



NextGen Mobility

The Revolution is Just Getting Underway

Technological innovation is accelerating the pace of disruption in the multi-trillion dollar global mobility industry.

This revolution in global mobility is being driven by: 1) a confluence of environmental, socio-cultural, economic, and policy related pressures, 2) changes in consumer behavior, and 3) rapid technological advances in areas as diverse as material sciences, big data / AI analytics and digital connectivity. Emerging business models and products in the areas of mobility-as-a-service, electrification, connectivity, and autonomy are together revolutionizing mass transportation in much the same way as the introduction of the internal combustion engine ("ICE") or commercial air travel did in the 20th century. By 2030, more than USD 12 trillion in enterprise value is expected to be created by companies that emerge as leaders in nextgen mobility. Notably, this value creation is already underway, with multi-billion dollar investor returns from companies such as Uber, Didi, and Mobileye. This transition is only expected to accelerate over the next decade.

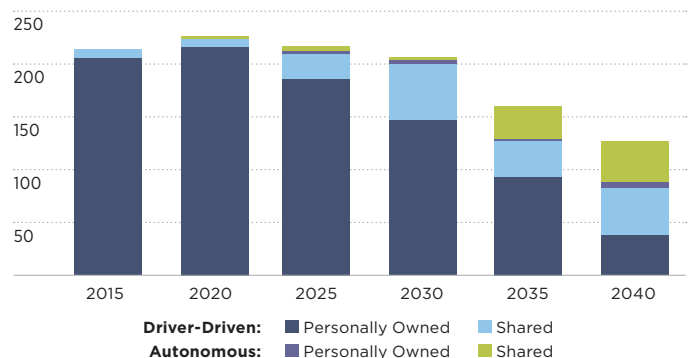
Largest Disruptive Opportunity in Decades

The global revolution in mobility is the largest disruptive economic opportunity to emerge in decades. Of the estimated USD 8-10 trillion global annual spend on the transport of people and goods, about 25% comes from what is generally considered the global automotive industry. Other critical areas of the global mobility value chain, such as aftermarket sales and service, fuel and energy, and financial services such as insurance and financing, each account for at least 10% of the global annual spend on mobility. Hence, the range of companies facing disruption include

auto OEMs, suppliers, dealers, auto insurers, energy companies, and logistics providers. In fact, 40 of the Fortune Global Top 100 companies are linked to the mobility sector, whether as auto or energy companies, or tech companies with interests in next generation mobility technology or tech-enabled services.¹ And 8 of the top 10 companies in the world today are either automotive or energy companies.

Even in a sector such as insurance, which is not generally thought of as a mobility-related sector, the rise of nextgen mobility business models such as ridesharing over owner-operated vehicles, micro-mobility solutions for last mile transportation and logistics, and autonomous driving could lead to a decline of as much as 80% in traditional auto insurance premiums by 2040.² New insurance models will almost certainly need to be developed for pay-as-you-go mobility and autonomous vehicles, for example.

Insurance Premiums Projected Disruption (PREMIUM NEEDS, USD BN)



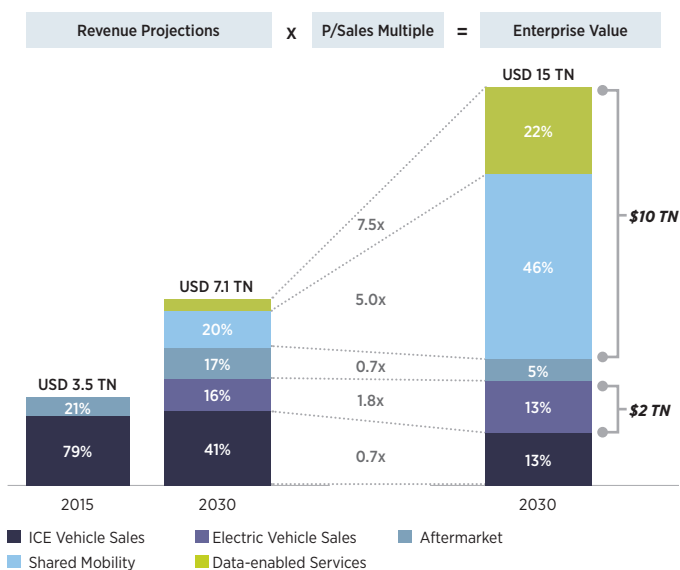
New and Shifting Business Models Creating Value

New revenue streams and profit pools are emerging as trends in mobility expand the auto industry's boundaries and new markets, products or services become the driver of profitability across the mobility industry's value chain.

The automotive industry itself is expected to double its global annual revenue from 2015 to 2030. However, the source of these revenues will undergo a dramatic transformation. The share attributable to new vehicle sales is expected to decline from almost 80% to less than 60% of total industry-wide revenue. While this decline nevertheless implies growth in absolute revenue, from USD 2.75 trillion in 2015 to USD 4 trillion in 2030, almost the entire growth in unit sales will come from emerging markets. In addition, electric vehicles ("EVs") are expected to constitute almost 30% of annual new vehicle sales by 2030, up from a very small level in 2015. These sales will represent a far higher percentage of the USD 4 trillion in projected market value of auto OEMs by then. In short, today's dominant auto industry business model, dominated by the sale of ICE driven vehicles across the developed markets of the US, Europe and Japan, has already peaked.³

Even more significant is the emergence of revenue streams from new business models such as ride sharing, micromobility, autonomous vehicles, and data connectivity, which will collectively represent more than a quarter of the industry's revenues by 2030.⁴ More importantly, revenue from shared mobility and data-related services will be recurring revenue from the total stock of vehicles on the road, as opposed to one-time revenue from vehicle sales or aftermarket parts and services. This change has already led to, and will likely sustain, vastly different market valuations for businesses across these industry segments. On an EV / Revenue basis, traditional automakers are currently valued at ~1x, and providers of automotive aftermarket services are typically valued at approximately 0.7x. However, shared mobility service providers are valued above 5x, and data services providers are typically valued at 5-10x. Applying these indicative valuation multiples to the respective segment revenues implies that shared mobility and data services may collectively represent more than 2/3rds of the automotive industry's market value by 2030, while only accounting for a quarter of the revenue. On an absolute basis, this creates the potential for more than USD 10 trillion in enterprise value to be created over the next decade.

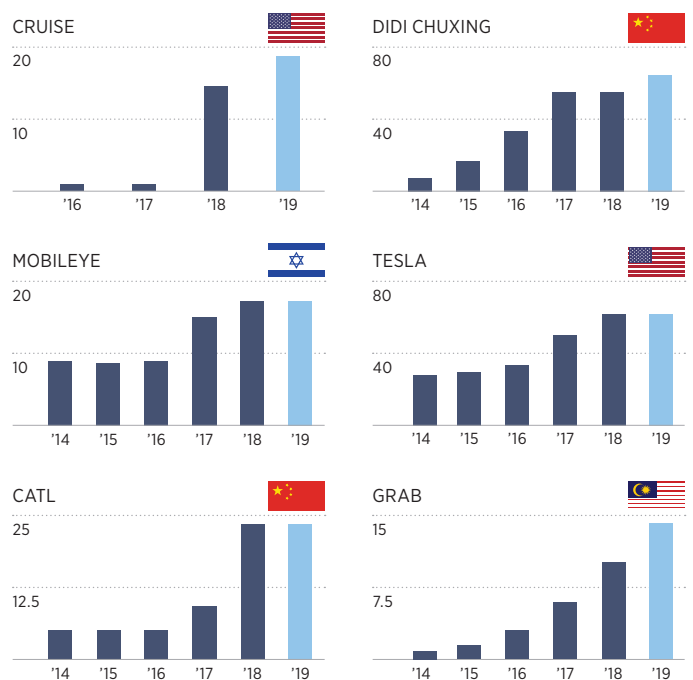
Nextgen Mobility to Create USD 12 Trillion in Value



Financial Investors Benefitting from Early Successes

Investors have taken note of the scale of the investment opportunity in nextgen mobility and have invested more than USD 220 billion in over 1,100 companies since 2010. Traditional automakers have only accounted for 10% of this investment activity, whereas capital markets pools such as venture capital, private equity, and IPOs represent approximately 50% of capital invested. The reason for this difference is that many of the themes within nextgen mobility, such as data analytics, sensors and software for connectivity, and infotainment / e-commerce targeted at vehicle occupants, are areas where financial investors have greater experience and skillsets to identify and support disruptive technologies and trends. In response, global automakers are increasing their focus and investment across all elements of nextgen mobility and represent an attractive eventual exit opportunity for financial investors, as they will be large investors or acquirers of more proven venture-backed companies in the sector.⁵ As the following exhibit highlights, while the mobility revolution is still young, there are already numerous examples of multi-billion dollar businesses being created over a relatively short period,⁶ with returns of 5-50x for early investors.

The Growth of Mobility Companies (USD BN)

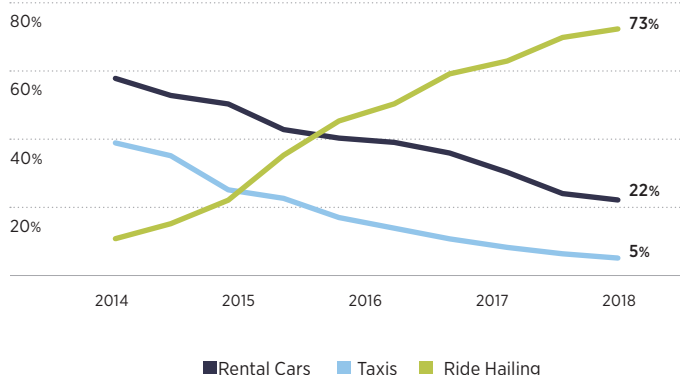


THE FOUR MAJOR INVESTMENT THEMES IN NEXTGEN MOBILITY

1. Mobility-as-a-Service

Shared mobility, or ride sharing, has seen the fastest growth and greatest value creation to date within the mobility value chain. With more than 650 million global users, ride sharing has rapidly eclipsed traditional forms of comparable shared transportation such as taxis and rental cars.⁷ The rise of shared mobility has the potential to significantly disrupt the private vehicle ownership and insurance markets, while giving rise to new opportunities in micro-mobility and pay-as-you-go business models. Ride sharing platforms such as Uber, Lyft, and Didi currently dominate

Ride Sharing Eclipses Traditional Transportation



this segment, but new business models continue to emerge, such as subscription based platforms, sharing models for logistics providers, battery swapping, and other online marketplaces.

While shared mobility models have to date primarily focused on providing single mode, point-to-point transportation services, the segment is already evolving towards a multi-modal, frictionless, mobility-as-a-service (MaaS). A single digital MaaS platform can provide end-to-end trip planning, booking, ticketing, and payment services across multiple modes of transportation, both public and private. Ford Motor Co. estimates that mobility services could grow to a USD 10 trillion annual business, with profit margins double the 10% operating margins for automakers in their peak cycle years.

2. Autonomous Driving

The autonomous driving evolution has been underway for more than a decade, with technologies such as adaptive cruise control, lane departure warnings, assisted braking, etc. gradually being introduced as standalone driver aids in new vehicles in recent years. As the following exhibit indicates, these aids represent elements of Level 1 or 2 driving autonomy, with specific driving functions no longer requiring drivers to use their feet or hands for certain functions. Fully autonomous driving is a natural evolution of this trend, as automakers integrate assisted driving features into an integrated, “always-on,” primary operational mode for vehicles, with Level 5 driverless vehicles the long-term target. This evolution towards autonomous driving is creating investment opportunities in critical technology, hardware, and software, including chips, LIDAR, and big data / AI applications. Business model innovations that are expected to emanate from the move towards autonomous driving include robotaxis, and the increasing shift of delivery business models away from humans towards driverless deliveries.

Much of the early commercialization of autonomous vehicles has been targeted at closed circuit systems for specific B2B applications in which the surrounding environment is less dynamic, vehicles move at low speeds, and goods rather than people are transported. There are, however, numerous pilot programs in the US and China where companies are testing autonomous vehicles for use on public roads for B2C applications. [Pony.ai](#), a Chinese autonomous vehicle startup, announced the first autonomous ride-sharing fleet offering public rides in China. It is currently valued at nearly USD 1 billion and has raised over USD 100 million from several major VCs in China, including IDG Capital, Sequoia Capital, DCM Venture, Morningside Venture Capital, Legend Capital, and NIO Capital. The company also has autonomous driving testing permits in California.

The 5 Levels of Driving Automation

		Definition	Example
DRIVING AUTOMATION	5 Full Automation 	Not designed for human intervention	Full autopilot
	4 Mind Off 	Human intervention not required, but available	Autopilot under standard on-road conditions only
	3 Eyes Off 	Steering AND speed concurrently	Adaptive braking or cruise control + steering / lane keep assist
DRIVER AIDS	2 Hands Off 	Steering OR speed at a time	Emergency braking, lane change assist
	1 Feet Off 	Any single driver aid	Cruise control

3. Connectivity & Data

Most new vehicles sold today are already “connected,” in the sense that data is continuously being pushed or pulled for navigational, entertainment, and diagnostic services. The pace of acceptance of connected cars has risen rapidly, and virtually all new cars sold by 2020 will be connected to the internet.⁸ The rise of 5G wireless networks, IoT technologies and the associated cybersecurity, software, communication technology, data analytics and consumer content, both entertainment and e-commerce, is expected to be a USD 273 billion potential revenue opportunity by 2026.

Connectivity and data is essential not only for the safe and efficient operation of autonomous vehicles, but also for the provision and monetization of smart mobility services and the broader commercial / entertainment offerings that are expected to become available to consumers once they no longer have to focus on controlling and operating their vehicles. Venture capital and technology investors have natural advantages over auto OEMs or Tier 1 suppliers in assessing and rolling out critical components of such services, including content, communication, payments / billing, social media, and digital advertising. Consequently, it is highly likely that connectivity and data plays will be a major opportunity for venture investors seeking to participate in nextgen mobility.

[Best Mile](#) is the world's first cloud platform for the operation and management of autonomous and driven vehicle fleets for both fixed-route (e.g., scheduled public bus services) and on-demand (e.g., ride-hailing) services. The platform offers features such as fleet and resource management, mobility service operations and optimization, business back office support, and data intelligence. Best Mile works with transportation network operators, public transit agencies, and private communities and campuses for closed-loop transportation services. The Swiss / US headquartered company was founded in 2014 and has raised -USD 16.5 million in VC funding from the likes of Partech Ventures, MobilityFund and Airbus Ventures.

In the UN's 2030 Agenda for Sustainable Development, sustainable transport is directly and indirectly connected to several Sustainable Development Goals ("SDGs") and targets, including those related to health, energy, economic growth, infrastructure, and cities and human settlements. Transport drives development, links people, connects local communities to the world, builds markets and facilitates trade. In turn, sustainable transport drives sustainable development, fundamental to meeting the needs of people in their personal and economic lives, while respecting the ability of future generations to meet their needs.



<https://sustainabledevelopment.un.org/sdgs>

4. Electric Vehicles

The hardware transition in the automobile world is just getting underway. Electric vehicles represent less than 2% of total auto sales today,⁹ but are expected to rapidly gain market share and represent 28% of light vehicle sales by 2030. By 2040, electric vehicles are expected to represent a majority, at 55%, of new passenger vehicle sales, by which time they will account for 33% of the then operating global fleet of passenger vehicles¹⁰. The transition towards electrification of mobility will give rise to businesses focused on batteries, including the development of battery technology, and applications such as battery swapping models, and EV components. In addition, significant businesses will be created that focus on the enabling infrastructure and services required for the operation of electric vehicles, including charging stations and other hub infrastructure.

Norway is the most notable country in electric vehicle adoption, with EVs representing over a third of new vehicles sold in 2018. However, the five leading countries in the world in EV penetration rates collectively account for only 0.5% of the global population. For electric vehicles to truly break out in user adoption and sales volumes, the larger economies in the world, primarily the US and China, need to ramp up their EV adoption rates. A major challenge to greater EV adoption in the US is the fragmented landscape in terms of emissions regulations, and incentives and subsidies provided to EV manufacturers and customers, respectively. China is probably the most advanced among the major global markets

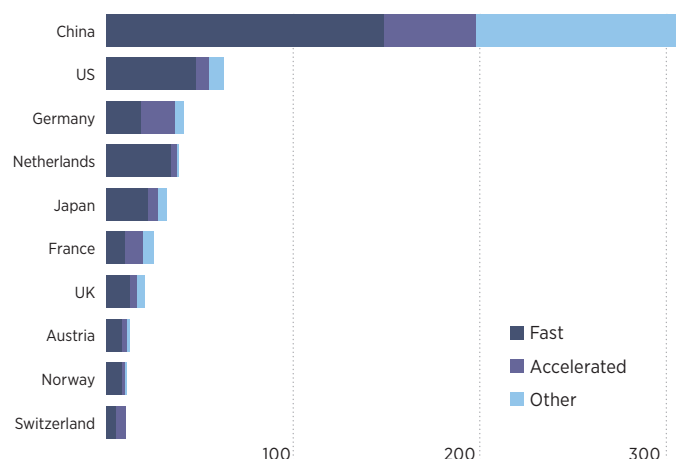
in creating a regulatory framework that incentivizes automakers and consumers to adopt electric vehicles. As the preceding exhibit highlights, China possesses not only the largest electric vehicle charging network in the world by far, but also the most efficient in charging speeds.

Much of the innovation in the electric mobility space globally is also originating from China, including the development of innovative business models leveraging existing technologies. *Immotor* is a Chinese venture-backed company that has launched an innovative, subscription based, battery-as-a-service business model for operators of battery electric two-wheel scooters and mopeds. Subscribers obtain access to batteries through automated battery exchange kiosks that operate like a vending machine for subscribers to exchange their depleted batteries for new ones. At the same time, enterprise customers can access cloud-based data and analytics, which provide valuable information on asset utilization and customer metrics. The company operates over 500 battery swapping / charging stations across 16 cities in China.

Conclusion

We stand at the cusp of a mobility revolution, with tremendous value already created by early investors in the space. Given the centrality of mobility to global commerce, the opportunity set is expected to grow dramatically over the next decade, particularly in emerging markets, where there is less legacy infrastructure to be disrupted, and where the rapid pace of urbanization and increasing population density in key markets limit the viability of traditional forms of mobility. With more than USD 12 trillion in enterprise value expected to be created by 2030, nextgen mobility represents the next great frontier of investing in global innovation.

China Leads in Number of Charging Stations (Source: Bloomberg)



SOURCES: 1 Fortune 2018. 2 Deloitte University Press. 3 OCIA. 4 McKinsey & Co. 5 McKinsey & Co., "Reserve a Seat - The Future of Mobility is Arriving Early". 6 CB Insights, Morgan Stanley, via Forbes; public data. 7 Certify, via Bloomberg. Data counts the number of transactions per category, not the total spent. 8 PwC, "The 2017 Strategy & Digital Report", September 2017. 9 BIS Research. 10 Bloomberg New Energy Finance 2018.

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