

McKinsey Center for Future Mobility

# Mobility's future: An investment reality check

In this time of crisis, the auto industry can't afford to ignore crucial technology trends. Our analysis of the mobility-investment landscape helps company leaders make smart decisions now.

*by Daniel Holland-Letz, Matthias Kässer, Benedikt Kloss, and Thibaut Müller*



**In 2020, the global COVID-19 pandemic** triggered one of the worst economic downturns in a generation, and the mobility industry was one of the most heavily affected sectors. The crisis has given automotive OEMs, suppliers, and other mobility players a new revenue and profit mandate: develop a sustainable business strategy that aligns with the realities of the next normal.

To help both incumbents and new businesses achieve this vision, we recently reviewed the landscape for mobility start-up and investment. In addition to looking at the amounts invested by and into specific companies, we identified the technologies that attracted the most funding, focusing on 17 critical categories related to automation, connectivity, electrification, and smart mobility (ACES).

### **To gain a competitive edge, invest wisely**

Despite the global pandemic, mobility players cannot ignore ACES-related developments if they wish to achieve a competitive edge over the next decade. (See sidebar, “Understanding the ACES trends,” for more information on recent technological advances). Even though the current economic landscape has increased financial pressures on mobility players, ACES technologies will continue to evolve and disrupt the automotive landscape.

While all the areas of ACES remain in play, the pandemic has introduced major uncertainties that could complicate technology investment. As our consumer surveys showed, business and leisure travel around the globe has dropped significantly. Moreover, consumers now consider shared modes of transport, such as ride services or subways, less safe than private modes. Such changes could have a lasting impact on transportation preferences and patterns, even after the pandemic abates.

To ensure their future success in this changing environment, company leaders must take two steps. First, they must review potential ACES investment themes and identify the most promising ones, since it would be impossible for a single player to pursue all trends. (When it comes to ACES, the old gambler’s line about knowing when to hold or fold is appropriate.) Second, companies must create a plan that supports their selected investment priorities. It should describe the specific technologies or assets that merit investment and how the company will spend money to achieve the desired capabilities. The “how” part raises some strategic questions, such as whether companies should pursue ACES trends in-house, strike a partnership, or go the M&A route.

## **Understanding the ACES trends**

**Since 2010**, we have analyzed future trends in mobility investment, focusing on the four ACES technologies: autonomous driving, connectivity, electrification, and smart mobility. Our current analysis reflects findings from McKinsey’s 2020 overview of the landscape for mobility start-up and investment. Prior publications in this series include our 2017 article, “Analyzing start-up and investment trends in the

mobility ecosystem,” and 2019’s “Start me up: Where mobility investments are going.”

This year, our analysis includes some new areas. First, we complemented our analysis of investments in mobility companies by studying patent-filing activities. Through this lens, we gained greater insights about the technologies that companies prefer to develop in-house, rather than through

inorganic growth (for instance, through investment). Second, we took a fresh look at future-mobility investment by identifying the technologies that support ACES trends and looking at investments and patent-filing activities for each one. This analysis provides insights on emerging technologies that would not be available through a simple analysis of investments in mobility companies.

**The continuing relevance of ACES**

Since 2010, investors have poured nearly \$330 billion into more than 2,000 mobility companies focused on ACES, with over \$80 billion of this amount invested since the beginning of 2019 alone (Exhibit 1). About two-thirds of the total investment, or \$206 billion, went to autonomous-vehicle (AV) technologies and smart mobility. A lower amount—about \$123 billion—went to connectivity and electric vehicles (EVs), suggesting that companies prefer to develop these technologies in-house, rather than by pursuing inorganic growth.

*Recent investments have flattened.* After a decade of steady growth in average annual investments in mobility companies, our analysis reveals an overall flattening of specific expenditures for the first time. The drop has been particularly intense in e-hailing and infotainment. (The former drove the early market but has recently seen an investment decline.) Meanwhile, investments in operational technologies remain small but continue to increase, particularly for car sharing, charging stations, and battery technologies, with a total of \$29 billion invested since 2010. It is important to note that this trend was under way well before the pandemic.

Our analysis also reveals an acceleration of patent-filing activity across all four ACES technologies, suggesting a greater emphasis on in-house development and a move toward operationalizing prior investments.

*Technology investments during the COVID-19 pandemic.* Investment in future-mobility technologies has continued throughout the pandemic. For example, a US automaker reached an agreement with another auto company in the spring of 2020 to develop new EVs, using the second brand’s battery technologies. Later that year, a commercial-vehicle manufacturer announced partnerships with two technology companies to develop AVs. According to our analysis, investment in mobility technologies totaled \$39 billion through October 2020, suggesting that total spending for the year will likely be similar to the \$51 billion seen in 2019. Overall technology investments have been decelerating in recent years, well before the pandemic increased economic pressures

Exhibit 1

**Investors have spent nearly \$330 billion on mobility technologies, with two-thirds going to autonomous technology and smart mobility.**

**Total disclosed investment in mobility technologies since 2010 by ACES trend,<sup>1</sup> \$**

Total 329			
Autonomous	Connectivity	Electrification	Smart mobility
106	61	62	100

<sup>1</sup>As of October 2020.  
Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan; McKinsey Growth Analytics – Innography

**Outsiders continue to outspend incumbents.** Our analysis reveals that nonincumbents have made over 90 percent of investments in future-mobility companies since 2010, with 65 percent coming from venture-capital and private-equity (VC/PE) companies and 28 percent from tech players (Exhibit 2). Traditional automotive companies only accounted for 7 percent, or roughly \$20 billion to \$25 billion, of the total invested.

Although auto incumbents accounted for only a small portion of investment in future-mobility companies, they have allocated more than \$200 billion to develop ACES technologies in-house since 2014. About 80 percent of the total went to electrification. The high in-house investment suggests that many incumbents are more interested in building in-house capabilities than pursuing external partnerships.

A more detailed, quarterly view of investments between 2014 and 2020 reveals that, with the exception of one quarter in 2017, VC/PE firms have

consistently outspent their peers when it comes to investing in mobility companies (Exhibit 3). Their investment peaked at about \$4.6 billion in the second quarter of 2017 and subsequently fell to a rather constant level of \$2 billion to \$3 billion per quarter. Meanwhile, investment by hardware-tech companies dropped significantly between 2018 and 2019 but recovered to nearly \$1 billion in 2020. Investment by software-tech companies has steadily declined from a high of \$1.3 billion in 2017. Finally, investment by auto brands reached over \$400 million in 2015 but has since dropped to about \$100 to \$200 million per quarter.

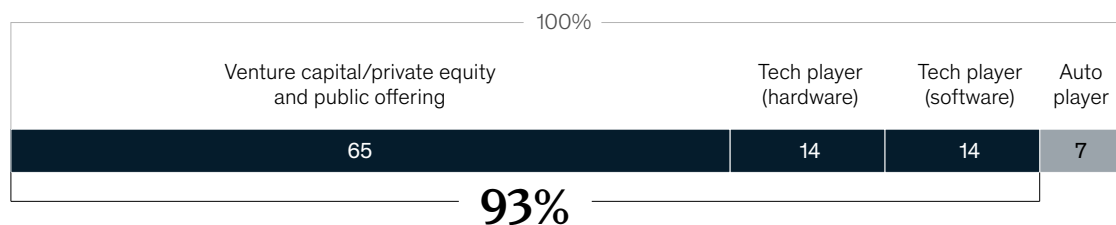
### The core technologies fueling an investment race

During our analysis of investment in mobility companies, we broke each ACES trend into company clusters. For instance, automation includes clusters for semiconductors and components of advanced driver-assistance systems (ADAS), among other clusters. There were 20 clusters overall.

Exhibit 2

## Technology and venture-capital/private-equity firms spent 93 percent of total investment in mobility tech, outpacing auto brands by a magnitude of 13.

Total disclosed investment in mobility technologies since 2010 by investment type,<sup>1</sup> %



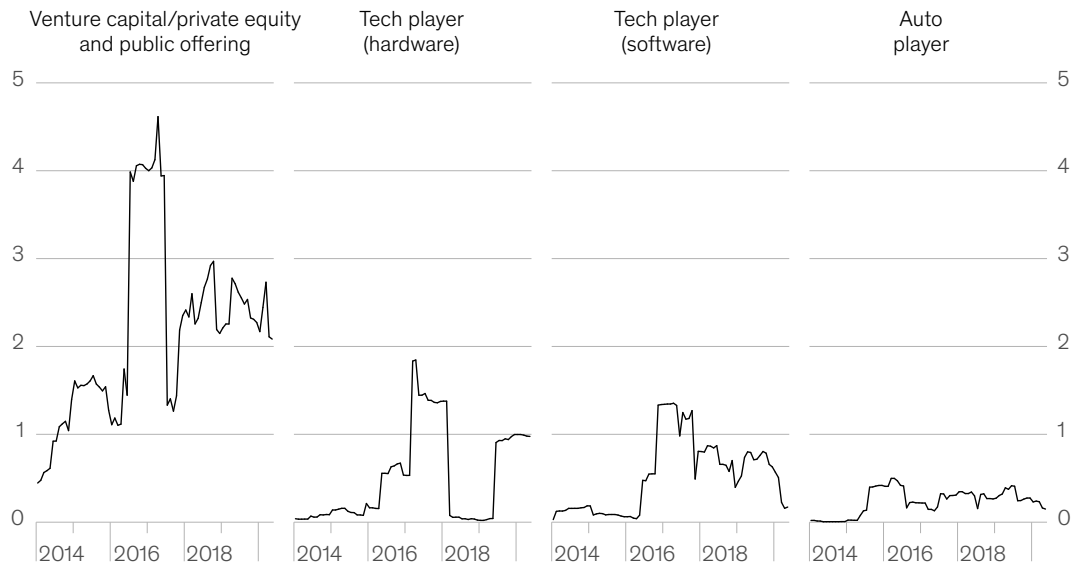
<sup>1</sup>As of October 2020.

Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan

Exhibit 3

**Venture-capital and private-equity firms have consistently outspent their peers, with invested capital peaking at \$4.6 billion per month in 2017.**

**6-month rolling average of disclosed investment amount by investment type, \$ billion**



Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan

Our analysis reveals that companies have poured the largest sums into the e-hailing cluster over the past decade, with the \$83 billion invested representing over 80 percent of all smart-mobility investments. The next most popular clusters included semiconductors (\$51 billion) and ADAS components (\$36 billion). Together, e-hailing, semiconductors, and ADAS components account for over half of all ACES investments (Exhibit 4).

**Patent activity varies across ACES trends.** As Exhibit 4 also shows, companies have filed over 60,000 patents in ACES since 2010, with more than 80 percent targeting AVs and EVs. Companies have filed the most patents for ADAS components (about 9,000), semiconductors (5,000), EVs (10,000), batteries (7,000), and charging solutions (7,000). Patent activity in smart mobility is negligible, which suggests that business models and customer scaling—rather than technology—drives this pillar of ACES.

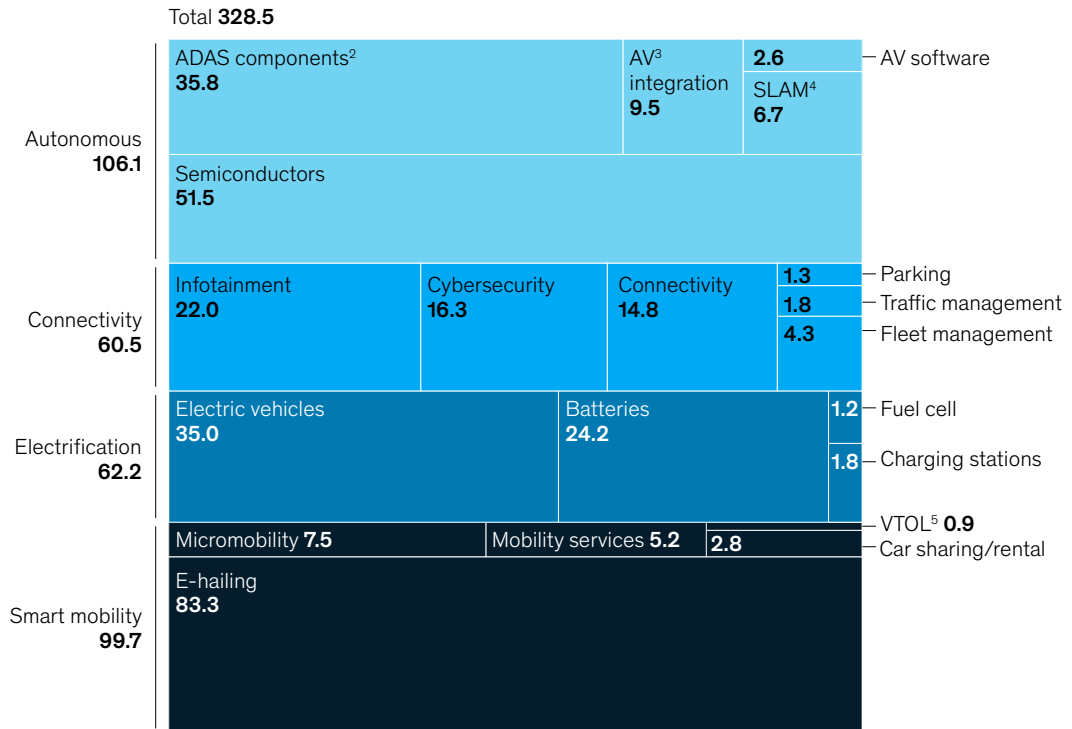
**Large investment deals are significant.** The preponderance of investment in ADAS components, e-hailing services, and semiconductors is mostly a result of large investment deals. (More than 50 percent of total investment in these areas—about \$170 billion—comes from around 1 percent of all transactions.) Investment flattened from 2018 through 2020 largely because investment in ADAS, e-hailing, and semiconductors decelerated.

**Investment is shifting among ACES trends.** In other developments, investment in autonomous driving peaked in 2017 and then dropped significantly (Exhibit 5). Interest has been rising since mid-2019, however. Connectivity investments also peaked in 2017 and then lost traction.

Exhibit 4

**E-hailing, semiconductors, and advanced driver-assistance systems attracted over half of all investments by amount.**

**Total disclosed investment in mobility technologies since 2010 by company cluster,<sup>1</sup>\$ billion**



<sup>1</sup>As of November 2020.

<sup>2</sup>Advanced driver-assistance systems.

<sup>3</sup>Autonomous vehicle.

<sup>4</sup>Simultaneous localization and mapping.

<sup>5</sup>Vertical takeoff and landing.

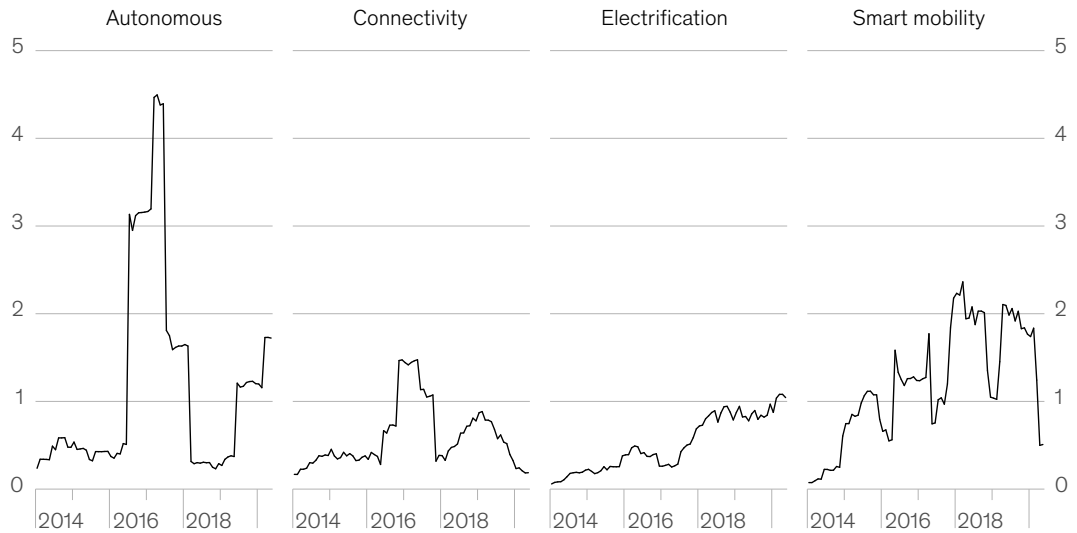
Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan; McKinsey Growth Analytics – Innography

**Setting the right technology focus and having a detailed understanding of the technologies underlying the ACES trends is crucial to securing a strong position across the four ACES areas.**

Exhibit 5

**Investment in electrification has grown steadily since 2017, reaching \$1 billion per month in 2020.**

**12-month rolling average of disclosed investment amount by ACES trend, \$ billion**



Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan

*New avenues are emerging for growth in autonomous vehicles and smart mobility.* While overall investment growth has flattened, some company clusters that had previously attracted relatively little interest have recently gained traction. When looking at investments from 2018 onward, compared with the period from 2014 to 2017, the most dramatic increases have occurred in companies involved with AV integration (a fourfold increase), AV software (threefold), micromobility (fourfold), and car sharing (seven- to eightfold).

In smart mobility, companies outside of e-hailing are increasingly attracting investors. Meanwhile, investment in e-hailing services has slowed slightly, which might suggest that this mobility vertical has reached investor saturation. Investment in shared micromobility and car sharing has risen. The largest investments are going to asset-free-platform

business models, primarily peer-to-peer (P2P) car-sharing platforms that connect private car owners with car-sharing users.

Overall, the mobility market appears ready to enter a new stage of operationalization and commercialization.

### Mapping investment to crucial technologies

We estimated that securing a strong position across all four ACES areas would cost a single player more than \$70 billion through 2030. It is doubtful any individual company could shoulder this level of investment by itself. Setting the right technology focus is crucial and requires a detailed understanding of the technologies underlying the ACES trends.



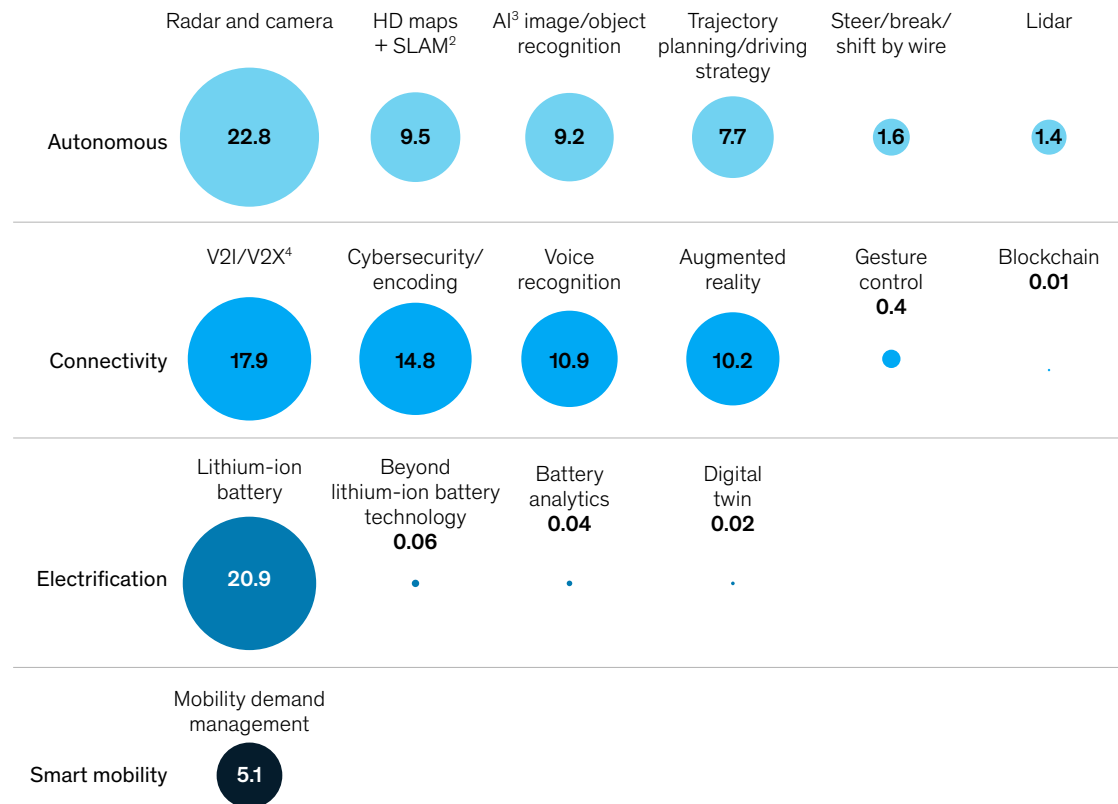
To assist companies, we investigated patent and investment activities by underlying technology—an analysis that goes beyond market trends and company-level specifics. We first examined over 2,000 mobility businesses as outlined before and then mapped nearly 1,000 of them into one of the 20 company clusters we had previously identified. This mapping allowed us to identify 17 specific underlying technologies tied to investment and patent-filing activities. About half of the companies in our sample developed such technologies, with total funding exceeding \$100 billion (Exhibit 6). This amount is nearly a third of the total \$330 billion invested in ACES trends.

According to our analysis, the underlying ACES technologies that attract investment are mostly related to autonomous driving, connectivity, and electrification. For AVs, the main investments focus on radar and camera technologies (about \$23 billion), with about \$1.4 billion going to light detection and ranging (Lidar). In connectivity, vehicle-to-infrastructure and vehicle-to-everything (V2I/V2X) communication solutions attracted approximately \$18 billion in spending. In electrification, \$21 billion went to lithium-ion battery technology. Companies investing in the smart-mobility cluster make limited investments in technology, instead channeling funds to build the future customer base.

Exhibit 6

## Investors have spent over \$100 billion on 17 critical technology clusters in the past decade.

Total disclosed investment in 17 critical technology clusters since 2010,<sup>1</sup>\$ billion



<sup>1</sup>As of November 2020. Some companies are tied to multiple technology clusters.

<sup>2</sup>High-definition + simultaneous localization and mapping.

<sup>3</sup>Artificial intelligence.

<sup>4</sup>Vehicle to infrastructure/vehicle to everything.

Source: Capital IQ; Pitchbook; McKinsey Growth Analytics – Horizon Scan; McKinsey Growth Analytics – Innography



### **Smaller, targeted investments in underlying technologies**

When we looked at investments from a technology angle, rather than a company angle, some differences emerged. For instance, investments in shared-mobility companies tend to be larger, since they often focus on gaining scale and building the customer base. Technology investments may be lower in value because they often go to smaller players with distinctive technologies.

### **Accelerating investments in electrification and some autonomous-driving technologies**

Technologies related to electrification saw the strongest acceleration in investment. This trend may be occurring because many OEMs and suppliers are trying to reach regulatory emissions targets. For autonomous driving, image-recognition technology saw 3.5-fold growth and trajectory planning saw fivefold growth. Other technologies, particularly radar and camera technology, augmented reality, and voice recognition, have experienced a deceleration in investment, resulting in an overall flattening of investment in ACES technologies.

The investment plateau, combined with the increased patent activity across all four technology sectors, could indicate an industry shift toward making technology solutions operational, especially for the more established ones already used in premium vehicles.

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For mobility investors, the COVID-19 crisis has added a new layer of complexity to an already challenging situation. In this time of uncertainty, it is critical for all mobility stakeholders, including incumbents, tech giants, and investors, to understand where the market is moving and why. By analyzing investments in ACES and the underlying technologies, business leaders can identify emerging opportunities. In other words, the best way to understand the industry at this highly volatile moment is simple: follow the investments *and* the technology.

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