

# Mobility Tech

3Q 2019

## Report preview

The full report is available through the PitchBook Platform.





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# Executive summary

Consumer transportation is a massive global industry. In the US alone, households have spent roughly \$1.1 trillion annually for “on-road” transportation services, which includes the purchase, operation and maintenance of personal vehicles.<sup>1</sup> Despite the size and maturity of this market, however, it is rife with inefficiencies. Vehicles are often underutilized while large incumbent auto manufacturers and taxi service providers remain stagnant. This stagnation is reflected in the market capitalizations of the world’s largest auto companies which, for the past decade, have been relatively unchanged and have dramatically underperformed the broader stock market. While automakers have gone a long way in integrating automation technologies to extract more efficiencies from existing processes, these changes have not had a transformational impact on the industry. At the same time, the consistent rise in auto loans underscores the increasing reliance consumers place on their cars even as the average automobile sits parked for 95% or more of its usable life.<sup>2</sup>

The development of the digital economy and mobile connectivity has altered this paradigm, giving rise to new technologies and business models that cater to what we see as strong underlying demand for low-cost, convenient and efficient mobility solutions. We believe this emerging industry of alternative mobility has helped bridge the divide between legacy methods of transportation and emerging methods of digital communication. This industry has given rise to several disruptive products and services including ridesharing and delivery platforms, micromobility scooter and bike services, commercial-scale fleet management tools and emerging autonomous vehicle technology.

As the world becomes increasingly connected, we believe demand for mobility tech—or the intersection of transportation and technology—is higher than ever.

Venture funding has been key to fueling the growth of mobility tech. Since 2009, venture investors have poured \$173.9 billion into mobility technology, with \$26.6 billion invested across 432 deals in 2019 to date. This sustained ability to finance capex-heavy private mobility startups helped fuel the rise of Uber and Lyft, two companies revolutionizing and disrupting traditional methods of consumer—and increasingly commercial—transportation. We believe autonomous vehicles may represent the next phase of disruptive mobility technology, with startups including **Zoox** and **TuSimple** poised to usher in a new era. This report provides an overview of the mobility tech landscape and the products and services of the venture-backed startups in the space.

1: “TET 2018–Chapter 6–Household Spending on Transportation,” Bureau of Transportation Statistics, United States Department of Transportation, n.d.

2: “‘Cars Are Parked 95% of the Time’. Let’s Check!” Reinventing Parking, Paul Barter, February 22, 2013



# Mobility market map

## Autonomous software



### Perception

### Simulation & development tools

### Full stack

### Localization/mapping

## Autonomous hardware



### Radar

### LiDAR

### V2X

### Cameras

## Shared mobility



### Ridesharing

### Smart transit

### Micromobility

### Carsharing

## Transportation logistics



### Freight

### Last-mile delivery

## Electrification



### Electric vehicles

## Fleet management & connectivity



### Connectivity & data management

### Fleet management

### Cybersecurity

### Parking

Companies included are VC-backed, segmented by primary use case and sorted by total capital raised as of September 30, 2019.

SEGMENT DEEP DIVE

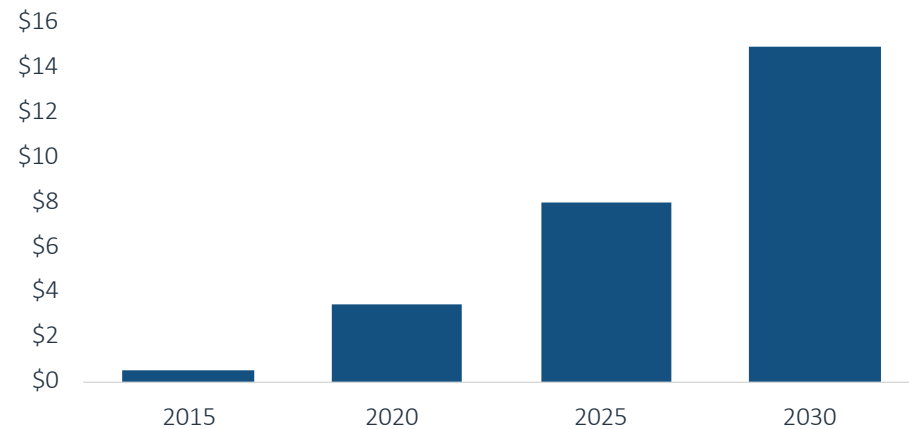
# Autonomous vehicle software

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## AUTONOMOUS VEHICLE SOFTWARE

Figure 5. MARKET SIZE (\$B)



Source: Roland Berger, internal PitchBook estimates | Geography: Global  
 Note: This chart represents global autonomous vehicle software revenue (sales of internal autonomous vehicle software).

## BUSINESS MODEL

Autonomous vehicle software companies provide software and solutions enabling vehicle autonomy. Some providers focus on specific aspects of autonomy such as localization, mapping, perception and simulation, while others focus on building full-stack autonomous solutions.

Companies in this space monetize by licensing software to automakers and automotive suppliers. In the future, full-stack providers could monetize by operating cost-effective ridesharing/delivery platforms or through direct vehicle sales.

## KPIS

- Total miles driven
- Miles per safety critical event
- Simulated miles driven
- Ride quality
- Autonomous fleet size
- Total AV patents

## KEY PROVIDERS



## NOTABLE DEALS

scale

August 2019  
 \$100M Series C

Led by:  
 Founders Fund  
 \$1B post-money  
 valuation



July 2019  
 \$2.6B corporate  
 round

Led by:  
 Volkswagen  
 \$7.3B post-money  
 valuation

## INDUSTRY DRIVERS

- Consumer and enterprise demand for more economic forms of transportation, logistics and delivery
- Large potential market opportunity ripe for monetization
- Regulation concerning accidents, congestion, pollution and other negative externalities associated with passenger vehicles
- Demand among large ridesharing platforms (Uber and Lyft) to reduce driver costs

## KEY INVESTORS



SEGMENT DEEP DIVE

# Ridesharing

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## RIDESHARING

### Overview

Ridesharing consists of hailing a private vehicle or a taxi via a mobile app or platform for a shared or individual ride. The industry began with the launch of Uber in the US 10 years ago and has since expanded into a multibillion-dollar global business. Ridesharing has achieved widespread adoption as it solves the cost and convenience issues of incumbent transportation services. The industry now faces a shift toward platformization and expansion into new auxiliary services.

The relatively lower pricing of ridesharing companies is a result of platforms that serve primarily as a software intermediary between riders and independent drivers with their own vehicles. This allows ridesharing companies to avoid many of the costs associated with employment and vehicle maintenance. Convenience stems from the ability to provide fast, on-demand pickup times, and leading platforms Uber and Lyft have scaled via the benefit of network effects (i.e. more drivers attract more users, which attracts more drivers, etc.). Consumers are also attracted to the price transparency and seamless payment processing of ridesharing services.

As ridesharing matures (the industry is still growing in the 20% to 30% range, annually), leaders such as Uber and Lyft are increasingly expanding into additional services to become MaaS providers. MaaS platforms function as one-stop transportation hubs that provide access to ridesharing, micromobility, public transportation booking and other ancillary services. For example, Lyft now operates the largest bike-sharing service in the US and has a section of its app dedicated to finding public transportation options in select cities. Uber has expanded into food delivery, micromobility and freight brokerage to help drive growth. These non-core services are now growing faster than the companies'

## Ridesharing







## RIDESHARING

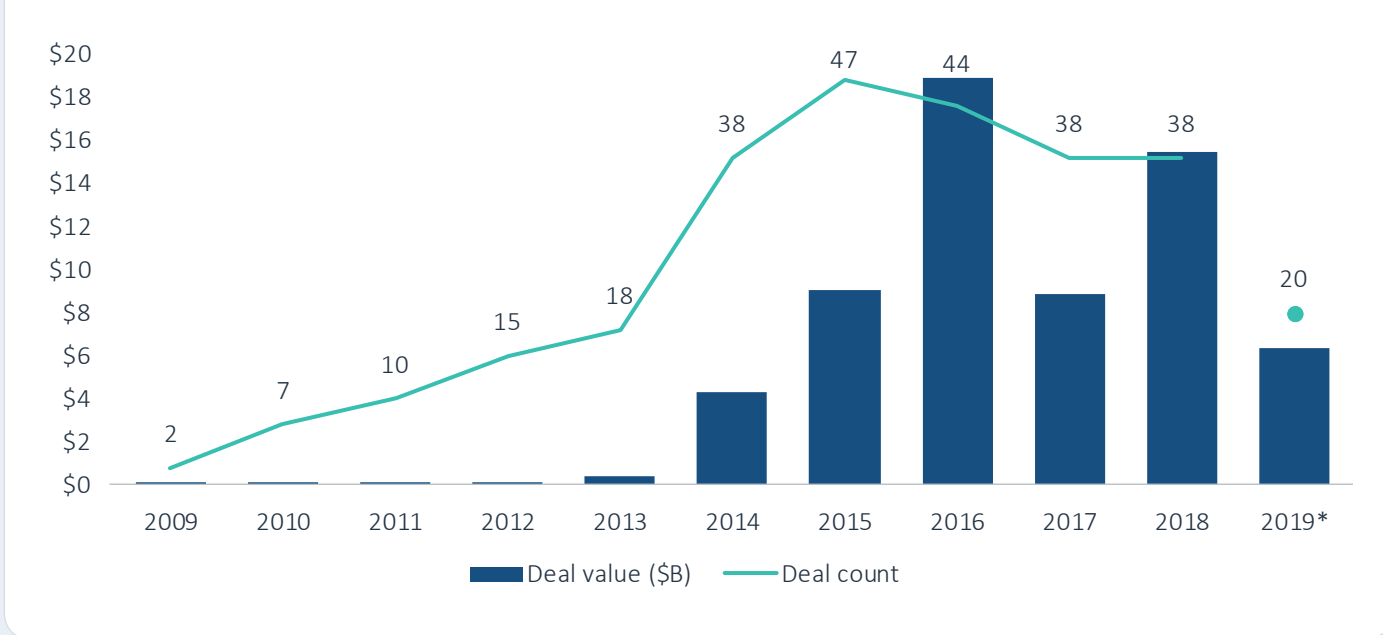
core ridesharing businesses. Another example is **Go-Jek**, which has built a fast-growing ridesharing platform in Indonesia that has integrated many other courier-related services.

We see long-term benefits to a MaaS strategy as it enables companies to expand into new markets where they may have competitive advantages compared to more pure-play or single-service business models. Similar to how Amazon has monetized its user base across several services (i.e. video, grocery, AWS), we believe commuters of the future could rely on a MaaS platform as their primary interface for urban transportation. While the ridesharing industry has expanded quickly, slowing growth, regulation and labor practice scrutiny has us less confident in its outlook. The success of ridesharing, along with the success of many gig-economy business models, has been partially driven by the ability to classify delivery drivers as independent contractors. In September 2019, California passed a law making it more difficult for ridesharing and food delivery companies to classify drivers as independent contractors. New York City and Seattle are passing similar legislation to boost minimum wages for drivers. While the full impact of these rules remains unclear, we expect similar legislation or policies could be enacted in other states as well.

### VC activity

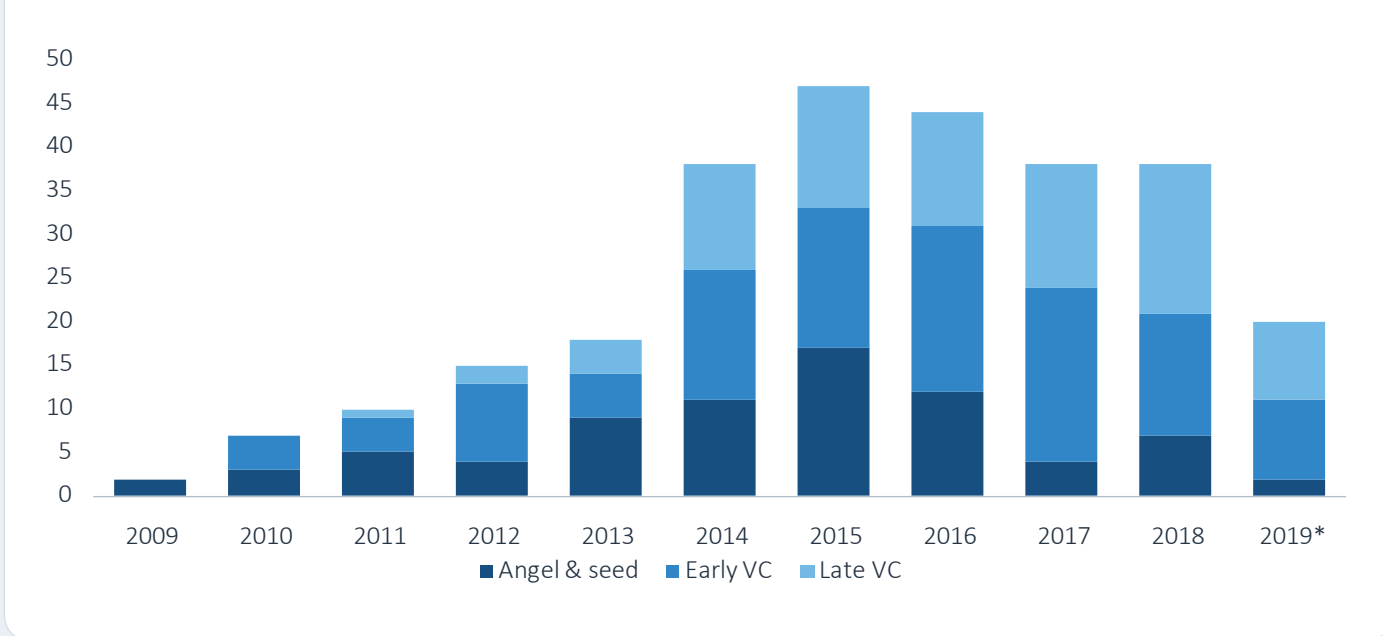
The US ridesharing industry has matured from a VC standpoint with leaders Uber and Lyft exiting the venture ecosystem and debuting on the public markets. Despite tepid performance post-debut, the success of Uber and Lyft getting to market likely serves to validate VC backing of other global ridesharing applications. We expect continued VC investment to focus largely on late-stage ridesharing competitors such as **Grab, Didi Chuxing, Go-Jek** and **BlaBlaCar**.

### Figure 19. VC DEAL ACTIVITY



Source: PitchBook | Geography: Global | \*As of September 30, 2019

### Figure 20. VC DEALS (#) BY STAGE

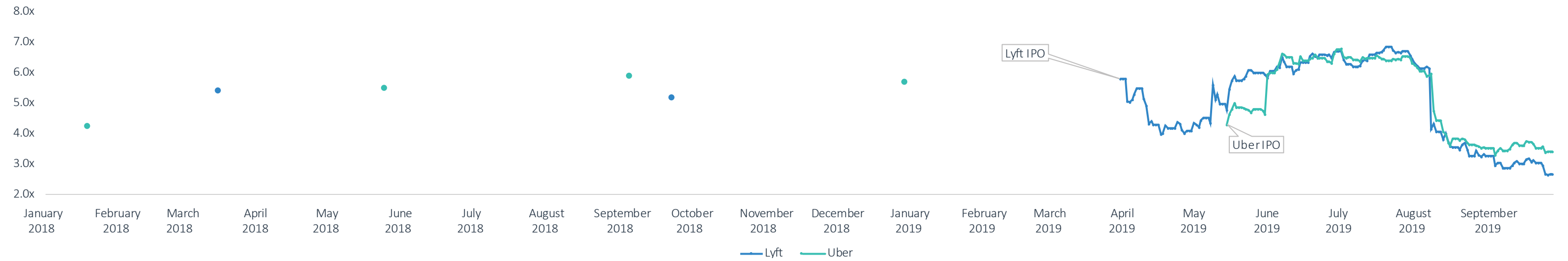


Source: PitchBook | Geography: Global | \*As of September 30, 2019



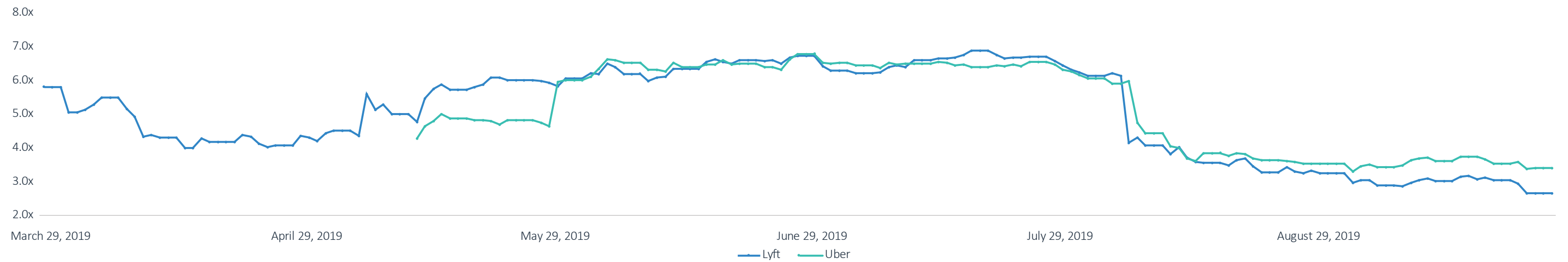
# RIDESHARING

### Figure 22. Uber and Lyft EV/forward revenue before and after IPO



Source: PitchBook, Morningstar data | Geography: Global | \*As of September 30, 2019

### Figure 23. Uber and Lyft EV/forward revenue after IPO



Source: PitchBook, Morningstar data | Geography: Global | \*As of September 30, 2019

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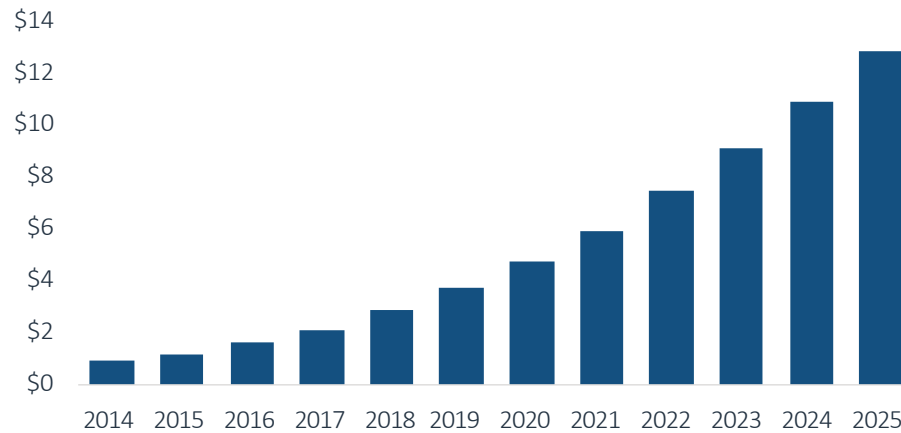
# Micromobility

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# MICROMOBILITY

Figure 24. MARKET SIZE (\$B)



Source: Morningstar, internal PitchBook estimates  
Note: This represents global revenue for micromobility service providers.

## BUSINESS MODEL

Micromobility operators create and operate shared networks of electric bikes, scooters and other light vehicles. These companies monetize by charging rental or subscription fees. Technology enablers such as data analytics platforms and positioning tool providers sell software to network operators, typically on a subscription and/or per-vehicle basis.

## KPIS

- Scooter life (days operational before replacement)
- Rides per day
- Net revenue per ride
- Scooter cost
- Charging cost per ride
- Repair cost per ride
- Payment processing and insurance cost per ride
- Contribution margin %
- Customer acquisition cost (CAC)
- Monthly active users (MAUs)

## KEY PROVIDERS



## NOTABLE DEALS



October 2019  
\$275M Series D

Led by:  
Caisse de depot and  
Sequoia Capital  
\$2.8B post-money  
valuation



July 2019  
\$310M Series D

Led by:  
GV, IVP and  
Andreessen Horowitz  
\$2.4B post-money  
valuation

## INDUSTRY DRIVERS

- Large addressable market opportunity with low penetration of micromobility solutions
- Increased consumer demand for fast, convenient and low-cost last mile urban transportation solutions driven by long-term global expansion of the middle class and population growth in urban centers
- Trend toward bundling among shared mobility providers in a bid to drive stickiness, marking a shift away from pure-play ridesharing applications



## MICROMOBILITY

Figure 28.  
First-generation model for life cycle revenue, costs and profit per electric scooter

REVENUE PER SCOOTER	
Days operational	██████████
Net revenue per ride	██████████
Rides per day	██████████
Revenue per day	██████████
<b>Total revenue per scooter</b>	██████████

OPERATING COSTS	
Scooter cost	██████████
Charging	██████████
Repair	██████████
Payment processing & insurance	██████████
Operations & support	██████████
Municipal fees	██████████
<b>Total costs per scooter</b>	██████████
<b>Contribution profit</b>	██████████
<b>Contribution margin</b>	██████████

Source: Published data from The Information and Quartz, PitchBook estimates

Note: Holds rider utilization and per ride revenue, charging cost and repair cost per ride constant

Figure 29.  
Next-generation model for life cycle revenue, costs and profit per electric scooter

REVENUE PER SCOOTER	
Days operational	██████████
Net revenue per ride	██████████
Rides per day	██████████
Revenue per day	██████████
<b>Total revenue per scooter</b>	██████████

OPERATING COSTS	
Scooter cost	██████████
Charging	██████████
Repair	██████████
Payment processing & insurance	██████████
Operations & support	██████████
Municipal fees	██████████
<b>Total costs per scooter</b>	██████████
<b>Contribution profit</b>	██████████
<b>Contribution margin</b>	██████████

Source: Published data from The Information and Quartz, PitchBook estimates

Note: Holds rider utilization and per ride revenue, charging cost and repair cost per ride constant

Figure 30.  
Improving fundamentals in e-scooter financials (estimated)

PER RIDE REVENUE		
	Mid-2018	Mid-2019
Net revenue	██████████	██████████

PER RIDE COSTS		
	Mid-2018	Mid-2019
Charging	██████████	██████████
Repair	██████████	██████████
Payments & insurance	██████████	██████████
Depreciation	██████████	██████████
Operations & support	██████████	██████████
Municipal fees	██████████	██████████
Charging as % of net revenue	██████████	██████████
Repair as % of net revenue	██████████	██████████
P&I as % of net revenue	██████████	██████████
Depreciation as % of net revenue	██████████	██████████
Ops & support as % of net revenue	██████████	██████████

Source: The Information, Quartz, Bird Rides, internal PitchBook estimates



## MICROMOBILITY

for competitors. Depreciation, reliability and durability of the vehicles are also important considerations for the long-term health of these companies.

### Outlook

**Beneficiary of labor regulation:** We see micromobility as an indirect beneficiary of continued scrutiny on the ridesharing industry. Recent legislation such as California's AB 5 bill, which makes it more difficult for ridesharing and food delivery companies to classify their drivers as independent contractors, could have a broadly negative impact on gig-economy business models. We believe these complex issues could be contributing to the shift in VC funding from ridesharing businesses (i.e. those that connect people to other people providing services) toward fast-growing carsharing and micromobility businesses (i.e. those that connect people to transportation assets such as cars or scooters). As micromobility businesses generally do not rely on other people to provide services, such as drivers or other workers, they are less exposed to the kinds of labor-contract issues currently affecting ridesharing. In addition to scooter companies **Bird** and **Lime**, this includes carsharing providers, such as **Turo** and **Getaround**, which recently announced a \$202 million Series D round valuing the company at \$1.7 billion, double its last valuation in November 2018.

**Ridesharing companies to increase market penetration:** As labor legislation creates headwinds for ridesharing companies and potentially reduces growth and margin potential, pivoting to micromobility services could increase exposure to a high-growth market with more favorable unit economics. According to The Information, Uber and Lyft

planned to invest a combined \$1 billion into micromobility.<sup>24</sup> Although this could have a negative impact on micromobility pricing in the near to midterm (as Uber and Lyft have a history of underpricing to rapidly gain market share), we believe increased investment in micromobility will drive wider adoption of last-mile mobility solutions and generally be favorable for the industry in the long term.

**More focus on Mobility-as-a-Service:** Recent pivots among providers toward micromobility, food delivery, fintech and other services reflect a secular shift away from pure-play, single-service offerings in favor of bundled platform solutions. Having gained scale from ridesharing, companies such as Uber, **Grab**, **Ola** and **Go-Jek** are investing in complementary services to become full-suite Mobility-as-a-Service (MaaS) platforms. Meanwhile, some micromobility companies such as **Lime** are moving upstream into carsharing. We believe offering multiple services creates a source of competitive advantage for mobility companies, allowing them to scale more quickly and maintain user engagement.

**Increased vertical consolidation:** We expect consolidation to continue going forward as larger companies seek to expand their scale and limit competitive pressure. **Bird's** recent acquisition of **Scoot** at a price lower than its last round illustrates the setbacks faced by struggling smaller providers in the space. We see early-stage technology enablers that offer advanced software tools as attractive acquisition targets for large network operators such as **Bird** and **Lime** that are seeking to vertically integrate. We also believe **Bird** and **Lime** could be attractive acquisition targets for larger transportation companies, such as Uber, to gain a leading position in the micromobility market.

24: "Inside Bird's Scooter Economics," The Information, Amir Efrati & Cory Weinberg, October 23, 2018

SEGMENT DEEP DIVE

# Fleet management & connectivity

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## FLEET MANAGEMENT & CONNECTIVITY

### Opportunities

**Advanced fleet management:** We see opportunity in full-service, cloud-hosted fleet management platforms such as **G7** and **Samsara** to provide actionable business intelligence into potential fuel savings, routing and dispatch efficiency gains, improved safety outcomes, asset utilization and seamless document upload. Effective fleet management solutions provide plug-and-play bundled software and hardware that is easy to integrate with existing backend systems and can scale as the customer base grows.

**Driver monitoring & predictive analytics:** We see a large market opportunity in driver monitoring platforms, with a near-term focus on the commercial fleet market relative to consumer applications. The fleet management industry has recently expanded its focus from tracking and vehicle positioning (i.e. fuel and routing efficiency) to driver performance, which is linked to both collisions and inefficiencies. Driver distraction causes approximately 71% of collisions and rapid acceleration,<sup>45</sup> and hard braking can lower fuel economy by 15% to 30% at highway speeds.<sup>46</sup> Camera-based platforms that monitor driver behavior can enable fleet operators to reduce costs associated with collisions and inefficiencies. There are over 100 million commercial vehicles on the road today, and we estimate less than 10% have driver monitoring tools. We see a long runway of growth for driver monitoring providers.

We believe driver monitoring platforms that utilize predictive analytics are best positioned to succeed. These solutions typically pair cameras with a predictive analytics platform to flag problematic behaviors, such as distracted and drowsy driving, speeding and tailgating. Predictive analytics enables fleet operators to provide better driver training, incentivize better driving and potentially avert incidents before they occur.

45: "Commercial Driver Safety Report," Nauto & Atlas Financial Holdings, 2018

46: "How to Maximize Fuel Economy," AAA, n.d.

Figure 58.

### Select predictive commercial driver monitoring platforms

COMPANY	LAST FINANCING DATE	LAST FINANCING SIZE (\$M)	TOTAL RAISED (\$M)	MAIN INVESTORS
<b>SmartDrive Systems</b>	September 13, 2019	\$90.0	\$320.5	Oak, NEA, Wabco, Bridgescale, TPG, Michelin
<b>Nauto</b>	July 19, 2017	\$159.0	\$174.2	Greylock, SoftBank, Playground
<b>NetraDyne</b>	September 24, 2018	\$21.0	\$37.0	M12, Point72 Ventures, Reliance Industries

Source: PitchBook | Geography: Global | \*As of September 30, 2019



SEGMENT DEEP DIVE

# Electrification

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## ELECTRIFICATION

### Considerations

**Complications of fleet electrification:** Without the right technology and products, moving a fleet to electric can be a dauntingly complicated process, and this may slow adoption. The back-end logistics of scheduling and routing vehicles to charge efficiently can be disruptive to daily operations and harm customer experience. We believe that integrated charging solutions (i.e. charging locations, software and other infrastructure) that can share information with existing fleet management software (i.e. routing, dispatch and telematics) represent a key point of differentiation, as this enables fleet operators to monitor fleets in real-time and power delivery based on business conditions. Moreover, as charging stations are often located within parking garages or parking lots, their ability to connect with a structure's electric grid can help optimize energy consumption. As this emerging industry develops, we believe fleet managers will increasingly seek full turnkey-managed charging services that can help them navigate the complications of developing and implementing charging infrastructure. We think companies such as **ChargePoint** and **AMPLY Power** that offer these bundled, integrated solutions are well positioned to benefit from fleet electrification.

**High capital intensity and thin margins:** Developing and manufacturing electric vehicles is a capital-intensive business model with thin margins even at scale. For example, Tesla reportedly came close to bankruptcy while ramping up production of the Model 3. Electric vehicle maker **Faraday Future**—which has yet to produce a product—has also reportedly faced significant financial and management problems this year, having received a \$225 million bridge loan in April and support from a local government in Inner Mongolia. These

companies' difficulties reflect challenges hindering success in the automotive industry, which is stacked with well-funded, entrenched incumbents.

**Scrutiny from investors in an increasingly competitive space:** Cracks in the electric vehicle story have emerged in the form of potentially diminished demand from consumers, especially in China. Data released earlier this year shows that sales of electric vehicles have moderated significantly from strong growth rates seen last year.<sup>52</sup> Electric vehicle manufacturers such as Tesla and Nio have stumbled when it comes to hitting delivery targets and have suffered issues such as car fires, leading to sharp declines in their share prices.

**Funding availability:** So far this year, startups developing electric vehicles have raised just \$2.3 billion in venture investment, well below the \$10.9 billion raised last year. We believe this shortfall may reflect growing skepticism of early-stage companies in the industry and more caution among investors.<sup>53</sup> It is particularly pronounced in China, where government subsidies promoting electrification have recently been limited and qualification requirements have become stricter. Venture investment in China-based electric vehicle companies totaled \$1.6 billion in the first two quarters of 2019, putting the full year on pace to fall short of the previous year's peak of \$7.6 billion.

**China cutting subsidies:** According to Chinese government data, approximately 330 electric vehicle companies are registered for subsidies. However, China is moving toward reducing subsidies and raising qualification standards.<sup>54</sup> Electric vehicles with ranges under 155 miles have been disqualified, and many vehicles meeting this requirement will see their subsidies cut by as much as 60%. This is part of a broader effort by the Chinese government to focus

52: "A Year Ago, China's Electric Vehicle Sales Grew 126%. Now They're at 2%" Quartz, Echo Huang, June 12, 2019

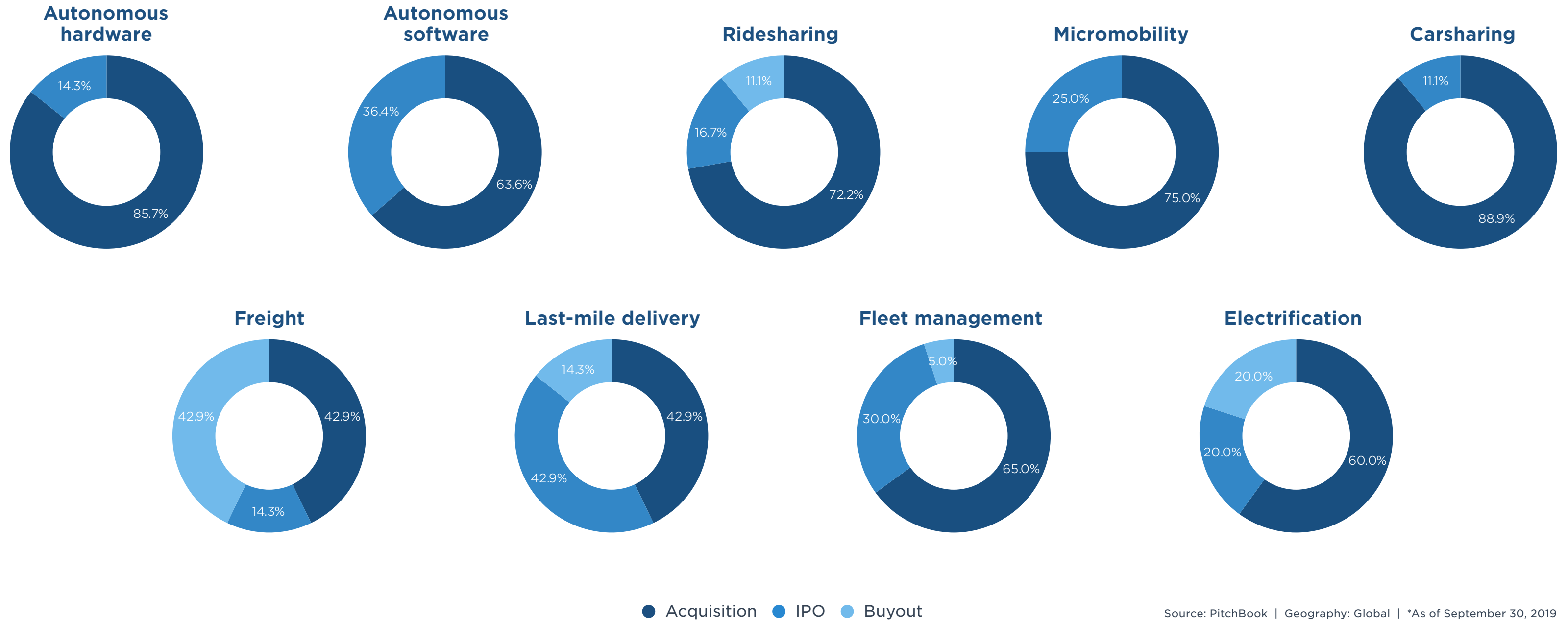
53: "Electric Dreams in Danger as Funding Dwindles for China's Tesla challengers," Reuters Business News, Kane Wu, Yilei Sun, and Julie Zhu, June 18, 2019

54: Ibid.



## SUPPLEMENTAL MATERIALS

Figure 82.  
Mobility tech VC exits (#) by type (2009-3Q 2019)



Source: PitchBook | Geography: Global | \*As of September 30, 2019

# About PitchBook Emerging Tech Research

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As the private markets continue to grow in complexity and competition, it's essential for investors to understand the industries, sectors and companies driving the asset class.

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