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# THE AUTOMOTIVE REVOLUTION IS SPEEDING UP

## A perspective on the emerging personal-mobility landscape

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How fast is disruption reshaping the personal-mobility landscape, and what will new value pools look like as the ecosystem evolves?

### Introduction

What a difference a few years makes—the automotive sector is changing, and it's changing fast. Start-up CEOs have risen as superstars of the industry almost overnight. Artificial intelligence is poised to become a base technology for every engineering department. Automotive OEMs are exploring other parts of the ecosystem, even taking part in conferences once aimed squarely at the film and music industries. Consumers talk more about systems and technologies embedded in cars than about horsepower. And investors have taken the wheel in shaping the mobility system in certain countries.

Would anyone have envisioned all these shifts happening by 2017?

For more than two years, the industry has been talking about the four disruptive trends changing the rules in the mobility sector: autonomous driving, shared mobility, connectivity, and electrification. A McKinsey report from January 2016 integrated the impact of these trends into a single picture for the first time. Today, we can offer a perspective on three questions that are a top priority:

- What is the speed of change?
- What do the new value pools look like?
- What is required to succeed in the future?

This article addresses the first two questions; the third question will be covered in a forthcoming piece.

### Text Box 1: How we derive insights

We developed our perspective drawing on a number of sources:

- An established market model based on scenario-tested development of the four disruptive trends and consumer-mobility behavior in five city archetypes
- Hundreds of conversations with executives of mobility players and public-sector stakeholders across the globe
- Joint projects with various industry associations and academic institutes in Asia, Europe, and North America
- Big data analyses on specific industry perspectives, for example, the investment landscape

### The four disruptive, technology-driven industry trends are gaining significant momentum

The transformation of the automotive industry we described in our report from January 2016 has taken a step change forward over the past two years.

All four mutually reinforcing trends—autonomous driving, shared mobility, connectivity, and electrification—show signs of acceleration. Indeed, the entire industry shows signs of increasing momentum (see Text Box 2).

### Text Box 2: Indicators of the revolution's acceleration throughout the industry

Several data points suggest the pace of change is increasing:

- The average disclosed start-up investments per year in new core technologies (such as sensors, sharing solutions, and cybersecurity) increased twelvefold from 2010 to 2016.
- 95 percent of disclosed investments in companies focusing on any of the four disruptive trends come from nonautomotive players—over 50 percent of which are tech players.
- The yearly transaction volume consolidating the supplier industry has grown sevenfold since 2013.
- The complexity of in-vehicle software has doubled since 2006 and is expected to further increase fourfold by 2030, requiring an additional 100,000 software engineers in the United States alone.
- The number of patents filed annually in autonomous technology, to take one of the disruptive trends as an example, has almost doubled since 2012; patents filed by tech players in this area have increased by an average of 25 percent annually.

A few developments illustrate some of these advances:

- **Autonomous driving.** In 2016, only about 1 percent of vehicles sold were equipped with basic partial-autonomous-driving technology. Today, 80 percent of the top ten OEMs have announced plans for highly autonomous technology to be ready for the road by 2025.
- **Shared mobility.** In major regional and local markets, large shared-mobility providers dominate, with combined market shares of up to 90 percent. As of this writing, in 2017, at least \$32 billion had been invested in ridesharing start-ups alone. There is strong growth potential: less than 1 percent of passenger miles traveled today are carried out using shared-mobility services, and US customers expect usage of shared mobility to increase by around 80 percent once robo-taxis are available.
- **Connectivity.** Only 12 percent of cars today are equipped with embedded connectivity solutions, and monetization is still weak (less than \$1.5 billion in revenue). But the importance of cars as part of a connected network for the consumer is growing: the percentage of consumers ready and willing to change car brands for better connectivity has doubled over the past two years. In the premium segment, a majority of OEMs have already installed fully connected infotainment systems in 100 percent of their new vehicles. These systems are used to provide a diverse range of in-vehicle services to drivers and diverse data sets to third parties.
- **Electrification.** Whereas less than 5 percent of vehicles sold in 2016 were equipped with electrified-vehicle (xEV) powertrains, the industry aspires to have over 50 percent of all new models in 2021 equipped with xEV drivetrains. Between now and then, many mass-market OEMs are planning to add ten or more xEV models to their lines as they project they can reach potential sales of 100,000 to 600,000 xEVs in the next five years.

Within each trend, individual players are already making headway on key technologies, even though no player seems likely to be able to dominate in all of them (for the foreseeable future). Yet there remain technological and economic challenges for each trend that must be overcome. The speed at which this can be achieved will ultimately define how quickly all trends can gain a real foothold across the industry. Here are two examples:

- **Battery cost and scale.** For producers to reach parity in total cost of ownership and profitability between battery-electrified vehicles and internal-combustion-engine vehicles, the cost of batteries would need to be reduced by 25 to 40 percent. Lithium-ion-battery production will need to increase significantly to meet the demands of millions of new xEVs.
- **Ability to extract value of shared mobility.** Greater proliferation of shared mobility depends, in part, on the ability to broaden the addressable market. Use cases such as commuting would require a much lower price level than a typical ride-hailing offer today. This will require new offers (for example, for pooling) and new technologies (for instance, autonomous driving).

### **A new personal-mobility landscape is emerging and starting to take shape**

It's clear that personal mobility is evolving. Several scenarios could unfold, depending on a number of variables: the technological focus will shift, market perspectives should become more granular, and understanding customers will be essential.

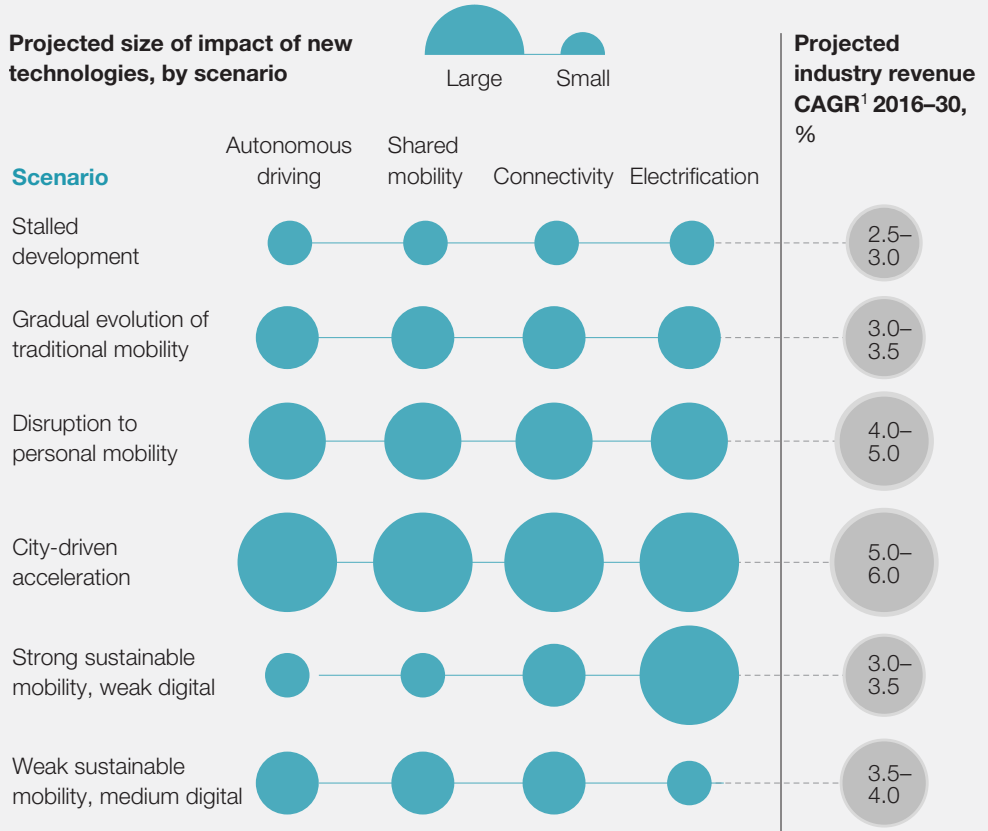
### **Understanding how mobility could develop through 2030**

While the global industry is expected to continue to grow, likely market scenarios for 2030 could differ almost up to 40 percent in revenue potential due to a high variance in prospective growth of disruptive technologies and new business models, whereas many traditional revenue sources could remain relatively stable.

Projecting the various development paths of the four disruptive trends—and their impact on the industry—led us to define six potential mobility scenarios for 2030 (Exhibit 1). Four scenarios were built using the same degree of technology diffusion for all four trends, since we found that all trends are mutually reinforcing and the success or failure of one affects the others. Given that the key drivers of diffusion for electrification (consumer pull, technological readiness, and regulation push) can be independent from those of the other three trends, we added two additional scenarios in which we vary the diffusion trajectory of the trends.

**Exhibit 1**

6 scenarios with varying technology diffusion show differences in revenue potential of up to 40 percent by 2030.



<sup>1</sup> Compound annual growth rate.

McKinsey&Company | Source: McKinsey Center for Future Mobility

Although the overall industry is expected to continue its path of growth, the range of possibilities for the future is broad. The variation in revenue potential across the six market scenarios could be almost 40 percent. This may be driven strongly by the likelihood and ability of evolving disruptive technologies to unlock new use cases and value within the personal-mobility landscape. While more traditional revenue sources could also show some variance in their prospective growth, they will likely prove to be more stable than the revenue sources from disruptive technologies (Exhibit 2).

## Exhibit 2

The potential growth of **disruptive technologies** varies widely by 2030; in comparison, traditional sources seem more stable.

### Traditional revenue sources stay relevant in 2030, with more stable growth



<sup>1</sup> Measured as increase of industry revenue in terms of consumer spend from 2016 to 2030.

<sup>2</sup> Calculated as: 1 – (smallest value/largest value).

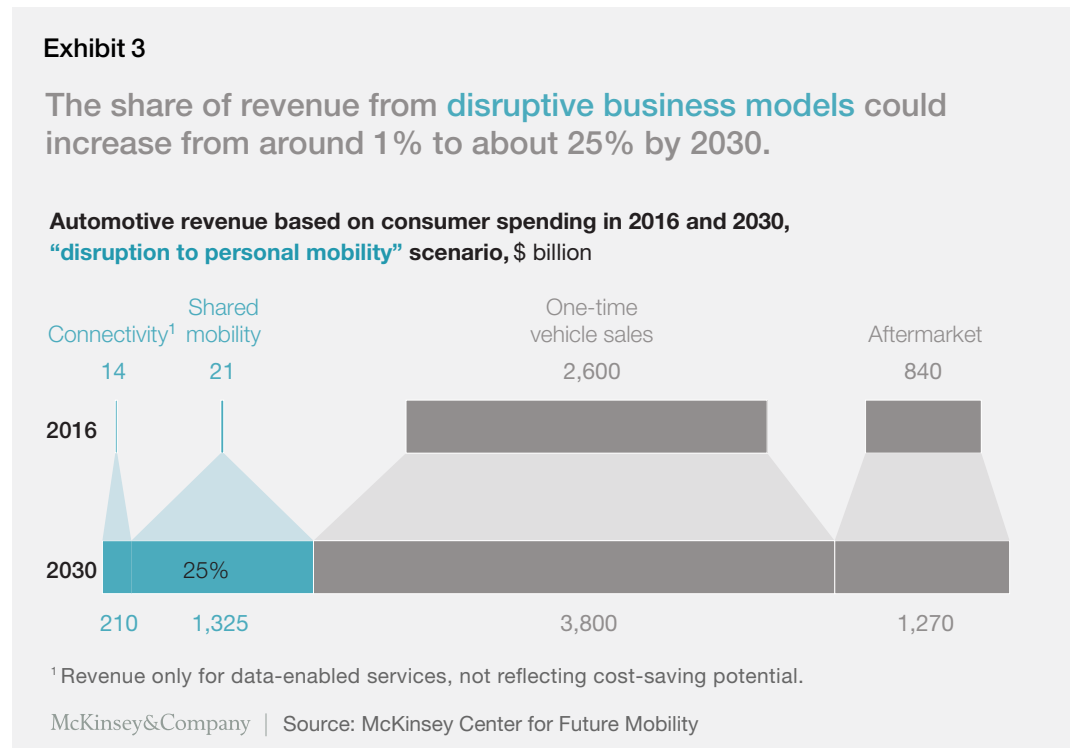
McKinsey&Company | Source: McKinsey Center for Future Mobility

Of the outlined scenarios, our research, recent developments, and conversations with players across the personal-mobility landscape led us to believe a more disruptive development is most likely. We'll consider the "disruption to personal mobility" scenario the new base case, in which the overall industry could have the potential to grow 4 to 5 percent annually, doubling in size to roughly \$6.6 trillion by 2030.

### Spotlighting new business models

The share of revenue from disruptive business models could increase from about 1 percent in 2016 to up to 25 percent by 2030.

The new base case could mean that business in the personal-mobility landscape may look very different in the future. Value is likely to shift toward new, disruptive business models, with shared mobility and connectivity solutions potentially accounting for up to 25 percent of total automotive revenue in 2030 (Exhibit 3).



Of course, there's no guarantee this scenario will emerge. Reaching four milestone statistics is crucial to it becoming reality:

- 100 percent vehicle connectivity and the commercial introduction of robo-taxis covering up to 5 percent of passenger miles traveled by 2030
- 90 percent adoption rate of smartphone ridesharing apps by 2030
- Tenfold growth in reliance on shared mobility, accounting for about 15 to 20 percent of vehicle miles traveled in dense cities by 2030
- 50 percent of vehicles sold have cost-efficient electrified powertrains in 2030.

If this scenario comes to pass, new business models on shared mobility and car-data-enabled services will require players to build on different technology and competencies as well as new types of partnerships to unlock value and serve increasingly diverse customer needs.

One example of how multiple players are starting to partner on new business models can be observed in the development of in-car delivery solutions. While same-day delivery still seems like a novelty to many, automotive, e-commerce, and logistics players are already working on solutions that use data from fully connected vehicles to have packages delivered to car trunks, regardless of where the driver is.

#### Reconciling disruptive technologies with traditional products and services

While about 20 percent of revenue in new vehicle sales could shift to disruptive technologies, traditional products and services may still account for over 60 percent of the total value in new mobility-as-a-service business models.

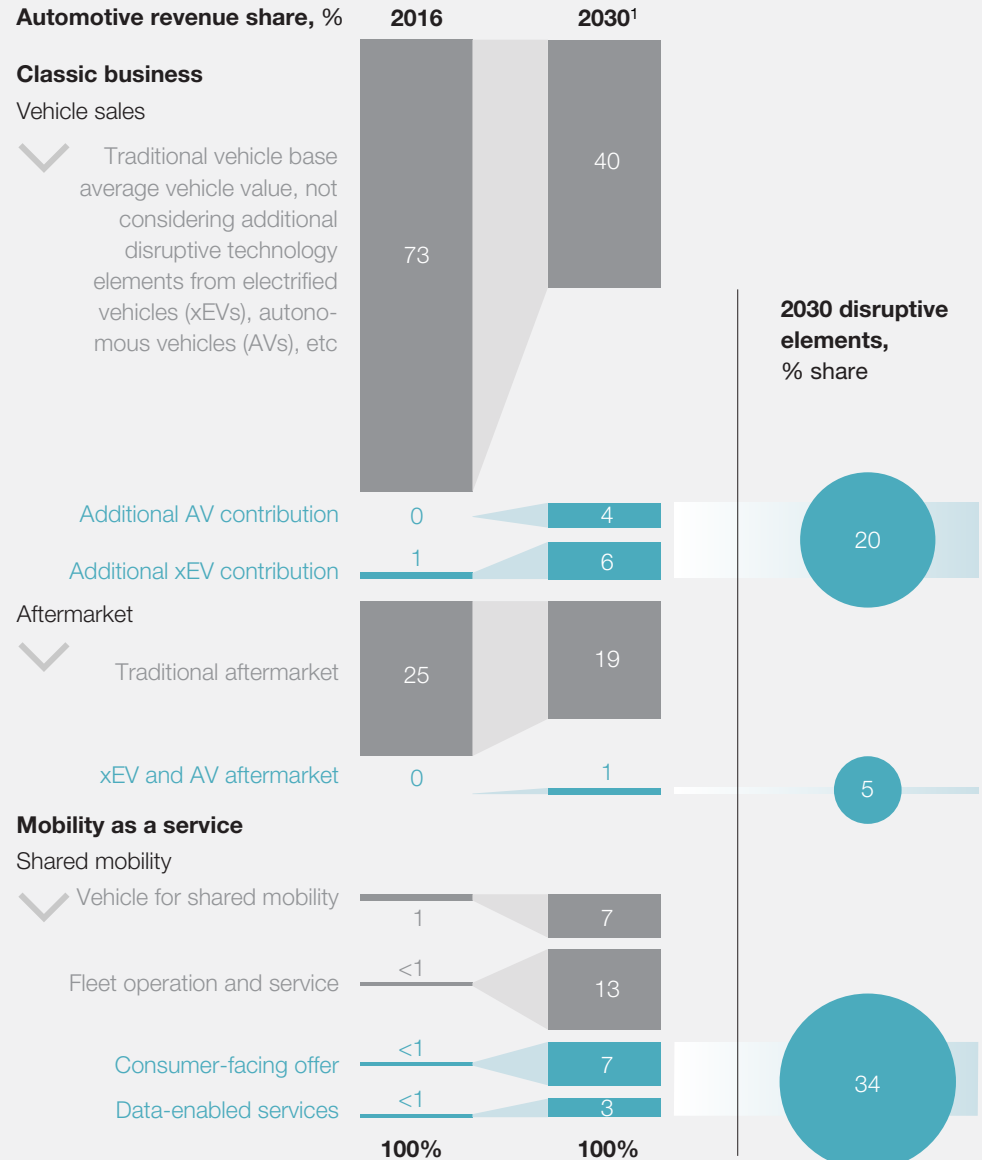
The growing importance of new business models is accompanied by a shift in technological focus, which is required both in classic vehicle sales and aftermarket as well as in new, disruptive business models. Emerging technologies in the fields of electronics and software stand in contrast with more traditional areas, which are likely to remain a relevant share of the overall value pool.

Considering our base case, by 2030, about 20 percent of value generated from classic vehicle sales might shift toward new technologies, such as xEV powertrains or autonomous-vehicle software and components. But more than 60 percent of revenue from disruptive business models could still be carried by traditional elements, such as the shared vehicle itself or fleet operations (Exhibit 4).



**Exhibit 4**

**Disruptive elements** will account for more value in vehicle sales, but most recurring revenue will still be from traditional elements.



<sup>1</sup> Assumptions based on “disruption to personal mobility” scenario.

McKinsey&Company | Source: McKinsey Center for Future Mobility

This development will push players to bridge two worlds to serve their customers. Although incumbent players could face a major transition as the personal-mobility landscape evolves through 2030, they should look for areas in new business models where they can use their advantages in more classic industry capabilities. Similarly, despite the challenges of a transition, there may also be an opportunity to reduce the intensity of capital expenditure in the industry—an effect that may also increase the industry’s overall attractiveness for the financial market.

### Developing more granular market perspectives

The divergence of key technology adoption and global growth rates in national markets and city archetypes requires ever-more granular perspectives that put consumers at the center.

“The customer is king” is not a new law to live by. Yet in the new personal-mobility landscape, it can make changes in market structures more prominent and may require industry players to take an ever-more granular perspective on how to best serve their customers. This is not a surprising development; other industries, such as telecommunications, have already gone through a similar shift. Two factors are primarily responsible for the need for a granular market approach: different growth rates and different speeds of trend adoption.

First, growing regions are likely to become even more important. Most significantly, China could experience growth in sales volume of more than 50 percent by 2030. With an expected 8 percent compound annual growth rate, it would grow to represent about a quarter of the industry’s revenue by then. Similarly, dense, developed metropolitan areas could increase their market share by 50 percent as well, accounting for 20 percent of industry revenue.

Second, we are on track to see an increasing divergence in the adoption of key technologies in all markets. Again, China’s consumers seem to remain front-runners, with 90 percent of our recent survey respondents willing to switch brands for better autonomous-driving functionalities—compared with 56 percent of consumers in the United States and 49 percent in Germany. The regulatory drive toward electrification may also play out differently in different cities, even within the same country. And it’s worth noting that consumers in dense cities will require mobility services that differ from those for people in small towns or rural areas.

With diverse sets of customers across the globe taking center stage in defining the future of mobility, the development of the four technology-driven disruptive trends has the potential to vary significantly by market. This requires industry players to act at an extremely granular level.

## Rethinking the industry to reflect a consumer-centric mobility landscape

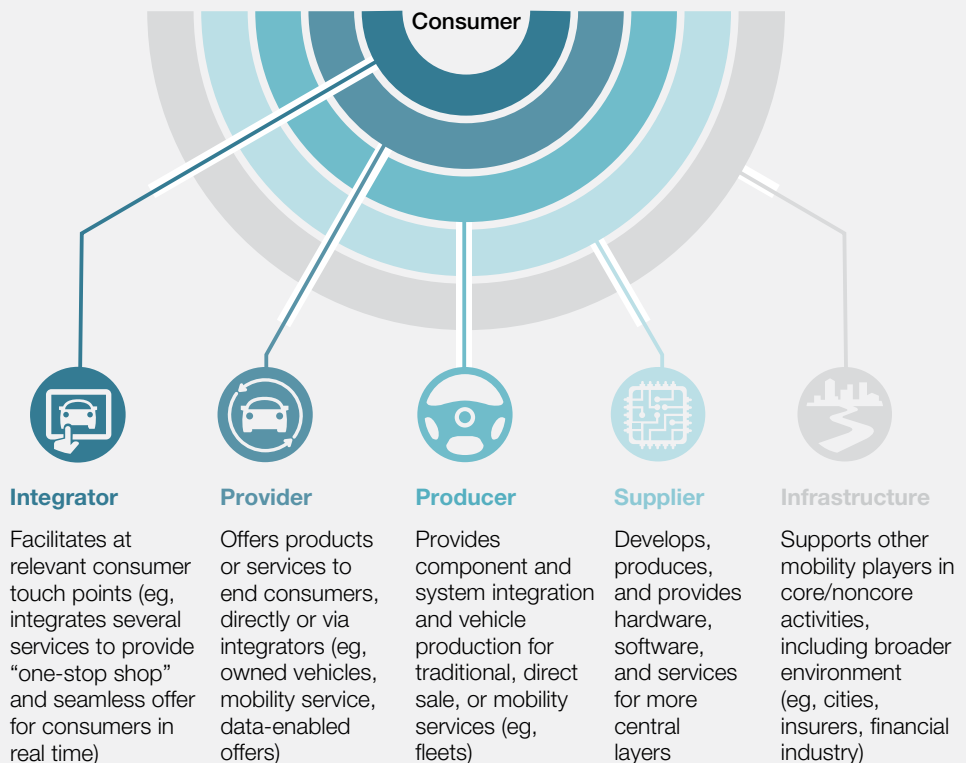
Disruptive developments require us to redefine our view of the industry structure toward a personal-mobility landscape focusing on the consumer.

The increasing momentum of all disruptive trends, the shifts in value pools and corresponding capabilities, and the growing need for more granular perspectives on consumers requires we rethink our view of the automotive industry. The new personal-mobility landscape that is emerging is much broader than the traditional automotive industry; it is extending to include, among many others, tech players and new entrants from other industries such as software and utilities. Whether incumbents or challengers, all players will find themselves part of an increasingly diverse playing field (Exhibit 5).

### Exhibit 5

Technological focus and business-model orientation shape the layers of the personal-mobility landscape to emerge by 2030.

#### 5 layers of emerging mobility landscape



McKinsey&Company | Source: McKinsey Center for Future Mobility

In this emerging landscape, players should not define themselves as belonging to one layer, quadrant, or technology type. Instead, they may be active in different business models, engage multiple technologies, and play more than one role across layers, depending on what their capacity to deliver value to their customers allows. A classic OEM, for example, could grow from its traditional core of building vehicles for ownership toward developing provider capabilities. Furthermore, it could participate in new mobility services for end consumers in order to capture value that is generated in new areas of the landscape and that increasingly gravitates toward its center.

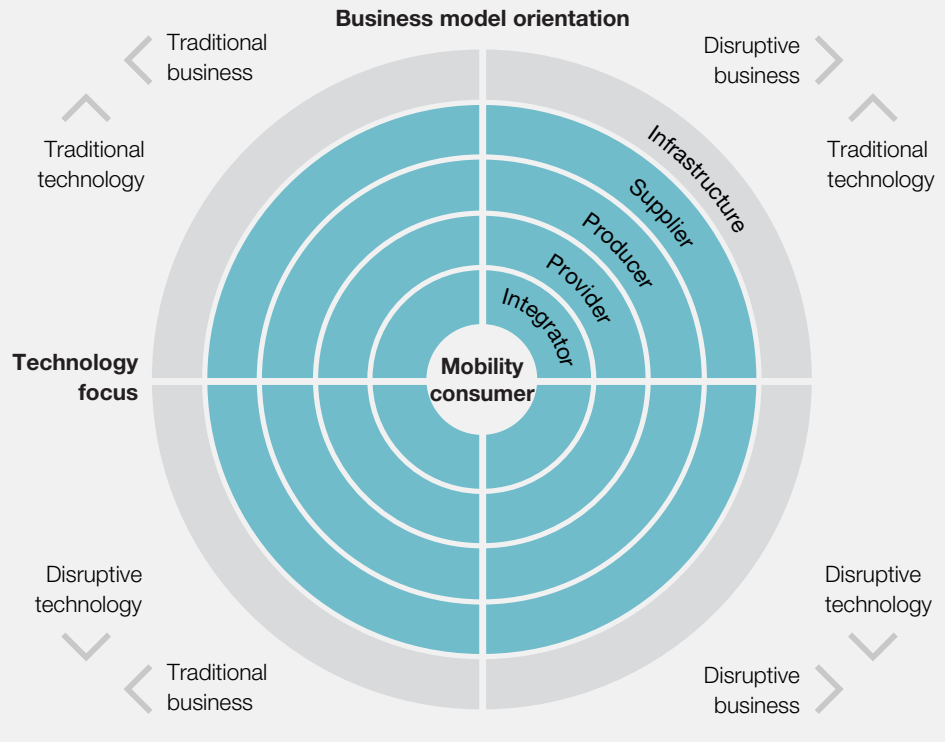
Those closest to the center may tend to be more focused on how they serve the mobility end consumer. Their business models are likely to be more targeted than those of players operating mainly on the outer layers of the landscape. Actors in the supplier or infrastructure space, on the other hand, have a broader audience and likely cater to both other industry players and the end customer, regardless of whether they are active in the mobility-as-a-service space or in traditional vehicle sales. A tire manufacturer may sell the same product to manufacturers, car owners, and mobility fleet operators, for example.

On the other hand, these outer-layer roles may tend to be more focused on specific technologies or solutions in order to deliver the best offer to their broader market. Roles close to the end consumer, however, will probably have to provide a combination of technologies. Fleet operators, for instance, may choose to offer a range of premium products and services (including the newest electric and autonomous technologies).

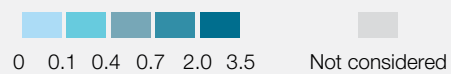
Such changes mean that players will have to think actively about positioning themselves. A snapshot of these changes emerges when we consider the likely shifts in value discussed above, and thus the respective revenue opportunities, between today and 2030 in the new personal-mobility landscape (Exhibit 6). To illustrate this, we will refer to the revenue potential of our base case—\$6.6 trillion by 2030—and will not consider broader opportunities, such as those in the infrastructure layer.

**Exhibit 6**

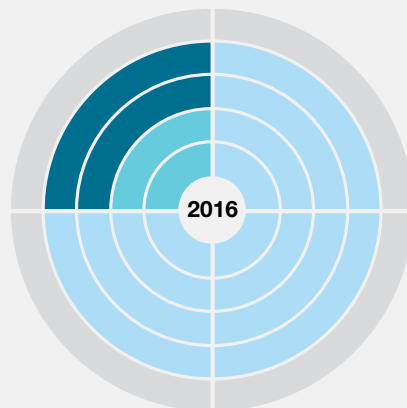
The revenue composition of the mobility market will shift from traditional to disruptive from 2016 to 2030.



**Mobility consumer scenario, \$ trillion**

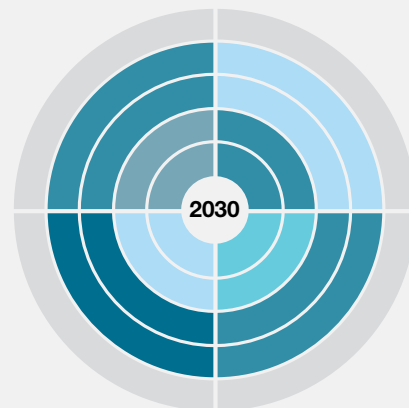


Status quo



2016 total \$3.5T

“Disruption to personal mobility” scenario



2030 total up to \$6.6T

McKinsey&Company | Source: McKinsey Center for Future Mobility

Today, the market is consolidated and focused on providing the traditional, privately owned vehicles that the majority of consumers use for their personal transportation needs. In the future, the mobility landscape may be highly disrupted and require many new layers of offers, given the potential for value shifts and additional value being created through new powertrains, autonomous-driving technology, in-vehicle connected services, and shared mobility.

As personal mobility continues to improve with these new offers, the biggest beneficiary of this disruption is likely to be the end consumer. Mobility as a service may fundamentally change the consumer's relationship to the car. Just like the mobile phone, changes in mobility will open up the possibility for new services and completely new forms of value creation in daily life.

This new way of looking at the personal-mobility landscape allows us to map developments and identify new opportunities as players seek to meet the needs of the mobility consumer of the future and capture a fair share of the market. The question of what will be required to succeed in this future landscape—potential strategies, partnership types, and transition paths—will be the focus of a forthcoming article.



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