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# Where to Profit as Tech Transforms Mobility



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# Where to Profit as Tech Transforms Mobility

**Michelle Andersen, Thomas Dauner, Davide Di Domenico, Nikolaus Lang, Andreas Jentzsch, Thomas Palme, and Philipp Sadek**

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## AT A GLANCE

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The rise of electric vehicles, self-driving cars, and shared mobility will dramatically change the sources of profitability in the automotive industry. Over the next 10 to 15 years, the market structure will shift, as suppliers, ride-hailing companies, tech giants, and cities seek to gain influence at the expense of OEMs.

### **NEW SOURCES OF PROFITABILITY WILL EMERGE**

Emerging profit pools—including battery-powered electric vehicles (BEVs), components for BEVs and autonomous vehicles, data and connectivity services, and on-demand mobility offerings—will account for 40% of industry profits in 2035, up from 1% in 2017. This shift in profit pools will intensify at the same time that growth in new-car sales slows.

### **INCUMBENTS MUST START PREPARING**

The industry will need to invest more than \$2.4 trillion in new growth areas by 2035. The majority of that will come from OEMs, which will have to make these investments even as margins in their core business decline. To thrive in the changing market, incumbent OEMs and suppliers must lay the groundwork today. Exploring scenarios for the market's development provides the basis for defining a winning strategy.

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*This report is part of BCG's research on the future of automotive, a series of publications focusing on new technologies that are transforming the industry. Here, we examine the impact of technological change on industry profit pools. The Reimagined Car looked at the ways in which shared autonomous electric vehicles will change mobility in the US, and The Electric Car Tipping Point focused on the evolution of powertrain technologies.*

**N**EW DEVELOPMENTS IN MOBILITY technology will promote a dramatic shift in where automotive industry players should look for profits. A recent BCG study finds that, in the most likely scenario, the share of industry profits generated by new mobility technology will grow from just 1% in 2017 to 40% in 2035. (See the sidebar, "About Our Research.")

As profit pools shift, incumbent OEMs and suppliers will find their competitive positions under pressure from newly empowered market players, including new suppliers, on-demand mobility companies, and tech giants, as well as from cities, which will play an increasingly active role in regulating and promoting specific modes of transport. Although the changes will occur gradually, incumbents must lay the groundwork today in order to thrive in a fundamentally transformed market. By exploring scenarios for the market's development, they can define a strategy for capturing the lion's share of the profits as new mobility technology increasingly dominates the industry.

## The Forces of Change

Previous reports in this series discussed the trends driving the industry's fundamental transformation. There are three main developments:

- **Electrification.** We believe the adoption of electric vehicles will reach a tipping point around 2025 as declining battery prices make battery-powered electric vehicles (BEVs) economically competitive with gas-powered vehicles across most regions and market segments. Additionally, the increased availability of new models and public charging stations will lower adoption barriers and help to generate a critical mass of consumer interest in BEVs. As a result, we estimate that by 2035, 30% of new cars sold globally will be BEVs.
- **Self-Driving Vehicles.** We expect to see the commercial deployment of fully self-driving cars (with no driver attention required) in cities by 2025. Regulatory approval is on the agenda of many jurisdictions, and there is positive momentum. Costs for components of autonomous vehicles (AVs) will decline sharply

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## ABOUT OUR RESEARCH

Our research, which drew upon BCG's recent studies of the automotive industry, focused on understanding how the adoption of new mobility technologies will affect sales, profits, and investments. The forecasts we discuss are based on what we identified as the most likely scenario for the industry's development. Given that many factors will influence that development, more or less aggressive scenarios are possible.

A detailed forecast for the volume of new-car sales was the starting point for modeling the development of profit pools. A previous BCG study (see *The Electric Car Tipping Point*, BCG Focus, January 2018) built a model to forecast global car sales by fuel source. The model used multiple total-cost-of-ownership (TCO) analyses to estimate future sales volume. It calculated TCO for different combinations of vehicle segments, powertrain technologies, regions, and points in time. The TCO-based forecasts were then adjusted to account for regulatory requirements in four major markets: China, Europe, Japan, and the US.

To supplement the previous work, we built a model to estimate growth in the volume of self-driving taxis and its effect on new-car sales. For the US market, we drew upon a BCG study of the effects of shared autonomous electric vehicles on mobility in the US. (See *The Reimagined Car*, BCG Focus, December 2017.) For China and Europe, we built a detailed model that compared the cost of using a self-driving taxi with that of buying a personal car over various periods of

time and in different cities. The analysis provided a TCO comparison for more than 600 urban areas in China and Europe. This comparison allowed us to determine the share of population for which it would be economical to use on-demand, self-driving taxis instead of buying and maintaining a personal vehicle. Taking into consideration several constraints on that shift (such as a preference among some people for owning and driving a personal car), we derived the volume of self-driving taxis on the road for various points in time. In 2035, we estimate that the substitution for personal vehicles will account for approximately 75% of the volume of self-driving taxis, while the remainder will be attributable to pooling and sharing (approximately 20%) and the substitution for traditional taxis (approximately 5%).

To derive how these developments will affect industry profit pools, we created sizing methodologies for each revenue source (new-car sales, vehicle components, financing, aftermarket, data and connectivity services, and on-demand mobility). Next, we researched current profit margins, relying on industry reports and data reported by comparable companies. Finally, we applied insights from discussions with experts and our knowledge of the changing industry landscape to gauge how margins would develop.



once mass production starts. Consumers, especially the younger generation, will be increasingly receptive to using self-driving cars. We estimate that by 2035, nearly one in four of new cars sold globally will be fully autonomous.

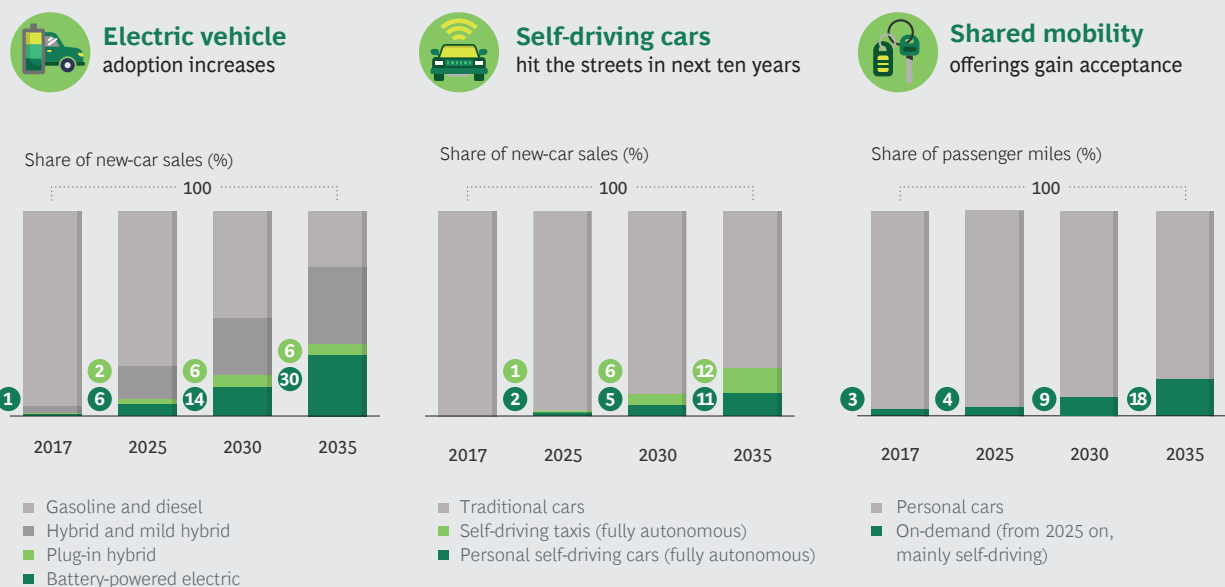
- **Shared Mobility.** In addition to technological changes, two broad social trends—urbanization and the rise of the sharing economy—will feed demand for shared mobility. We estimate that 66% of the world’s population will live in cities by 2050, compared with 54% in 2015. Moreover, the younger generation shows greater openness to sharing products and services and has diminishing interest in car ownership. By 2035, we estimate that 18% of passenger miles will be driven in vehicles shared on demand, primarily autonomous BEVs.

These developments, which are mutually reinforcing, will have tremendous implications for new-car sales, sources of revenue, and, ultimately, profit pools and capital investments. (See Exhibit 1.)

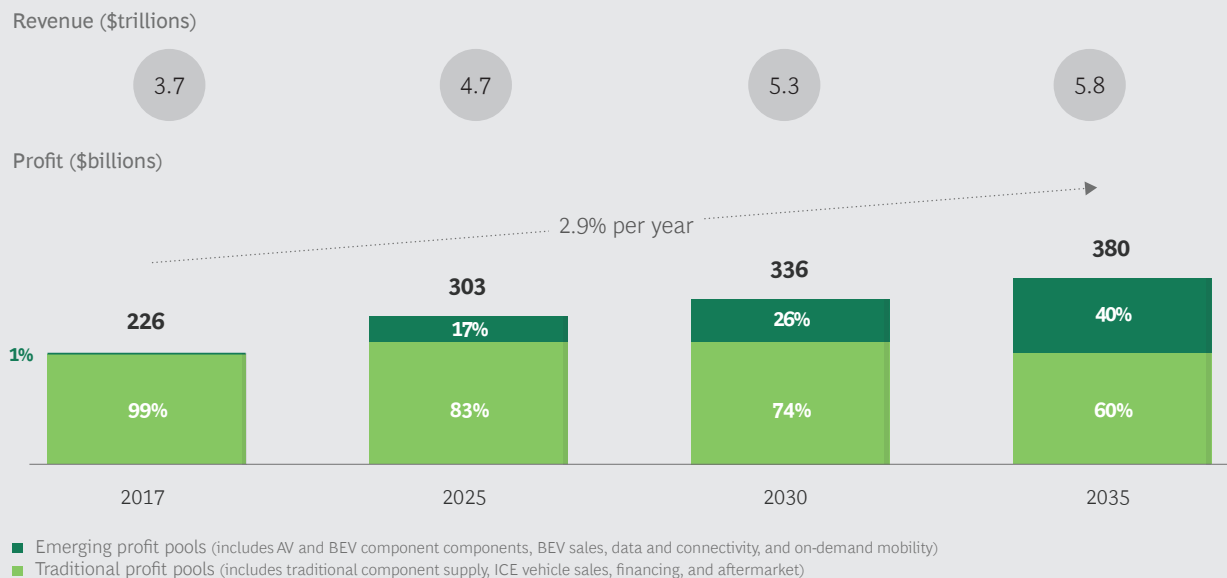
## New Sources of Profitability Emerge

Incumbents will initially enjoy a deceptively smooth ride. New-car sales volume will continue to grow, year-over-year, through 2025, driven largely by volume growth in China and other emerging markets. However, sales growth will stall as volume growth in China slows and breakthroughs in autonomous driving enable cheaper and more convenient on-demand mobility services. During the same period, the global annual volume of vehicles sold for on-demand services could grow to more than 10 million units.

EXHIBIT 1 | New Mobility Tech Is Changing the Industry



## EXHIBIT 2 | Growth Will Continue, but Profits Will Shift to New Mobility Tech



Source: BCG analysis.

Note: AV = autonomous vehicles; BEV = battery-powered electric vehicles; ICE = internal combustion engine vehicles.

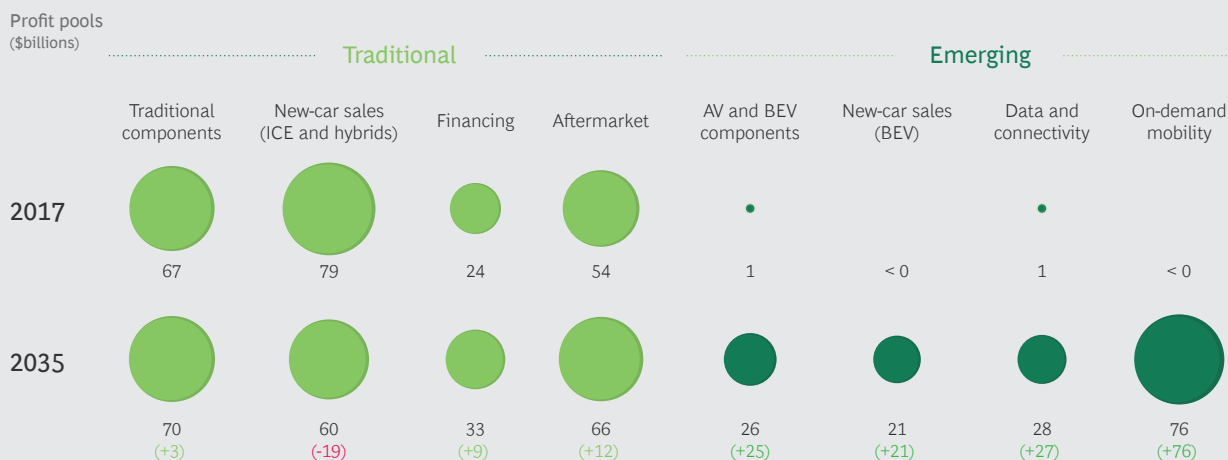
Even with these disruptions, aggregated industry profits will grow at a rate of about 3% a year through 2035. (See Exhibit 2.) However, as AV and BEV adoption increases, new technologies will expand the industry's boundaries and the sources of profitability will change. The share of industry profits represented by emerging profit pools—including components for AVs and BEVs, sales of BEVs, data and connectivity services, and on-demand mobility offerings—is projected to reach 40% in 2035. By then, traditional profit pools—including traditional components, sales of internal combustion engine (ICE) and hybrid-electric vehicles, financing, and the aftermarket business—will represent only 60% of industry profits, down from 99% in 2017. On-demand mobility is expected to be the largest of the emerging profit pools, reaching \$76 billion in 2035. (See Exhibit 3.)

A review of the factors underlying the forecast provides some insight into how the market is developing.

**New-Car Sales.** Annual sales volume for new cars could increase by 17 million units by 2035. But volume will remain relatively flat from 2025 onward, as the new-car market will be affected both positively and negatively by a variety of developments. Sales volume will be bolstered by the continued growth (albeit at a slower rate) of China and other emerging markets. Additionally, revenue will get a boost from higher vehicle prices. Costs for ICE vehicles will increase as OEMs try to meet ever more stringent emission standards, while the high cost of battery cells will cause BEV prices to exceed today's average vehicle prices. However, the higher utilization of self-driving taxis compared with privately owned vehicles will negatively affect sales volume, despite a shorter replacement cycle.



### EXHIBIT 3 | Emerging Profit Pools Will Grow Dramatically



Source: BCG analysis.

Note: AV = autonomous vehicles; BEV = battery-powered electric vehicles; ICE = internal combustion engine vehicles.

**Component Supply.** Value creation will shift from OEMs to suppliers as BEV penetration increases. OEMs' value share (that is, their share of the costs of components manufactured per vehicle) is expected to fall to around 10% to 20% for BEVs in 2030, considerably less than what it is today for ICE vehicles (27%). We forecast that new AV and BEV components, primarily manufactured by suppliers, will represent 50% of the component value of autonomous BEVs. Today, OEMs typically manufacture the ICE powertrain in-house. However, it currently appears that many OEMs will outsource production of battery cells and other new components for AVs and BEVs. In that scenario, suppliers of new components would be big winners, while traditional suppliers of ICE-related components would see their market contract over the long term.

**Aftermarket.** OEMs' high-margin aftermarket business will be hurt by the adoption of BEVs, which need nearly 60% less maintenance per year than ICE vehicles. However, the negative impact will develop slowly, because BEVs will make up only about 10% of the vehicles on the road by 2035. Operators of on-demand fleets will also exert downward pressure on prices of aftermarket services. Some fleet operators may establish their own maintenance workshops or outsource the work to low-cost vendors. OEMs will be able to counter these potential threats by devising ways to leverage the higher complexity of AV and BEV components to capture value in the aftermarket. For example, OEMs could design AV systems so that only authorized workshops can appropriately maintain or repair them.

**Data and Connectivity.** The adoption of AVs will enable tremendous growth in revenue related to connectivity services. We forecast that revenue will increase from \$4 billion in 2017 to \$157 billion in 2035. Connectivity revenue will be generated by in-car advertisements and recommendations (such as those currently available in some taxi fleets); digitally enabled services, feature unlocks, and

subscriptions (such as GM's OnStar); and business-to-business data brokerage (in which an OEM sells vehicle-related data to third parties, such as maintenance shops or insurance providers).

**On-Demand Mobility.** Self-driving taxis will substantially reduce the cost of on-demand mobility compared not only with traditional taxis, but also with today's more affordable ride-hailing and car-sharing services. Indeed, instead of using a personal car, many people will hail an AV wherever and whenever they need it. The lower costs and greater convenience of using AVs hailed on-demand will lead to a substantial increase in market penetration, especially in cities, as shown in Exhibit 1. For example, by 2030, it will be more economical for 30% of Europe's population to use self-driving taxis than to purchase a car.

## A “Double Whammy” Investment Challenge

To unlock the promised value of mobility technology, industry players will need to invest more than \$900 billion in new growth areas by 2030 and more than \$2.4 trillion by 2035. Key areas for investment include:

- **AV Technology.** Cumulative investments in AV technology through 2035 will total \$45 billion, representing 1.7% of OEMs' cumulative R&D expenses. To fully develop AV technology, the industry will need to employ thousands of specialized engineers.
- **Battery Production Facilities.** The industry will need to greatly expand battery production capacity in order to meet demand arising from increased BEV sales. The total industrywide investments in battery production facilities would need to reach \$220 billion through 2035, equivalent to 13% of battery suppliers' revenue during the period. By that year, the industry would need to build 57 battery production facilities equivalent to Tesla's new Gigafactory, which has a planned annual production capacity of 35 gigawatt-hours.
- **Charging Infrastructure.** Cumulative investments in charging infrastructure through 2035 will need to total \$130 billion. To put it into perspective, that amount is equivalent to 30% of the German federal budget in 2017. More than 38 million additional public charging spots will be needed globally to meet demand.
- **Self-Driving Taxi Fleets.** The industry will need to finance large fleets of self-driving taxis. Capital amounting to \$1.8 trillion will be required to finance a total of 72 million self-driving taxis through 2035. This creates a major financing opportunity for many different types of players, including cities and their public-transportation authorities, car rental companies, OEMs, and banks or institutional investors.

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OEMs face the double challenge of needing to make their share of the investments in growth areas at the same time that margins in their core business are declining. Our analysis found that OEMs are likely to see their return on sales, close to 7%, drop by approximately 1 percentage point by 2025. Among the factors driving the

contraction will be lower profitability of BEVs and hybrid vehicles and the cost of compliance with emission regulations. Over the same period, the ratio of capital expenditures to revenue will climb by approximately 1 percentage point, as OEMs work to fund future growth areas.

## A Transformed Market Structure

As a result of these developments, OEMs will find their market position challenged on multiple fronts over the next 15 years. Suppliers, especially makers of AV and BEV components, will gain greater influence. Ride-hailing companies and tech giants will battle to dominate the customer interface and data flows. Startups, including digital natives, will enter the race to offer vehicle-centered services. And cities may emerge as the gatekeepers to local services.

Likely winners will be those market participants that are well positioned in future growth areas: AV technology providers (including electronics and software suppliers), battery makers, and on-demand platform providers and operators. Potential losers could include incumbent suppliers that focus on components for ICE vehicles; incumbent OEMs without a strong position in new business models or in AV or BEV technology; and dealerships and maintenance shops that cannot expand their service offerings.

Among suppliers, the new entrants represent a diverse set of firms, from large corporations to startups. These companies will offer a wide variety of new technologies, including AV software, sensors, engine control units, batteries, and navigation systems. For example, four companies—BYD, LG Chem, Panasonic, and Samsung—have expanded their roles in the mobility industry by becoming the dominant suppliers of batteries, the most expensive component of self-driving BEVs.

In the on-demand market, major ride-hailing companies—such as Uber, Didi Chuxing, and Lyft—have a strong head start. Their large driver networks and efficient routing algorithms help them provide the fastest pickups, and they have the know-how to compete in specific markets. As a result, each has a broad customer base and an established brand. However, given the expected adoption of self-driving taxis, the long-term outlook for these current leaders is unclear. The fastest pickup times will belong to the platforms that have the largest self-driving taxi fleets. Ride-hailing companies will also need to build expertise in managing local fleets, rather than drivers, and foster strong partnerships with cities.

On-demand mobility will need a new supporting ecosystem. It requires new infrastructure (including traffic management control centers, pickup and drop-off hubs, and dedicated lanes); purpose-built vehicles and the related financing and insurance; local operations (such as cleaning, maintenance, charging, parking, and roadside assistance); and a technology platform that provides the customer interface, routing and trip assignments, and payment processing. Local operations will represent the largest share of costs, potentially making them a critical source of competitive differentiation.

Tech giants such as Google and Tencent are building integrated service platforms. For example, Google Maps integrates ride-hailing services from Uber and Lyft, and

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Likely winners in the new market structure include AV technology providers, battery makers, and on-demand platform providers and operators.

Tencent's WeChat has an "order taxi" function that interacts directly with Didi. The tech giants have also invested in one or more of the leading ride-hailing companies. Because these giants control the customer interface and have deep pockets for funding, other players in the market must continue to find ways to collaborate with them.

The favorable prospects for newcomers to growth areas are reflected in their high valuations. For example, computer chip maker Nvidia has developed an artificial-intelligence technology platform that will be used in AVs. The company's market capitalization increased eightfold from early 2016 through mid-2018, reaching \$150 billion. Its ratio of market cap to revenue (an indicator of investors' expectations) was above 13, compared with ratios below 1 for leading OEMs and traditional suppliers.

Recognizing the opportunities, venture capital investors have been pouring money into growth areas. For example, three pure-play electric-vehicle OEMs—Faraday Future, NIO (formerly NextEV), and WM Motor—have each received venture capital funding in excess of \$1 billion. Zoox, an AV startup, has received \$290 million in funding. The biggest recipients of VC funding are on-demand companies, with Didi and Uber each receiving funding in excess of \$10 billion.

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Venture capital investors have been pouring money into electric-vehicle OEMs, AV startups, and on-demand companies such as Didi and Uber.

## How to Prepare Today

Given the large investments and long time frame required to adapt to the evolving market landscape, industry players must immediately begin defining their strategies for how to best prepare for the shift in profit pools. Each type of player has opportunities to pursue a variety of growth areas.

- **Suppliers** should decide how to participate in the market for AV hardware and software and BEV batteries and components. To secure an edge against new tech players, incumbent suppliers need to explore ways to reorient their businesses, such as through new business models, forward integration along the value chain, and adjustments to the product portfolio. In many cases, acquisitions will offer the fastest way to gain access to new capabilities and know-how. To ensure funding to pursue growth areas, suppliers will need to manage their legacy business to promote increased profitability and carefully scrutinize proposals to invest in new businesses.
- **Automakers** will need to manage their transition into new growth areas. Suppliers' increasingly important role as providers of components for BEVs and AVs poses a great threat. To secure their competitive edge, automakers will have to expand their competencies in the development of BEVs and related components and AV technology and software (including high-definition maps). Establishing partnerships along the entire value chain will be essential to gain access to technologies and capabilities. To address the "double whammy" challenge of increasing investments as margins shrink, automakers must improve their internal financing capacities, review the economics of investments in their legacy business, and establish partnerships with companies that have access to capital. Importantly, automakers also need to decide which role to play in the emerging ecosystem for urban on-demand mobility and how to best prepare.

- **On-demand mobility companies** need to build a broad customer base and strong brand and forge relationships with local and national regulatory authorities. Although on-demand mobility is the profit pool with the highest forecast growth, establishing a sustainably profitable business will be challenging. Once self-driving taxis hit the streets, companies will need to own or have access to a large fleet to ensure high utilization rates and short wait times. They must also define which operational tasks (such as customer service, roadside assistance, and vehicle maintenance) to perform in-house and which to outsource.
- **Cities** have an opportunity to actively shape the future of urban mobility. To do so, they need to implement an integrated mobility strategy that addresses how they will orchestrate an ecosystem through partnerships, actively manage traffic and commuter demand, and ensure fair and balanced competition. This should include defining the respective roles of public-transit agencies and on-demand mobility companies. Cities will also have to ensure the availability of the required infrastructure by setting priorities for investments in charging spots, dedicated AV lanes, and intermodal hubs. The changes will require cities to find new ways to accurately measure commuter demand and traffic patterns.

By defining and modeling different scenarios, incumbent companies can explore how the industry and its profit pools will develop. Such modeling should consider a range of scenarios, with different adoption rates for AVs, BEVs, and shared mobility. Specific growth areas within each profit pool should be evaluated as well.

Armed with an in-depth understanding of the scenarios, companies should consider how to best leverage their current strengths to capture a large share of the emerging profit pools. They should decide *where to play*, establishing strategic priorities with respect to products and services. Next, they should focus on *how to win*, identifying the most important assets and competitive differentiators as well as potential partners and acquisition targets. Finally, they must determine *how to execute*, setting out the required initiatives in an action plan for pursuing the opportunities.

**A**UTOMOTIVE INDUSTRY INCUMBENTS must avoid having a false sense of security about the market's development. It is true that industry revenue will continue to grow and that emerging profit pools will expand slowly at first. However, it is equally true that the sources of profitability will have changed dramatically 10 to 15 years from now. Executives should not leave it to next generation of leaders to prepare their companies for the new market landscape.

## About the Authors

**Michelle Andersen** is a partner and managing director in the Detroit office of The Boston Consulting Group. She leads the Detroit office, is a core member of the automotive sector, and is a member of the Industrial Goods practice leadership team. You may contact her by email at [andersen.michelle@bcg.com](mailto:andersen.michelle@bcg.com).

**Thomas Dauner** is a senior partner and managing director in the firm's Stuttgart office. He leads the global automotive sector and is a member of the Industrial Goods practice leadership team. You may contact him by email at [dauner.thomas@bcg.com](mailto:dauner.thomas@bcg.com).

**Davide Di Domenico** is a partner and managing director in BCG's Milan office. He leads the Industrial Goods practice in Italy, Greece, and Turkey and is topic coleader for digitization of the automotive value chain. You may contact him by email at [didomenico.davide@bcg.com](mailto:didomenico.davide@bcg.com).

**Nikolaus Lang** is a senior partner and managing director in the firm's Munich office. He leads the Global Advantage practice and is a core member of the automotive sector and the Industrial Goods practice. He is also topic leader for mobility, connectivity, and self-driving vehicles. You may contact him by email at [lang.nikolaus@bcg.com](mailto:lang.nikolaus@bcg.com).

**Andreas Jentzsch** is a senior partner and managing director in BCG's Munich office. He is a member of the Industrial Goods and Operations practices and leads the automotive sector in Central and Eastern Europe, the Middle East, and Africa. You may contact him by email at [jentzsch.andreas@bcg.com](mailto:jentzsch.andreas@bcg.com).

**Thomas Palme** is a principal in the firm's Beijing office and a core member of the automotive sector. You may contact him by email at [palme.thomas@bcg.com](mailto:palme.thomas@bcg.com).

**Philipp Sadek** is a consultant in BCG's Vienna office and a core member of the automotive sector. You may contact him by email at [sadek.philipp@bcg.com](mailto:sadek.philipp@bcg.com).

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