GLOBAL INSIGHTS • APRIL 2017

Future of the vehicle

Winners and losers: from cars and cameras to chips

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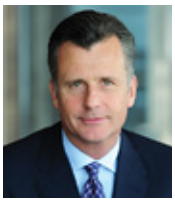

Philipp Hildebrand
BlackRock Vice Chairman

The world's automotive industry faces challenges of tougher regulation, shifting consumer demand and technological disruption. We see two big changes happening in parallel: first, the spread of advanced driver assistance systems (ADAS) potentially paving the way for the proliferation of self-driving vehicles; second, the rise of electric vehicles (EVs). Drawing on the insights of BlackRock's investment professionals, we explain the key stages of this evolution and discuss implications for automotive industry players, newcomers and other industries.

Our bottom line: we believe investors need to be selective as the race to the future of vehicles will create a significant dispersion between winners and losers.

Summary

We see rapid adoption of advanced digital safety features causing significant industry disruption in the coming five years, even though we do not expect to see fully autonomous vehicles widely adopted any time soon. We see the EV share of total vehicle sales ramping up gradually as costs fall and charging infrastructure improves, but do not see this trend starting to shake up the industry until beyond 2020. Overall, we expect the path of travel to have a cumulative, rather than sudden, impact.

We see semiconductor and software providers as primary beneficiaries of the rising digital content in vehicles, although automakers and part suppliers are working aggressively to catch up. Adapting to rapid technological changes while keeping prices competitive poses major challenges for both the traditional vehicle industry and technology sector newcomers.

Today's luxury value-added features are likely to become tomorrow's commodities. We believe investors may benefit from examining the supply chains of the industries related to both the production and use of vehicles. Lastly, we detail how the evolution of vehicles will have profound implications on industries well beyond vehicles and technology, including real estate and financial services.

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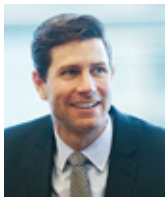

LEFT TO RIGHT

Hannah Gray – Natural Resources team, BlackRock Fundamental Active Equity

Tony Kim – Global Technology team, BlackRock Fundamental Active Equity

Charlie Lilford – Natural Resources team, BlackRock Fundamental Active Equity

Ewen Cameron Watt – Senior Adviser, BlackRock

Andrew Wright – Basic Value team, BlackRock Fundamental Active Equity

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Introduction

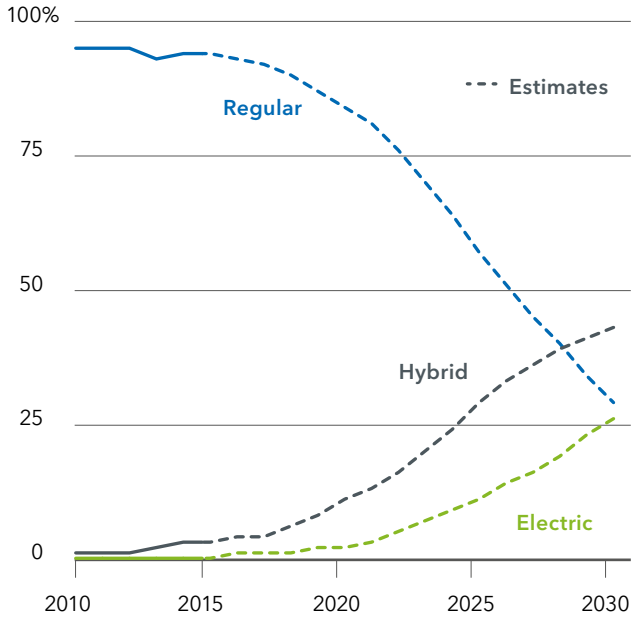
The global automotive industry stands at the forefront of technological change and regulatory risk. We expect profound changes to ripple across vehicle-related companies in the coming years – and see broad implications for other industries.

Technological disruption and climate-related regulation are leading to big changes in the automotive industry. We see ADAS features such as automatic emergency braking being installed in more vehicles. This is mostly driven by sound economics: falling prices and popularity of such features among consumers, governments and insurers. The eventual result is likely fully autonomous, or self-driving, vehicles. Yet some ADAS features are here today, and we see a significant near-term investment impact.

A parallel evolution is happening in the power train – from internal combustion engines to electric engines. We believe this transition is key to curbing greenhouse gas emissions. The global transport sector accounts for nearly half of the projected rise in global energy-related carbon dioxide emissions through 2030, the International Energy Agency (IEA) said in a 2015 ***report***.

Under the hood

Breakdown of global car sales by engine type, 2010-2030



Sources: BlackRock Investment Institute and LMC Automotive, April 2017.
Notes: regular refers to internal combustion engine while electric indicates battery electric engines. Figures after 2015 are estimates.

We think technological change is one of the four forces behind asset owner risk from climate change – the other three being physical risk, regulation and societal change, as concluded in our September 2016 report, ***Adapting portfolios to climate change***. Here we focus primarily on technological change, which has near-term implications. We define risk not as volatility – but as large and possibly permanent impairment of capital.

Technological advances are making hybrids (using some fuel) and battery EVs (battery only) more cost competitive. Estimates of mass adoption vary, but our analysis of industry trends points to growing shares of both in global vehicle sales, with combined hybrid and battery EV sales potentially set to exceed those of conventional vehicles in about a decade. See the *Under the hood* chart. China, aiming at growing its EV fleet to combat pollution, could account for up to 40% of the hybrids and battery EVs sold annually by 2030, our analysis suggests. We see the EV share of the global fleet rising more slowly, and view the next 12 to 24 months as crucial for adoption, as lower-priced models start to address the mass market.

The vehicle industry is capital-intensive, with long lead times in adapting to new technologies – it takes several years to develop a new car. Yet the accelerating pace of innovation poses challenges to traditional ways. Companies able to offer new features quickly at the same or lower prices can put severe pressure on competitors. Changes in the automotive industry will also ripple through basic materials, energy, utilities, real estate, infrastructure and financial services, we believe.

Bottom line: we see the deflationary nature of technological innovation playing out in the vehicle industry. Lower prices will redistribute the profit pool, creating as many winners as losers. We think investors need to stay away from companies with increasing credit and equity risk.

The future of driving

We see vehicles evolving on two parallel tracks: first, advanced driver assistance systems (ADAS) and the move toward autonomous driving; second, the adoption of EVs.

ADAS will be as essential to future drivers as seat belts are to today's. ADAS functions include blind spot monitoring, collision warnings and traffic jam autopilot. The spread of ADAS technology could pave the way eventually for autonomous vehicles – cars that can drive themselves. We see the evolution following that tracked by seat belts, air bags and anti-lock braking systems in past decades: ADAS features will move from being options in high-end cars to standard features, likely costing just a few hundred dollars – thus crimping assemblers' profits.

We illustrate rough estimates of when disruption from ADAS-autonomous technologies may hit in the *Adapting to autonomous* chart. We think of these milestones as potential tipping points for pricing and competitive dynamics, rather than forecasts for product rollout. For example, we see the impact of adaptive speed control already in force. Limited self-driving, which allows drivers to hand over full control to the car in certain situations, will likely gain in popularity through the 2020s. The final phase of ADAS – autonomous driving – is set to start rapid diffusion from the late 2020s, provided legal, ethical and other concerns can be overcome (who is liable if a self-driven car hits a pedestrian, for example).

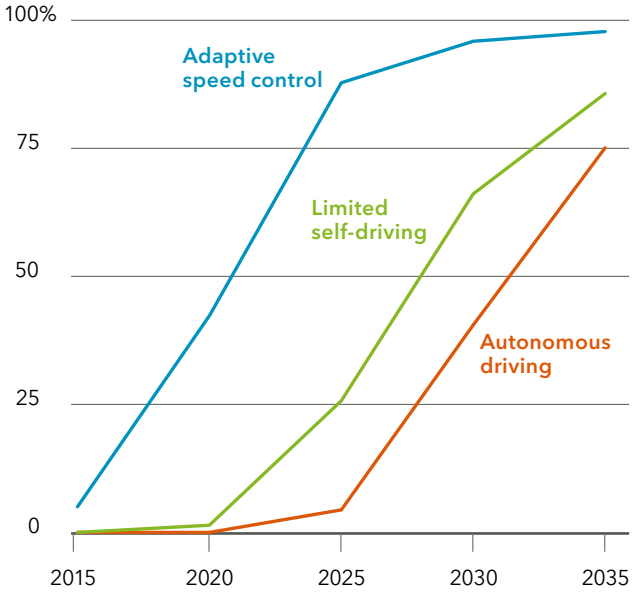
Regulations are a key driver for innovation on power train technologies. Take emission standards. The 2016 Paris Agreement on climate change aims to limit the global average temperature rise to below 2 degrees Celsius from pre-industrial levels. Global transport, which has seen faster emission growth than other sectors, needs to contribute one-fifth of the total reduction of greenhouse gas emissions from energy use in 2050 in order to help achieve the goal, the ***IEA*** says. Tightening emission standards pushed fuel economy of new cars globally up by 2% per year from 2005 to 2013, said the ***Global Fuel Economy Initiative.*** Aggressive fuel economy standards and fiscal incentives can deliver more fuel economy improvements, the initiative also said.

The new US administration looks likely to relax fuel economy rules, raising questions about the direction of US regulation. Yet we do not expect any regulatory changes to affect the shift toward EVs and autonomous vehicles significantly. Many US states such as California would likely fight to maintain tougher rules. The rest of the world appears set to tighten fuel economy standards further. And most importantly, the trends we detail are primarily driven by innovation, declining costs and safety concerns.

Diesel engines are under siege – and this could be an impetus for EVs. Air pollution in some European cities has prompted diesel vehicles bans. Car-makers are facing growing regulatory scrutiny after scandals over cheating on diesel engine emission tests. Without diesel, it may be difficult for automakers in Europe to hit fuel economy standards, raising incentives for them to speed up development of EVs and charging stations.

Adapting to autonomous

Estimated adoption rates by feature, 2015-2035



Sources: BlackRock Investment Institute and Navigant Research, April 2017.
Notes: adaptive speed control is an extension of cruise control, with the added feature of automatically adapting to local speed limits and environmental conditions. Limited self-driving capacity allows the driver to let the vehicle operate autonomously in certain situations, while still remaining available to regain control when needed. Autonomous driving means a driver is not needed at any stage, and the vehicle can be controlled remotely.

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Driver error

Safety is a critical catalyst in the evolution of vehicles. We believe the development and adoption of ADAS may help avoid and minimise the impact of accidents and improve road safety – just as existing safety features such as seat belts and air bags have done.

Deaths from traffic accidents have greatly fallen over the past two decades in most developed economies, as the *Safety first* chart shows. Yet it's worth noting that traffic fatalities have edged up lately in the richest countries. The US recorded in 2016 a second consecutive year of increases in traffic deaths due to a combination of factors including drivers distracted by smartphones. This demonstrates the importance of enhancing safe-driving technologies. Humans are hardly reliable operators of vehicles, it turns out. Driver error is the cause of 94% of vehicle crashes in the US, a 2015 report from the ***US Department of Transportation*** said.

Adoption of safety features has a long way to go elsewhere. About 90% of the world's traffic deaths occur in low – and middle-income nations, which were home to 54% of the world's registered vehicles as of October 2015, said the ***World Health Organization*** (WHO). Road deaths and injuries cost these countries up to 5% of gross domestic product (GDP) annually. Globally, road deaths and injuries eat up 3% of annual GDP, the organization also said.

Insurers have an incentive to push for faster ADAS adoption: they are anxious to reduce the cost tied to vehicle-related claims. In the US alone, the dollar amount of claims per vehicle per year has been rising, according to the ***Insurance Information Institute***.

Some insurers are already offering discounts on premiums for cars with certain ADAS features, such as automatic emergency braking. We expect more insurers to follow suit, as ADAS features improve further and demonstrate their ability to prevent collisions – and ultimately, reduce insurance claims.

We have high confidence that ADAS will cause a lot of disruption over the next five years. Yet we see a longer and more uncertain timeline for the adoption of autonomous vehicles – the ultimate goal of ADAS development.

Tomorrow's commodities

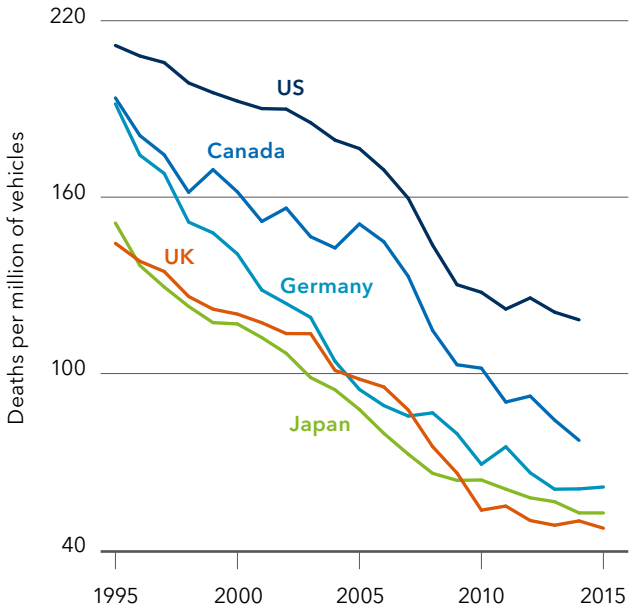
Vehicles of the future will be equipped with an array of cameras, radar and other data-collecting and analysing tools. Together, they will be able to warn about jaywalkers, wake up drowsy drivers and help with parallel parking. Regulators in the US, Japan, Europe and China are mandating many of these features. Rear-view cameras, for example, will be required in all US new cars from 2018.

Such mandatory requirements are leading to more rapid adoption and putting downward pressure on ADAS equipment prices. Automatic emergency braking costs at least hundreds of dollars as an option, but will become a standard feature on new vehicles in the US by 2022. There are dramatic price cuts. Take LIDAR (Light Detection and Ranging). It uses lasers to measure distance and is a favoured choice as the eye of self-driving cars. It used to cost more than $70,000 per unit, but now companies are developing models for just hundreds of dollars.

We caution that as ADAS features trickle down from the luxury to the mass market, there is a risk that the equipment and services will become commoditised in the future. What kind of suppliers could succeed in the long run? See **p. 9-10** for details.

Safety first

Deaths caused by road accidents, 1995-2015



Sources: BlackRock Investment Institute and the OECD, April 2017. Note: the lines indicate the rate of fatalities within 30 days of traffic accidents, with suicides excluded.

Share a ride

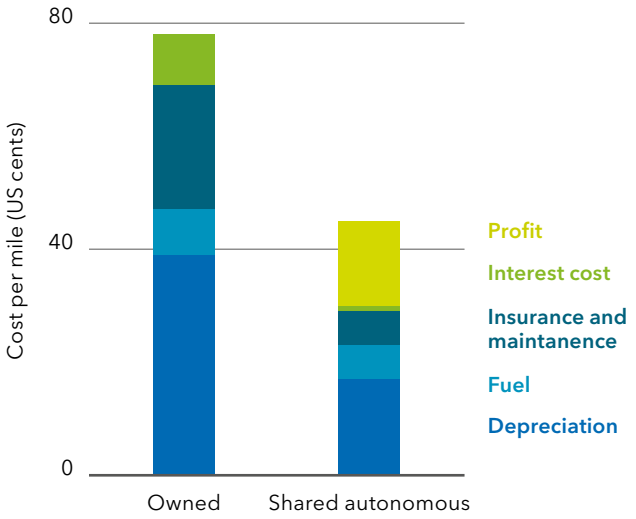
We see the growing popularity of ride-sharing contributing to the adoption of autonomous vehicles. The cost per mile of hiring a shared autonomous ride could be 40% cheaper than that of driving one's own car, our analysis shows. The higher utilisation rate of shared vehicles lowers depreciation, insurance and maintenance costs per mile. See the *Owned vs. shared* chart.

Ride-sharing has swept across cities around the world in recent years. In Asia alone, car-sharing and ride-on-demand have attracted more than $5 billion of funding in 2015, up from virtually nothing two years earlier, UBS data show. Car ownership is becoming more expensive, inefficient and less appealing for urban millennials.

Greater urbanisation and population greying could drive demand for a shared autonomous fleet, but challenges abound, such as consumer anxiety about safety and the need for highly accurate maps. A major hurdle is ethical. Would a self-driving car put pedestrians at risk to avoid a collision? There are job consequences, too. Autonomous vehicles could make taxi and truck drivers obsolete.

Owned vs. shared

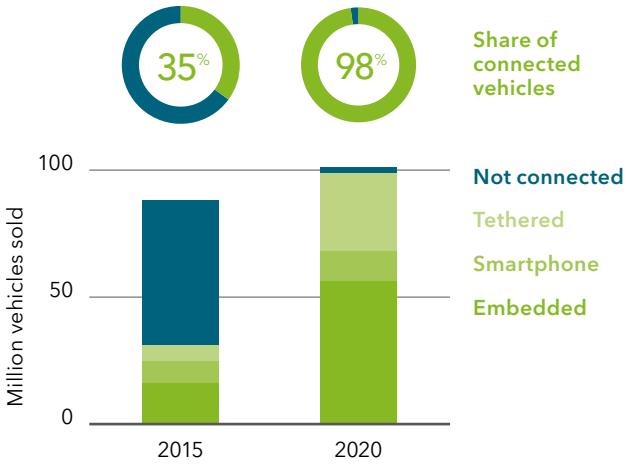
Vehicle cost per mile



Sources: BlackRock Investment Institute, American International Group, American Automobile Association, US Department of Energy and RBC Capital Markets, April 2017. Notes: the chart compares the cost of driving one's own car with that of hiring a hypothetical shared autonomous vehicle. Both scenarios assume a $33,000 gasoline-powered internal combustion engine vehicle, with an additional $5,000 cost for the autonomous vehicle . Costs under the owned scenario are based on US national averages. The shared autonomous scenario assumes the vehicle would travel an average 70,000 miles a year (vs. 11,000 miles in an owned vehicle), have an average life of 200,000 miles (vs. 400,000 miles of a New York City taxi) and offer an average fuel economy of 35 miles per gallon (vs. 25 MPG for an owned vehicle). Profit is that of the fleet owner.

Closer connection

New vehicle connectivity estimates, 2015-2020



Sources: BlackRock Investment Institute, IHS, SBD, GSMA and Accenture calculation, April 2017. Notes: connected vehicle technology enables wireless communications between vehicles and passengers' personal communication devices, and between vehicles and the infrastructure. Embedded connectivity means that a vehicle has built-in network connectivity capacities and applications. Tethered connectivity means that a vehicle could come with a digital interface and applications but relies on an external device, such as a cell phone, to get on the Internet. Smartphone integration means that the vehicle relies on a smartphone for services and applications.

Connection matters

The timeline for mass adoption of self-driving cars is uncertain. Yet this doesn't exclude some near-term impact on the automotive industry, we believe.

Many enhanced safety features rely on connectivity – vehicles need to communicate with each other and the traffic infrastructure to carry out certain safety functions. Connectivity enables the streaming of navigation and traffic information, music and video and other functions such as monitoring EV battery usage. It also brings the threat of car hacking – we see rising demand for specialised vehicle cybersecurity solutions.

About 35% of vehicles sold in 2015 already had some connectivity capacity, as shown in the *Closer connection* chart. By 2020, almost all vehicles should. We expect most of this connectivity to come from embedded software and networking capability in the car, with the rest through integration with the user's smartphone or 'tethering' to other networking devices. See the *Closer connection* chart.

The US Department of Transportation has proposed a ***rule*** facilitating vehicle-to-vehicle communication on all new light-duty vehicles to help improve road safety.

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Charge up the car

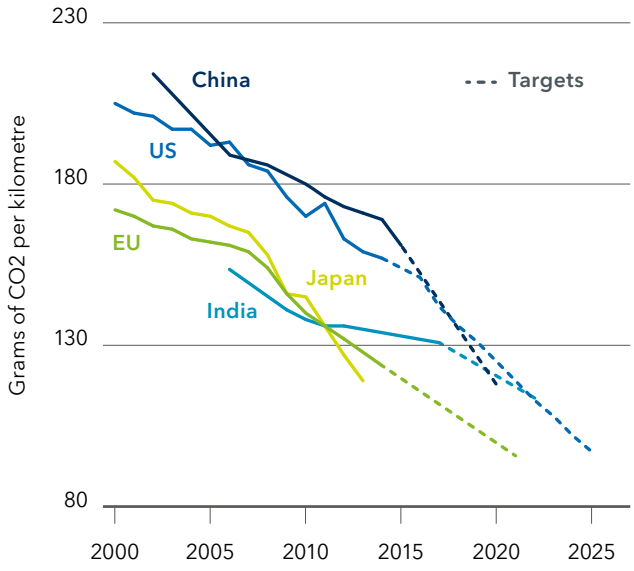
Tightening emission standards around the world provide an incentive for electrification of the global vehicle fleet. Chinese cars, for example, are expected to generate 45% less emissions by 2020 than they did in 2002. See the *What's my CO_2 allowance* chart.

Hybrids and EVs will both be part of the solution. We do not think EVs are needed to meet today's emission standards. Yet they will be essential in the next decade – along with hybrids. Producers of internal combustion engine vehicles have come under increasing pressure. They need to find innovative solutions – and potentially spend more – to reach fuel economy targets, because the easiest and cheapest measures have already been taken.

High prices and 'range anxiety' have crimped EV sales so far. EVs are often thousands of dollars more expensive than similarly sized gasoline-powered cars, and their driving ranges are much shorter due to limited battery life. Charging stations are only sparsely located in most of the world. We see hybrids, which offer fuel savings and the full range of combustion engines, as an essential interim solution before battery EVs can lower prices and extend ranges.

What's my CO_2 allowance?

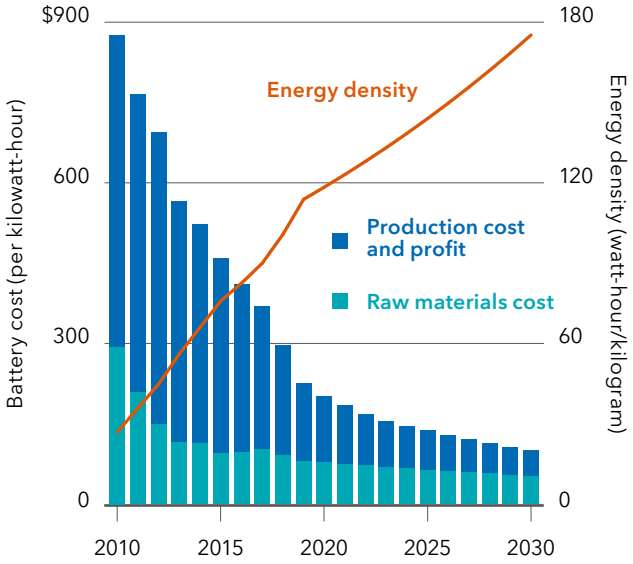
Vehicle emission standards for selected countries



Sources: BlackRock Investment Institute and the International Council on Clean Transportation, April 2017. Notes: the chart compares the actual and targeted carbon dioxide emission standards for passenger vehicles in the world's largest vehicle markets. The emission standard is shown in grams per kilometre travelled. The dashed lines refer to future targets. Japan had met its 2020 target (122 gram/kilometre) as of 2013, so there is no dotted line for Japan past 2013.

Battery breakdown

Cost and energy density of vehicle batteries, 2010-2030



Sources: BlackRock Investment Institute and Exane BNP Paribas, April 2017. Notes: battery cost is shown in US dollars per kilowatt-hour. Energy density refers to the amount of energy that can be stored for a given weight or volume and is shown in watt-hour per kilogram. Values before 2016 are based on Exane BNP Paribas data, and values from 2016 are its estimates.

All eyes on batteries

Cheaper, higher-capacity batteries and the development of public charging stations will be key to making EVs more appealing. Current forecasts point to battery costs declining an additional 73% by 2030. Energy density – the amount of energy that can be stored in a given sized battery – is expected to nearly double over the same period. See the *Battery breakdown* chart.

One potential concern is the pricing and availability of raw materials. Cobalt – a key ingredient in the dominant lithium-ion battery – could face a supply crunch. We estimate that cobalt's current global reserves could be exhausted by 2030 if the EV market share rises to 12.5% from under 1% today. Some mining companies are already planning to ramp up their cobalt production, expecting a demand surge. The price of cobalt has doubled in the past 12 months in anticipation, Thomson Reuters data show. EVs' growth also may eventually eat into oil demand, but the uncertain time-line of large-scale adoption makes that threat less imminent, we believe. See **p. 11** for details. The additional electricity demand for EVs could help offset overcapacity and falling demand faced by utilities in developed markets, while in emerging markets EV growth could complement the rapid growth of renewable energy.

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Investment implications

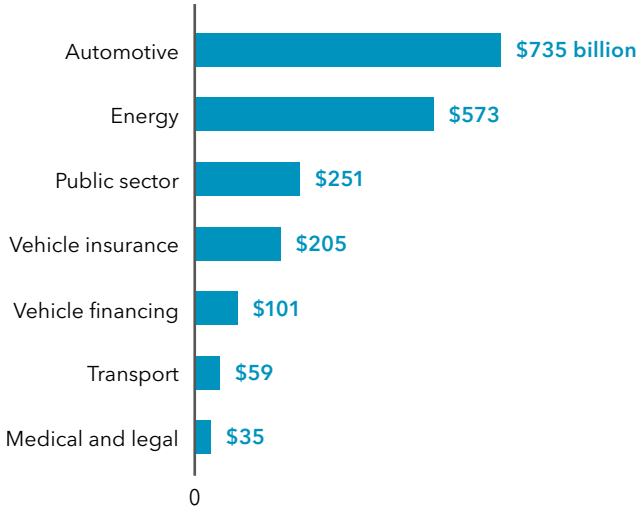
The implications of the future vehicle go far beyond the automotive and technology industries. Energy, raw materials, real estate and finance will all be affected.

Transport is central to modern life. In the US alone, the energy sector derived more than half a trillion dollars per year from selling fuel in 2014. Governments draw revenue from vehicle and fuel sales taxes and parking fees. Auto insurance and financing are big businesses in their own right. See the *Cars and beyond* chart.

At the epicentre of the sweeping impacts are traditional automakers and part suppliers. The technology industry's aggressive pursuit of automotive hardware, software and services has forced them on the defensive. Car-makers and suppliers are locked in a race against each other and against the disruptors. We don't believe they are destined for demise, even though tech companies may appear to have gained an advantage in early competition on electrification and automation. The key is how traditional automotive companies can adapt to new technologies, while keeping prices competitive.

Cars and beyond

US vehicle-related revenue by industry, 2014



Sources: BlackRock Investment Institute and Deloitte, April 2017. Notes: this is the most recent available data. The bars represent annual revenue in billions of US dollars for major vehicle-related sectors. Automotive includes sales of vehicles, service and parts. Energy refers to oil companies and service stations. Public sector refers to fuel and vehicle sale taxes, licensing and parking fees, public transit fares, and traffic and parking fines. Transport refers to cost of rental vehicles, taxis, limos and private parking garages. Medical and legal refers to fees related to traffic accidents.

Investors need to consider that the implications of evolving automotive technologies will likely be far-reaching and in constant flux, we believe.

One industry's gain could be another's loss. Growth in the EV fleet may put pressure on the supply of nickel and cobalt and support copper demand. It could also depress the demand for platinum group metals that are used to produce emission-reducing catalytic converters.

The implications could change over time even within one industry. Take insurance. More ADAS adoption and improving road safety could initially benefit vehicle insurers, potentially lowering losses while premiums remain fairly stable. Later on, reduced collisions would likely erode premiums. More sophisticated on-board systems could expand the role of commercial insurance as vehicles control an increasing number of functions. A switch to ride-sharing may eventually create a big enough risk pool for car-makers or fleet owners to self-insure. This would erode the market share of personal insurers, we believe.

We could also see rising funding needs for shared fleets, just as demand for individual vehicle loans decreases. If the number of autonomous cars were to reach 25 million in the US, or 10% of the country's fleet, $1.75 trillion of financing would be needed as of July 2016, investment banking advisory firm Evercore ISI estimates. This is a big number in the context of total outstanding vehicle loans at $1.2 trillion in the fourth quarter of 2016, according to ***Federal Reserve*** data.

The adoption of ADAS will likely weigh on the already declining residual value of the existing vehicle fleet, we believe. Rapid adoption of new safety features would cause the value of existing used cars to fall. It could also threaten the economics of leasing – a highly leveraged business and one of the drivers behind record US car sales in recent years. Nearly one-third of new vehicles registered were on lease as of early 2016, industry consultant ***IHS*** said.

Car-makers under siege

Nearly all major automakers have announced EV plans for the next few years, under the pressure of stricter emission standards and competition from impressive product rollouts by non-traditional car-makers.

New technologies don't come cheap, and current automotive industry players aren't as cash-rich as their tech industry peers in general. That is because their profit margins are typically much slimmer. See the *Where the money is* chart. Automakers face the challenge of how much to invest in EVs right now. If EV sales disappoint, they will lose money. But if they wait to see the demand evolve, they risk being left behind.

EVs will require more spending on research and development because they are different from combustion engine vehicles. They are more expensive to build, mainly due to pricey batteries, even as the rest of the EV power train costs less than the combustion engine power train. Battery prices have fallen, but still make up 30-50% of the cost of materials in today's EV models, our analysis shows. This puts luxury car-makers in a better place to pursue EVs, because their generally higher profit margins allow them to absorb the extra cost and have better pricing flexibility than their mass-market peers.

Automation will pose other challenges to car-makers. An automated shared fleet would mean a higher utilisation rate and potentially a smaller fleet. An average car in the US is parked 95% of the time, Donald Shoup, a professor of urban planning at the University of California, Los Angeles, wrote in his book *The High Cost of Free Parking*. If passengers start to treat cars like a public utility, the brand value that car-makers have taken decades to build up is at risk of being lost.

Automakers are lagging behind technology companies in areas such as software and artificial intelligence, which sit at the core of the future vehicle. Car-makers are luring talent in these fields, as well as partnering with and acquiring technology companies in an effort to catch up. Technology firms are also looking to add new specialised capacities. We expect the arms race to heat up, and see those with healthy balance sheets and the ability to pick the right technologies to pursue gaining an upper hand.

A new army of suppliers

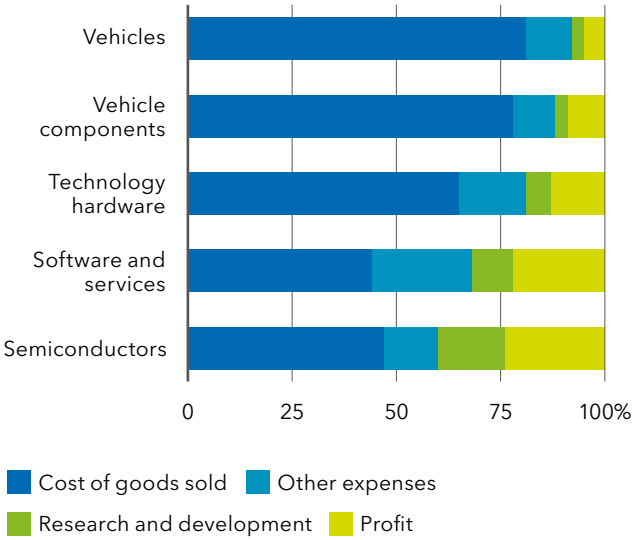
Traditional vehicle part suppliers also face a threat to their existence. Can they defend the turf against newcomers from the technology industry?

ADAS adoption grows the market for both existing and new suppliers. But EVs could quickly change the market dynamic, as they have fewer parts than internal combustion engine peers, and many of the parts are different. We expect suppliers of parts exclusive to the internal combustion engine power train and lead acid batteries to be at risk. Those without strong exposure to advanced safety, automation or electrification trends will likely face an army of unfamiliar competitors from the technology industry. Some suppliers may be taken over by tech companies aiming to gain access to car-makers.

The relationship between car-makers and suppliers is changing. Car-makers have historically led most innovations and contracted suppliers to produce the parts they need. Suppliers in the future could compete with, or even outpace, car-makers in innovation. The economics of distribution chains may change too as EV use rises. Fewer parts per vehicle reduce the need for servicing – and for mechanics to repair cars.

Where the money is

Profit and cost breakdown of selected industries, 2016



Sources: BlackRock Investment Institute, MSCI and Bloomberg, April 2017.
Notes: vehicles and vehicle components companies are constituents of the MSCI ACWI Automobiles and components Index (USD). Technology hardware, software and services, and semiconductor companies are constituents of the MSCI World Information Technology Index (USD). The aggregate is based on latest available full-year data. Profit is based on earnings before interest and taxes.

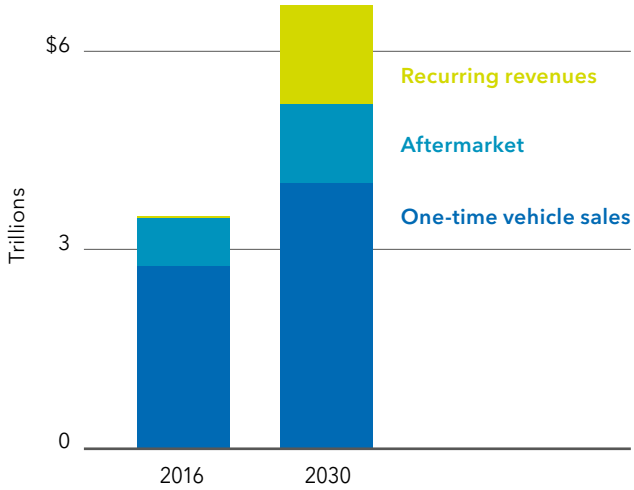
Smartphone on wheels

The technology industry pictures the future car as a giant smartphone on wheels. It is ready to cash in on the growing electric content in a vehicle, as well as new services including data connectivity and software upgrades. Meanwhile, one-off vehicle sales are set to make up a declining share of vehicle revenue in the decades to come. Recurring revenue from mobility services such as entertainment and navigation are expected to make up over a fifth of automotive revenues by 2030, compared with virtually nothing today. See the *New revenue* chart.

We see the vehicle semiconductor industry – armed with significant intellectual property (IP) and better pricing power after recent consolidation – as a big beneficiary and attractive investment opportunity. ADAS and autonomous driving need powerful chips. The average semiconductor content in an EV doubles that of a combustion engine vehicle, according to Bernstein. Software could also be lucrative. Tech conglomerates are gearing up to produce the equivalent of a smartphone operating system for vehicles. Wireless internet service providers will be another beneficiary. Automakers and suppliers are taking the challenge head-on by ramping up their technology capabilities, and some already have competitive products.

New revenue

Automotive revenue sources, 2016 vs. 2030



Sources: BlackRock Investment Institute and McKinsey, April 2017.
Notes: the analysis is based on McKinsey's 'high-disruption' scenario – electric vehicles are meeting with high demand due to stricter emission regulation and rapidly declining battery prices; autonomous driving is widely accepted with regulatory and technological hurdles overcome; there is a significant shift from private car ownership to shared mobility; and the vast majority of cars globally are connected while consumers are willing to pay for content in cars. New services include shared mobility, data connectivity services and software upgrades. After-market refers to maintenance spending.

Own the part

We think that the future vehicle industry could look similar to today's smartphone industry, in which most assemblers make no money and suppliers owning critical parts do. We already see some technology companies' interest in becoming car assemblers fading over time. We see semiconductors and software as the critical parts in vehicles of the future, and to a lesser degree, sensors.

The investment value in the long run will accrue to the categories with the most differentiation and intellectual property, we believe, as the rest of the vehicle becomes lower-margin and more commoditised. Batteries make up a chunk of EV cost today, but potential commoditisation puts their investment value in question. The average profit margin of battery makers is just 5%, our analysis of the latest fiscal year data shows. China's domestic battery suppliers could be an exception, since they benefit from the protected nature of their home market. China has also set a goal for 5 million EVs on the road by 2020, versus 1 million today. Chinese battery makers have global ambitions, yet we caution that history suggests industries reliant on government directives and subsidies for growth can be subject to boom-and-bust dynamics.

Asia is already the global centre of battery development. We believe the region's technology manufacturing industry will expand into the vehicle part supply market as electric content grows in vehicles. We see the ADAS market likely growing at least 20% a year through 2025, creating plenty of business for manufacturers of camera lenses, sensors and other items. Elsewhere in the world, several companies have built huge battery storage factories in the US, and Israel, which has no native vehicle industry, houses many start-ups working on automation technologies.

Chasing the latest technologies is challenging. Producers of sensors will need to invest heavily to bring down prices and maintain any early-mover advantage. Today's dominant players in various technologies may not always maintain their positions in a growing market. They could become targets of mergers and acquisitions. Buyers will be seeking leading technologies and products, while sellers may find it advantageous cosying up to a big brother in the increasingly capital-intensive industry.

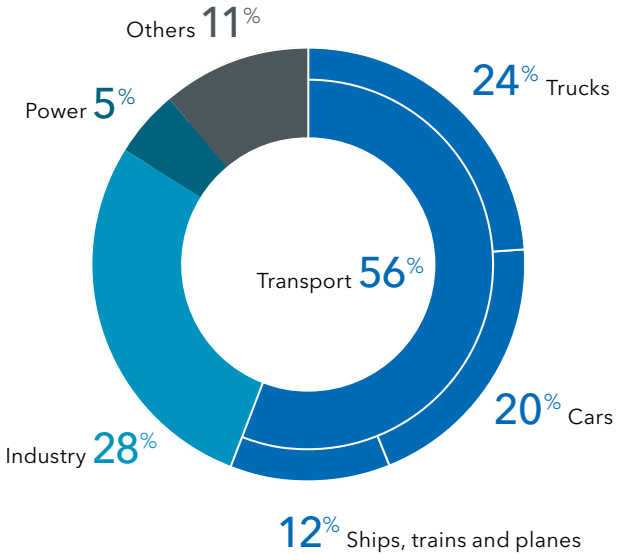
Peak oil

We don't expect EVs to have a meaningful impact on oil consumption in the next few years, but we do see this happening in the long run. If 25 million EVs were on the road, that would displace about 800,000 barrels of oil a day, or 2.5% of 2016 global gasoline demand, our analysis shows. In comparison, today the global EV fleet stands at less than two million. High costs and a lack of infrastructure are likely to impede EVs in many developing nations, a group expected to take up a larger share of global oil demand in the near future. We see passenger cars (mostly run on gasoline) as by far the most viable and predictable market for EVs to penetrate, while trucks may depend on the more powerful diesel for the time being.

Forecasts for peak global oil demand vary from 2020 to 2040. We think oil demand could peak around 2030, but see a possibility that it could arrive sooner due to faster-than-expected declines in battery costs. The global transport sector guzzles up more than half of oil demand, with a big chunk used by trucks and cars. See the *Oil guzzler* chart. The potential long-term impact from EVs on oil demand is one of the several factors leading oil companies to shy away from high-cost, long-lived reserves. Today, low-cost shale oil and price volatility are more serious threats.

Oil guzzler

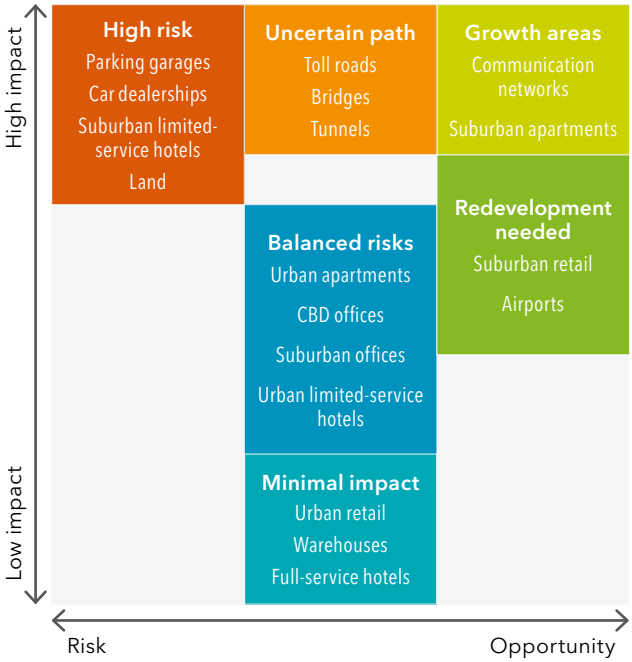
Global petroleum demand by use, 2015



Sources: BlackRock Investment Institute and BP, April 2017. Notes: this is the most recent available data. Demand is measured in million barrels per day. Trucks include sport utility vehicles (SUVs), and cars include motorbikes and other light duty vehicles. Other includes building use such as heating and non-combusted use such as feedstock for petrochemicals.

Under robocars' rule

Autonomous vehicles' impact on real estate industry



Source: BlackRock Investment Institute, April 2017.
Notes: the chart shows the degree of impact of autonomous vehicles on sectors within the real estate industry, and where these sectors could be on the spectrum of potential opportunity. The chart is based on BlackRock views and is for illustrative purposes only. This does not constitute any investment advice. There is no guarantee that any forecasts made will come to pass.

Land of cars

We see shared autonomous vehicles potentially having a profound impact on the real estate industry, as shown in the *Under robocars' rule* chart. Parking lots cover more than one-third of the land area in some cities, Eran Ben-Joseph, head of the Department of Urban Studies and Planning at the Massachusetts Institute of Technology, wrote in his 2012 book *ReThinking a Lot*. Shared autonomous vehicles could reduce the demand for parking due to their higher utilisation, dealing a potential blow to parking garages, we believe.

Reduced parking demand could lower the value of available land, but might lead to redevelopment opportunities. We think investors seeking existing properties should look for well-located assets with parking space that has potential for conversion. Self-driving vehicles could even spur the re-emergence of suburbs as people may tolerate longer but more comfortable commutes. They could also bring stiff competition to short-haul flights, but be welcomed by trucking companies for cutting labour costs and boosting fleet utilisation.

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