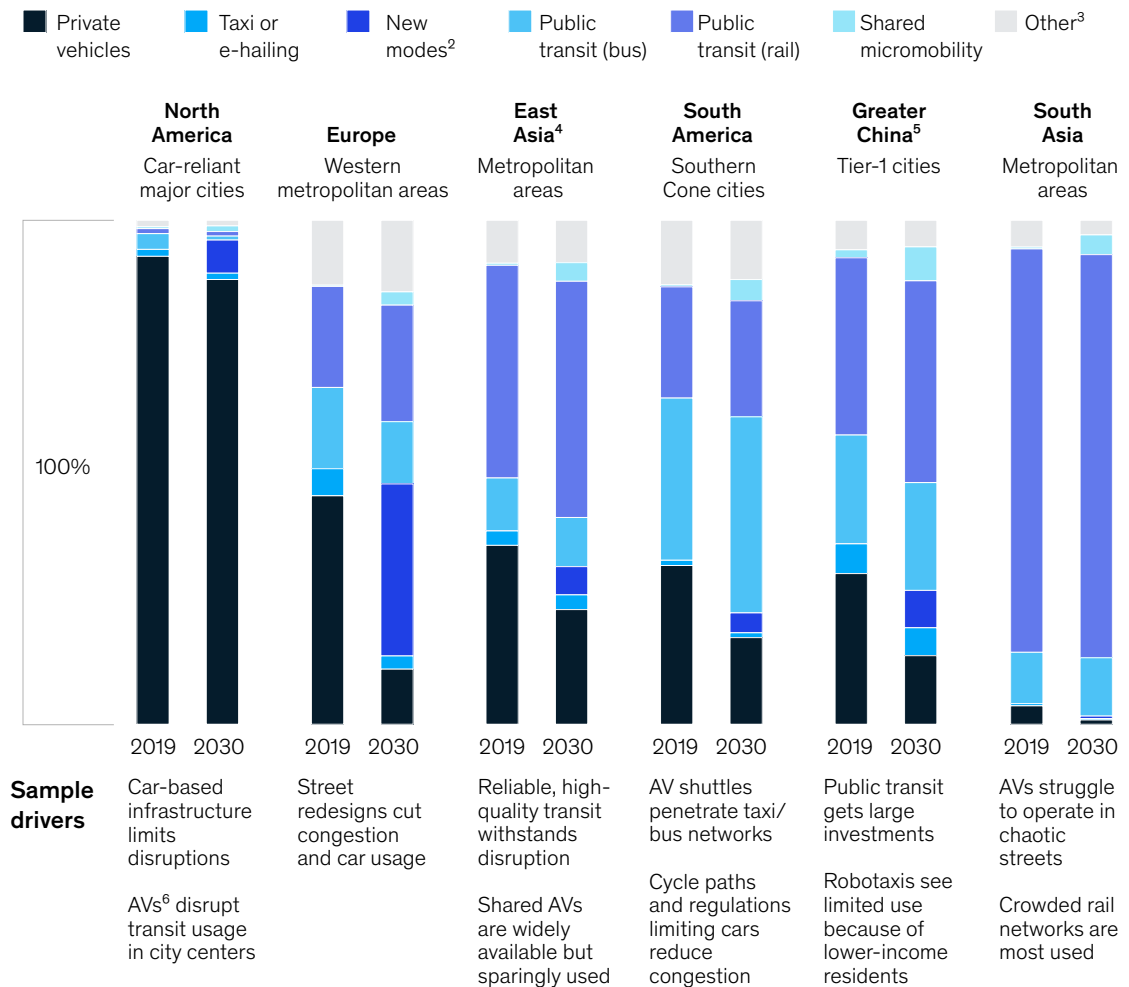
**Long-term mobility shifts**

Over the next decade, the changes in consumer preferences, technology, and regulations will contribute to major mobility shifts (Exhibit 12).

Exhibit 12

**Comparing large global cities highlights significant differences in expected regional mode-share shifts through 2030.**

**Passenger miles traveled, by city archetype,<sup>1</sup> %**



<sup>1</sup>Policy-guided shift to pooled autonomous-vehicle and transit scenario. <sup>2</sup>New modes include robo shuttles, as well as pooled and unpooled robotaxis. <sup>3</sup>Other\* includes walking, biking, private micromobility, 2- and 3-wheelers. <sup>4</sup>Utilizes Japan city archetype for Tokyo. <sup>5</sup>Greater China encompasses mainland China, Hong Kong, Macau, and Taiwan. <sup>6</sup>Autonomous vehicles.  
Source: McKinsey Center for Future Mobility

Regional variations will continue to be apparent because of differences in government responses, the intensity of the pandemic, and other factors. For instance, private-car use may drastically decrease in some major European cities. In North America, by contrast, this form of transport will see little change because there are limited incentives to change mobility behavior. Likewise, consumers in greater China may increasingly rely on public transit and rail, but major cities in South Asia will see little change in this area.

### **Implications for mobility players**

The novel coronavirus has forced many businesses, including those in the mobility sector, to cease or slow down operations. It has also accelerated many existing mobility trends, including those related to customer preferences and regulation. As our compendium shows, all mobility players, including OEMs, new entrants, investors, and regulators, must quickly adjust their strategies to navigate the current crisis and prepare for the next normal.

For automotive OEMs and suppliers, surviving and emerging stronger at the far end of this crisis will require thinking beyond the next fiscal quarter.

Success in the long run will require a journey across five stages: resolve, resilience, return, reimagination, and reform.

Despite the pandemic, many companies have continued to invest in disruptive mobility technologies, including autonomous technology, connectivity, EVs, and other areas. These businesses have the support of capital markets, and many special-purpose acquisition companies have recently made some successful deals. In 2021, disruptors will exert their presence more strongly. While they may compete with traditional companies in some areas, they will cooperate with them in others.

Regulators will continue to play a major role in helping the mobility sector recover from the pandemic. Many mobility solutions will have an intense local focus and take into account regional variations related to the pandemic, transportation preferences, and city layouts. In addition to creating mobility systems that serve the greater good, regulators will help ensure sustainability. Of course, they must continue to consider technological feasibility while trying to satisfy customer preferences.

The authors of this compendium are members of the McKinsey Center for Future Mobility. **Kersten Heineke** is a partner in McKinsey's Frankfurt office, **Philipp Kampshoff** is a partner in the Houston office, **Timo Möller** is a partner in the Cologne office, and **Ting Wu** is a partner in the Shenzhen office.

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