UBS

Longer Term Investments

Smart mobility

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- Smart mobility is set for takeoff. Regulatory changes and technological advances will lead to greater electrification of cars, autonomous driving, and new car- sharing mobility concepts. This will reshape the way we experience and consume individual mobility.
- We estimate that by 2025, the annual addressable market of our theme will be around USD 400 billion, or 10 times today's size.
- We see opportunities in electronics and electric components related to electrification and autonomous driving, while car-sharing concepts are best approached via private equity at this stage.

Our view

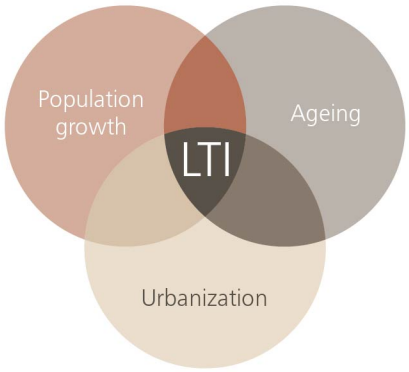
Smart mobility has just started, and we define it as a combination of smart powertrains (electrification), smart technology (autonomous driving) and smart use (car- sharing/car- hailing). Urbanization will be its main driver, with aging also a supportive factor. Sustainable investment aspects like safety, better fuel efficiency and lower emissions play nicely into our theme.

Over the next decade, we expect smart mobility to grow substantially, revolutionizing not only the automobile industry but also the way vehicles are "consumed." Costly technology will be deployed, and traditional auto companies and auto suppliers should either participate or risk being replaced, at least partially, by new entrants from the tech industry. More favorable regulation pushing alternative powertrains and new smart use/mobility concepts should help as well. Fast technological progress and a change in consumer behavior, in which using an asset will be more important than owning it, enable our smart mobility theme.

We believe smart mobility offers substantial business opportunities for years to come. We estimate that by 2025, the annual addressable market of our theme will be around USD 400 billion, or 10 times today's size. Our theme focuses on electronics and electric components related to electrification and autonomous driving as the near- term drivers. Car- sharing concepts including fleet management should also increase in importance over time. However, only the broad- based application of robotaxis beyond 2025 will ensure 100% of revenues end up in their hands.

Introduction to the Longer Term Investments (LTI) series

- **The Longer Term Investments (LTI)** series contains thematic investment ideas based on long term structural developments.
- Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



The combination of more favorable regulation, falling costs, and technological advances make smart mobility attractive for investors with a long-term focus, as the theme is cyclical in nature. Given that we are just at the beginning of this structural change, it is not yet fully recognized by the market.

Smart mobility drivers

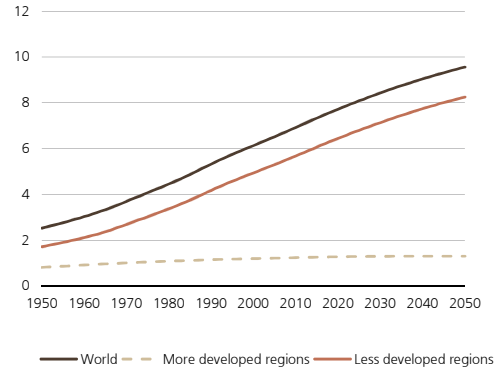
Individual mobility through automobiles has long been an aspiration of modern societies. In our view, we are just at the beginning of structural technological changes based on electrification, autonomous driving, and car-sharing concepts, which collectively make up our definition of **smart mobility**. Smart mobility will change the way we "consume" mobility for decades to come. **Urbanization** is the main long-term driver of our smart mobility theme, but **aging** and **population growth** are also supportive factors (see Figs. 1–3). Furthermore, sustainable investment aspects like safety, better fuel efficiency, lower emissions, the rise of millennials, and increasing mobile connectivity can be linked to this theme as well.

Looking at the technological drivers of smart mobility, **electrification** is increasingly gaining acceptance across societies. Governments and consumers have slowly but surely started to embrace it, although costs are still the biggest hurdle. In our view, regulatory changes and cost reduction efforts will help trigger a much faster rollout of electrified powertrains than the market currently expects. **Autonomous driving** through the application of a wide range of sensors, increased connectivity, and vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications will change the automobile and the way we drive. Finally, using a car does not mean owning it – **car-sharing concepts** will change the way automobiles are "consumed."

Whether car sharing will catalyze the migration to electric vehicles (EV) or new energy vehicles (NEV), or whether such vehicles will catalyze the migration to car sharing, is debatable. However, what is indisputable to us is that the rise in car sharing – especially "robotaxis" if they are adopted on a mass scale – could offer shorter investment payback periods through higher utilization. This makes car sharing an attractive option for consumers and an interesting business opportunity for companies. Electrification, autonomous driving, and car sharing form our smart mobility theme.

Fig. 1: World population (in billions, 1950–2050)

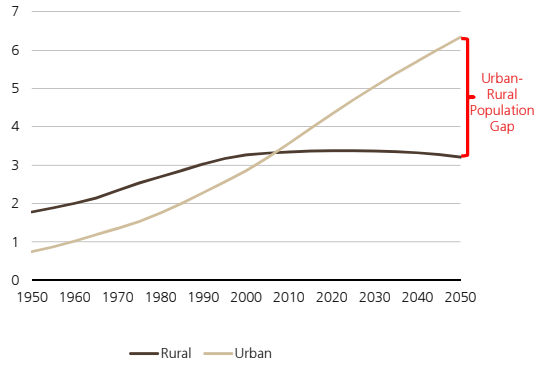
Less-developed countries fuelling growth



Source: United Nations, Department of Economic and Social Affairs, Population Division (2014); Note: including long-term forecasts

Fig. 2: World urban and rural population (in billions, 1950–2050)

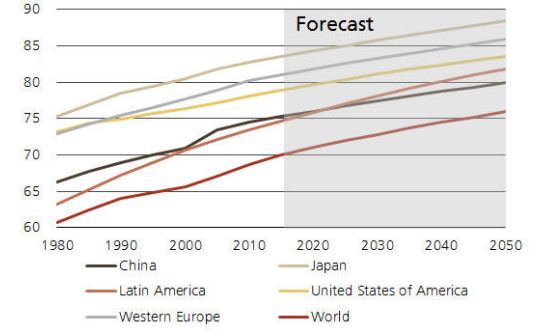
By 2050, a majority of the world's population will live in urban areas



Source: United Nations, Department of Economic and Social Affairs, Population Division (2014); Note: including long-term forecasts

Fig. 3: Aging (1980–2050)

Average life expectancy in years



Source: United Nations (UN) Population and Aging Database 2014, UBS

Urbanization supports car sharing and autonomous driving

Urbanization and the need for mobility often lead to congestions in existing infrastructures. Autonomous technology will help reduce traffic jams and the tremendous losses in both time and energy (such as gas and diesel; see Sustainable Investment aspects below). In many areas, roads and parking spaces are stressed to the limit. While the need for mobility will not go away, the usage of vehicles – not their ownership – will come into focus. And while "sharing economy" business models are often identified with millennials, they attract not only this young generation. House-sharing (e.g. via AirBnB) is now well established; for cars, we believe it is still in its infancy stage. Cars in general are an underutilized asset, with an average utilization of around 4% at any given time; this supports the case for car sharing (which is not the same as sharing a trip in the same car). That said, autos are an emotional and prestige product and rarely bought on economic grounds alone; hence, a fundamental change in the current auto-usage model, including mass adoption of car sharing and so-called robotaxis, will only happen over time. Furthermore, the concepts of autonomous driving and car sharing might diverge greatly not only by region but also between urban and rural areas. But change has begun and we expect **mobility as a service (MaaS)** to gain in importance.

Aging supports car sharing and autonomous driving

In an aging society, autonomous or automated driving will enable the elderly to maintain their mobility. A key long-term driver that supports this trend is the higher purchasing power of this age cohort. That said, car-sharing concepts also offer mobility for the less wealthy, as they allow people to only pay for the usage of MaaS rather than the upfront cost of owning a car.

Sustainable investment aspects: Safety, better fuel efficiency, lower emissions, better inclusion and more green spaces

There is an increasing awareness in both developing and developed societies that certain changes in mobility are needed. This growing awareness for environmental, health, and safety concerns has been around long before the Volkswagen diesel scandal broke in 2015.

A broad-based application of autonomous features, including artificial intelligence, could make driving safer and more environmentally friendly. It could result in less severe accidents and consequently fewer traffic-related deaths. According to the

Box 1: Definitions for car electrification:

a) BEV (battery electric vehicle): Propelled purely via electric power stored in a battery and converted into mechanical power by means of an electric motor. BEVs are charged externally (with a power cord) and through regenerative braking, i.e. the electric engine serving during the braking phase as a generator, charging the battery.

b) PHEV (plug-in hybrid vehicle): Can be driven on both purely electric power or fossil fuel power (gasoline or diesel). This vehicle's powertrain contains both an e-motor and battery that can be externally charged, and an internal combustion engine (ICE) that burns fuel to propel the car. PHEVs typically have a pure electric range of 30–50km, lower than the ranges for a BEV.

c) EV (BEV & PHEV): All plug-in electric cars.

d) New energy vehicles (NEV): China's definition for battery electric and plug-in hybrid vehicles (equal to EV definition above).

e) FCV (fuel cell vehicle): Propelled by an electric motor (like an EV), but uses power generated from hydrogen as fuel rather than power stored in a battery. An FCV carries compressed hydrogen gas in a tank and employs a fuel cell to ultimately convert the hydrogen gas into electricity.

f) HEV (full hybrid vehicle): Like a PHEV, it carries two powertrains (electric including battery and e-motor and ICE). In contrast to PHEVs, the battery cannot be charged externally. The battery is recharged only through regenerative braking. The pure electric range is lower than that for BEVs/PHEVs. HEVs typically use electric power at steady speeds and for acceleration to save fuel.

g) 48 Volt mild hybrid: Smaller electric engine used as a booster during the acceleration phase. Contains an extra 48 Volt battery which can also be used to power e.g. an electric turbocharger, and is recharged via regenerative braking.

h) Internal combustion engine (ICE): Traditional gasoline or diesel powered.

World Health Organization, in 2016, more than 1.3 million people died from traffic accidents worldwide – i.e. more than 3,000 per day – and 20–50 million were at least temporarily incapacitated. As objective algorithms overrule individual egos, the flow of traffic would be more fluid, potentially reducing traffic jams and improving fuel efficiency per mile traveled.

We see an increasing trend for electrification in automobiles. We estimate that by 2025, around 25% of new vehicles sold globally will be electrified, with at least 10% being battery electric and the rest plug-in hybrids. A wide-ranging rollout of 48 Volt mild-hybrid vehicles is not factored into this figure (see Box 1 for definitions). As a result, at least local emissions can be reduced even as the amount of greenhouse gas (CO_2) emissions still depends on the way electricity is produced. In our view, the number of deaths and cases of costly health issues caused by pollution (from nitrogen oxides and particulates, among others) should be substantially reduced over time.

Car-sharing concepts will also enable greater social inclusion by making mobility available to people who do not have or cannot afford their own vehicles. And because roads and parking spaces use up 15–20% of city space, car sharing should reduce congestion given fewer vehicles on the road and consequently less parking and road space needed. This should contribute to the greening of cities.

The smart mobility market

This year, around 94 million vehicles are expected to be sold globally, representing a market in excess of USD 1.5 trillion a year. Assuming a 2–3% long-term growth rate in car demand (roughly in line with 20-year historical average), unit sales could increase to 120 million in 2025, driven by demand from emerging economies. (Note that at this stage our theme's focus is on vehicles that provide individual mobility; it excludes commercial vehicles such as heavy trucks, buses, and vans which could add another dimension to this report.)

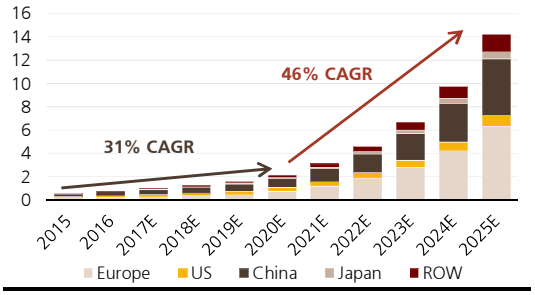
Given this large market for individual mobility, the long-term success of our smart mobility theme would depend on the regulatory environment, the technology being deployed, and the costs these changes entail. We are confident, however, that the smart mobility trend is unstoppable. The individual components and technologies of our smart mobility theme are strongly interlinked. We estimate that by 2025, the overall annual addressable market of our theme could be **around USD 400 billion** (see Fig. 4), i.e. about 10 times larger than it is today. We also make the following assumptions for market size:

Fig. 4 : Smart mobility addressable market
By 2025, smart mobility should be an over USD 400 billion annual market

in USD bn in 2025		Slow battery-electric rollout, high plug-in hybrid share	Faster battery-electric rollout, low plug-in hybrid share
Powertrain suppliers	Battery electric vehicles (BEV)	35	70
	Plug-in hybrids (PHEV)	30-45	15
	48 Volt mild-hybrid	10-15	10-15
	gaining	75-95	95-100
	losing	-70	-140
Battery value chain	Battery electric vehicles (BEV)	80-100	155-200
	Plug-in hybrids (PHEV)	15-25	10
	48 Volt mild-hybrid	5-6	5-6
	gaining	100-130	170-215
Autonomous Driving	ADAS	70	70
Car-sharing /Car-hailing	Fleet and platform	50-100	50-100
Smart Mobilty total		300-400	390-485

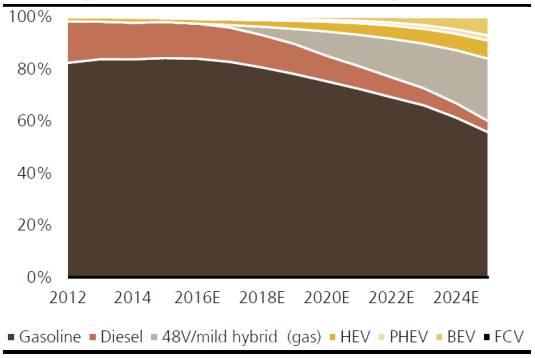
Source: UBS estimates October 2017; car-sharing/car-hailing numbers based on Goldman Sachs, September 2017.
Note 1: ADAS = advanced driver assistance systems
Note 2: Slow-battery rollout assumes 10% battery electric and 10–15% plug-in hybrid vehicles by 2025. The faster battery electric rollout assumes 20% battery electric and only 5% plug-in hybrids by 2025
Note 3: Our estimates are rounded.

Fig. 5: Electric cars – strong growth driven by China and Europe
Annual vehicle sales (in million units)



Source: UBS, as of May 2017

Fig. 6: Powertrain mix shift ahead
Traditional gasoline and diesel down, 48 Volt (mild) hybrids and electric vehicles up



Source: UBS, as of February 2017
Note: HEV = Hybrid electric vehicles; PHEV = Plug-in hybrid electric vehicles BEV = Battery electric vehicles; FCV = Fuel cell vehicles; gas = gasoline related to 48 Volt mild-hybrid systems

- Electrification – powertrain for suppliers: **USD 75–100 billion** (from less than USD 5 billion today), with the traditional supply chain at risk of losing USD 70–140 billion. Electrification will cannibalize traditional internal combustion engines (ICE). A faster rollout of battery electric at the expense of plug-in hybrids would result in the higher end of the potential loss for traditional powertrain suppliers. This is because plug-in hybrids still contain an ICE, and, hence, even more ICE would be replaced (see Fig. 4).
- Electrification – battery value chain: **USD 100–215 billion** (from low-double-digit USD billions today)
- Autonomous driving: **USD 70 billion** (roughly quadrupling from today)
- Car-sharing/car-hailing – fleet and platform: **USD 285 billion by 2030** (up from USD 36 billion today), split between ride hailers (USD 65 billion) and fleet managers (USD 220 billion), based on data from Goldman Sachs. Bear in mind that current revenues are split between ride hailers and drivers. Based on current strong growth rates, we believe car-sharing concept providers' share by 2025 could be **USD 50–100 billion** (up from around USD 10 billion today). Only in a "robotaxi" world would 100% of the revenues be in the hands of car-sharing concepts and fleet managers; this may happen beyond 2025, in our view.

In following chapters, we address these individual sub-categories.

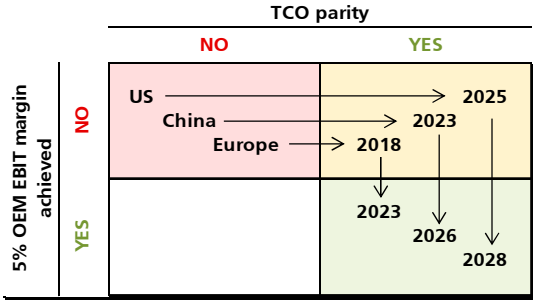
Electrification

The rollout of electrification has started. We expect growth to be exponential rather than linear from 2020 onwards. At this stage, we believe that by 2025 around 25% of new cars will be electrified, of which at least 10% will be battery powered full-electric vehicles and the rest plug-in hybrids. We also expect at least another 10–15% mild hybrids based on 48 Volt technology. This creates long-term business opportunities.

Current stance

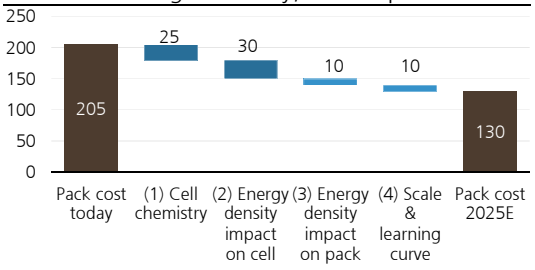
Since 2006, we have seen a roughly 30–40% improvement in fuel economy. However, current combustion engine technology has its limits. In our view, tougher regulation to reduce CO_2 emissions and fuel consumption will lead to a significant increase in the electrification of powertrains in the form of hybrid, plug-in hybrid, and battery electric vehicles, be it battery or potentially even fuel-cell powered (together alternative

Fig. 7: Inflection points ahead
Close to TCO parity for consumers and auto manufacturer margin to follow 3–5 years later



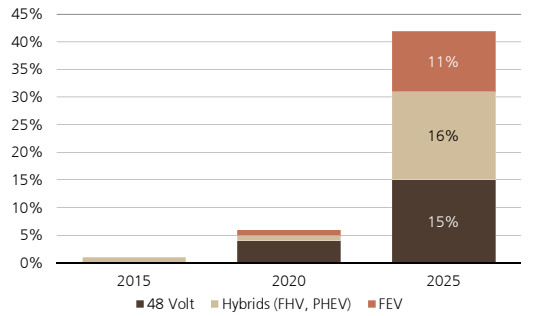
Source: UBS, as of 18 May 2017
Note: TCO = Total cost of ownership. TCO parity = the point when all-in costs for battery electric vehicles equal internal combustion engine vehicles

Fig. 8: Electric cars – battery cost will be key
Battery pack cost to decline by around 35% by 2025 on existing chemistry, in USD per kWh



Source: UBS, as of 18 May 2017

Fig. 9: Electrification to strongly increase
Electrification volume by 2025 – around 40% penetration



Source: Continental AG, Factbook 2016, as of March 2017; Note 1: based on Continental's estimates for 2025 of 110mn passenger cars and light trucks build; Note 2: FHV = Full hybrid vehicle; PHEV = Plug-in hybrid vehicle; FEV = Battery full-electric vehicle

powertrains).

Based on data from the European Automobile Manufacturers Association (ACEA), the overall market share of alternative powertrains in 1H17 was an insignificant 1.5% in Europe, nearly evenly split between battery electric and plug-in hybrid vehicles, i.e. around 60,000 vehicles each. Even government incentives – such as Germany's EUR 4,000 subsidy for full-electric cars and EUR 3,000 for plug-in hybrids – have not moved consumers to this direction. On a global level, the market share of electrified vehicles (full-electric and plug-in hybrid) stands only at roughly 1%.

Regulation

Regulation will force or incentivize producers to build and consumers to switch toward electrification over time, at least in China and Europe. With its NEV initiative toward zero- and low-emission vehicles, China could be the driving force for global supply and demand. It is already the largest electric car market today – Chinese consumers have the largest selection of electrified cars to choose from – and it is speeding up its electrification efforts. China is aiming for a NEV quota of 10% and 12% (around 2 million vehicles a year) by 2019 and 2020, respectively, and 20–25% by 2025. The applied formula is complicated and does not reflect the exact share; nevertheless, in our meetings with industry officials including VW's senior management, it was confirmed that this translates to 600,000 NEVs a year by 2025 for VW alone.

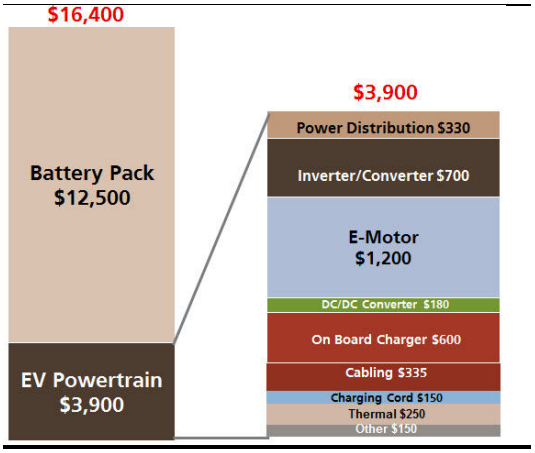
In Europe, various countries are determined to phase out traditional combustion engines (diesel and gasoline) – the UK and France from 2040, Norway potentially from 2025, and Germany from 2030–2040. The ban on diesel from inner cities (emission zones) or potentially even on all ICE-powered vehicles, as well as mandatory EV quotas, has been widely discussed, so our estimates on the uptake of electric vehicles overall may be too conservative.

We believe growth in alternative powertrains will take place in China and Europe (which together should account for 80% of the market by 2025), while the US is likely to lag on the full-electric front (see Figs. 5 and 6).

Growth

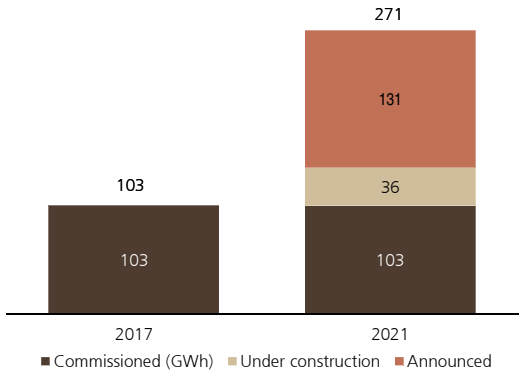
We believe that further cost reduction mainly on the battery side, and the rollout of attractive battery electric vehicles mainly from 2020 onwards, will ensure that smart mobility growth will not be linear but exponential. From a total cost of ownership (TCO) perspective, cost parity between ICE and battery electric

Fig. 10: Electric engine powertrain
The battery is the biggest cost item (in USD)



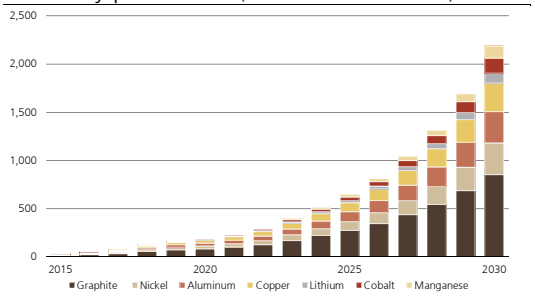
Source: UBS, as of 18 May 2017

Fig. 11: Battery manufacturing capacity to increase
A 2.5x increase is seen in the next four years to cater to increasing demand (in GWh)



Source: Bloomberg New Energy Finance's Long-Term Electric Vehicle Outlook 2017

Fig. 12: Metals and materials demand
Exponential growth is seen to cater the increase in battery production (in '000 metric tons)



Source: Bloomberg New Energy Finance's Long-Term Electric Vehicle Outlook 2017

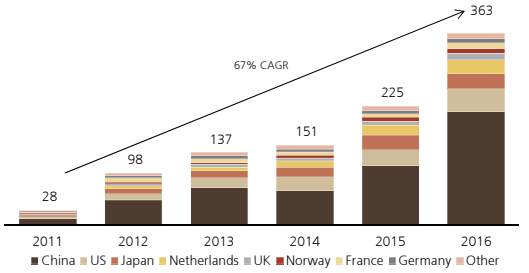
vehicles (BEV) may be achievable in the near term – 2018 in Europe and later in other regions (see Fig. 7). Sustained or even increasing subsidies could bring the timeline forward. For car manufacturers, we expect decent profitability (i.e. a 5% EBIT margin) to follow with a delay, potentially from 2023 in Europe and later in other regions. In our discussions with Daimler during the Frankfurt IAA Motorshow in September, it was highlighted that the first-generation electric cars' margin contribution would be around half of traditional ICE vehicles', indicating that, at this point, automakers are not necessarily the winners in smart mobility.

While we expect growth rates to be strong, investors should be aware that this is coming from a very low base. Furthermore, even with a strong projected drop of 30% in battery pack prices by 2025 (see Fig. 8), a battery electric car will likely still cost at least USD 16,000 (for 200km short-range models) to USD 21,000 (for 400km long-range models). Consequently, the growth in alternative powertrains will take place to a large extent in regions with higher incomes and purchasing power or regulatory pressure, i.e. China and Europe, rather than ordinary emerging markets.

We believe luxury and premium cars equipped with alternative powertrains will arrive first, as their buyers are less price sensitive, followed by the volume segment. Offering cheaper mainstream vehicles at lower price points over time will clearly depend on battery costs (see next section). The three German heavyweights – VW Group, Daimler, and BMW – currently sell and produce around 15 million vehicles each year globally. They aim for roughly 15–25% electrification (full-electric plus plug-in hybrid) by 2025 of their car divisions' sales. Including their targeted growth, this will translate to around 4 million electrified vehicles a year in 2025. As an indication of growth momentum, from January to September this year, BMW's electrified vehicle sales grew 64% year-on-year to 68,700 out of 1.81 million total vehicles sold (i.e. a 3.8% share).

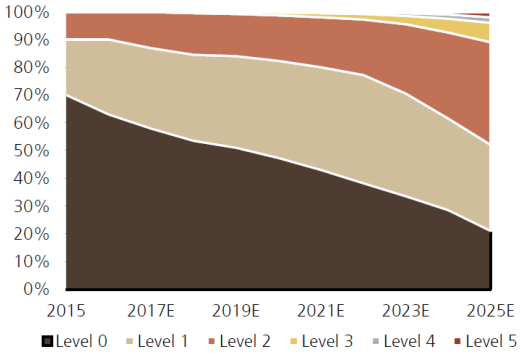
At this stage, we believe that by 2025 around 25% of new cars worldwide will be electrified, of which at least 10% will be battery-powered full-electric vehicles and the remainder will be hybrids, mainly plug-in hybrids (see Fig. 9). But industry estimates vary widely, as faster progress in battery technology and costs could speed up the rollout of battery electric cars at the expense of plug-in hybrids. From a production perspective, UBS estimates the breakeven point for a battery electric vs. a plug-in hybrid (which still needs a combustion engine) to be at a battery pack cost of around USD 140/KWh. This could potentially happen already by 2021–2022. Hence, the cheaper

Fig. 13: Charging infrastructure has increased strongly
A step in the right direction, but substantial investments needed (in '000 charging points)



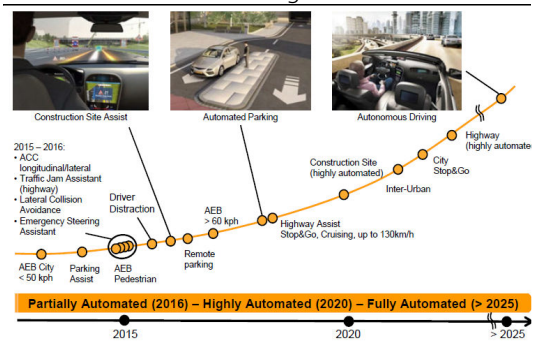
Source: Bloomberg New Energy Finance's Long-Term Electric Vehicle Outlook 2017

Fig. 14: ADAS penetration
Penetration forecast by ADAS level



Source: UBS, as of 16 February 2017

Fig. 15: Autonomous driving – a major pillar of the future
A continuous process toward highly automated and "accident-free" driving



Source: Continental AG, Factbook 2016, as of March 2017; Note: AEB = Automatic emergency brake; ACC = Adaptive cruise control

the batteries get, the more the case for plug-in hybrids falls apart in favor of battery electric vehicles.

Given the current discussion in places like Europe, we also assume that by 2025 pure ICE vehicles will no longer be sold, but at least 48 Volt mild hybrids will be, adding to the revenue opportunities for technology-focused suppliers. In our view, the US will follow later and phase out pure ICE by 2030. Hence, we expect at least another 20–25% share for mild hybrids based on 48 Volt technology by 2025.

Consequently, the value-added share of automakers and traditional auto suppliers is likely to fall due to the disruptive forces in the industry away from mechanical parts toward electrical and electronic ones (see Fig. 10). We expect the suppliers surrounding powertrain electronics to increase their content by 6–10x to around USD 600 per electric vehicle compared to a traditional combustion engine vehicle. Furthermore, battery cell producers would take a share of the value.

A word on batteries

Next to regulation, the rollout of electric cars would depend to a large extent on further advances in existing and new battery technology. Increasing energy density and reach, while at the same time substantially reducing costs and weight, will be key to ensuring a substantial pick-up in consumer demand. Battery costs have already come a long way down and are expected to drop further. We assume a 30% drop in battery pack prices by 2025 (see Fig 8). Currently, substantial investments in battery capacity are being made globally (see Fig. 11). Cost reduction also comes from scale, and we expect smaller companies to suffer from high capital expenditure needs and ongoing price erosion, which would only be partly compensated by a strong increase in volume. Hence, we would abstain from investing in smaller battery companies, which lack in scale and financial resources.

Implications for raw material demand

Graphite demand for batteries is estimated to multiply to more than 800,000 tons a year in 2030 from just 13,000 tons in 2015 (see Fig 12). Production of lithium, cobalt, manganese, and copper is also expected to rise. Over the last 12 months, raw material prices have soared – e.g. cobalt more than doubled to USD 55,000 per ton. In our view, this will incentivize the auto and battery industry to look for alternative materials over time, not least due to supply concerns as they come from sensitive regions (e.g. Democratic Republic of Congo). Looking at the latest announced changes in chemistry, the shift from so-called

NMC 111 batteries (1 unit of nickel, 1 unit of manganese, 1 unit of cobalt) or NMC 622 batteries to substantially cheaper NMC 811 batteries confirms that the auto and battery industry is trying to bring costs down. Investing in certain commodities or commodity-related sectors may be the most volatile part of investing in our smart mobility theme.

Charging infrastructure
While there has been a strong increase in the number of charging points in China (where investments in charging infrastructure have been in low-double-digit USD billions), it is still in its infancy in Europe (see Fig 13). We believe in Germany alone, substantially more than 25,000 fast charging points would be needed to cater to increased electrification (the current infrastructure includes 8,000 charging points and 14,000 gas stations). In Norway, which has the highest EV penetration in Europe, recent press reports have illustrated bottlenecks in charging points; ongoing strong investments in charging infrastructure have not been able to keep up with the demand. For many countries, there is still a long way to go. This will not only require additional investments by governments, but also offer business opportunities in the long run, e.g. via exclusive licenses to build up charging infrastructure for a decent return on investment. Further opportunities may also lie in wireless-charging infrastructure for private households over time.

Autonomous driving trend

The trend toward electrification plays nicely into the trend toward autonomous driving and connectivity. The commonly used expression ADAS stands for "advanced driver assistance systems," which is actually tiered from levels 0 (no automation) to 5 (full automation, i.e. no steering wheel needed). Currently, most cars are at levels 0 and 1 and some are in level 2. In our view, the ability to automate driving is likely to occur gradually over the next 10 years, for most to reach at least level 2 to 3, but we believe current estimates (see Fig. 14) are too conservative. Increasingly applying connectivity and vehicle-to-vehicle and vehicle-to-infrastructure communication will change the way we use automobiles.

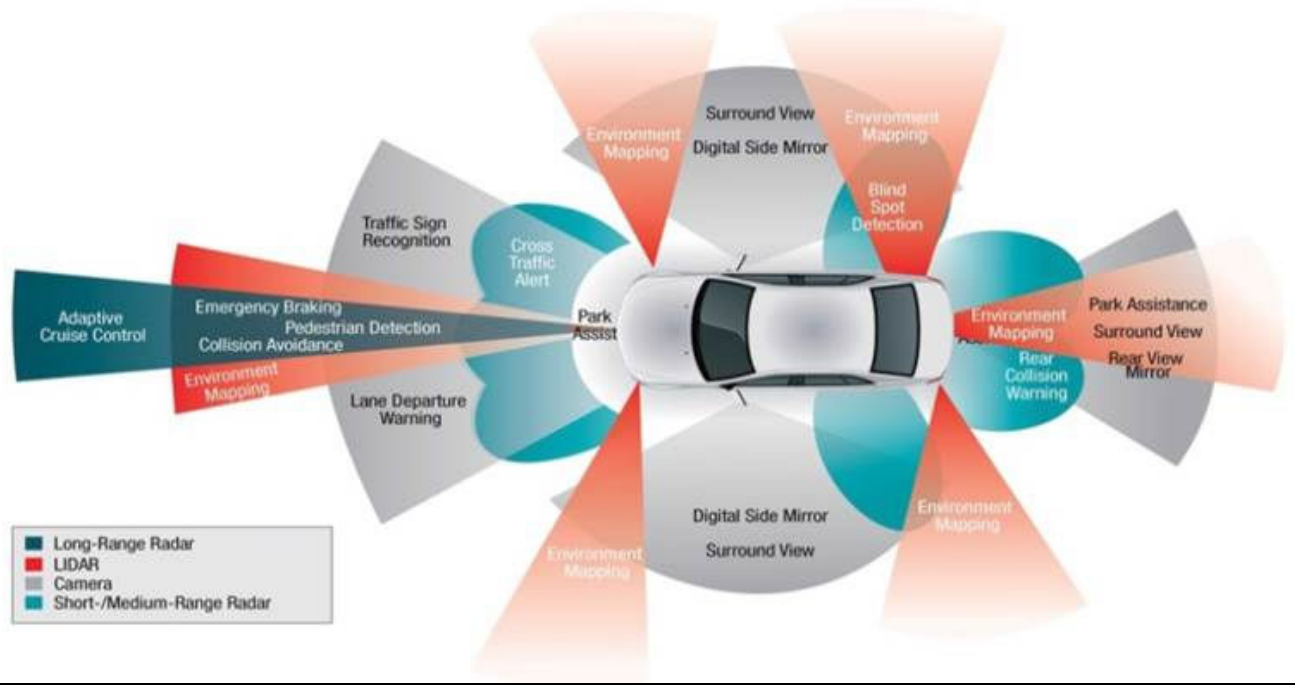
To increase safety on the road and reduce fatal accidents, we believe more features will be made mandatory in the future. Our ongoing discussions with companies confirm that the importance of ADAS will significantly increase over time, with its adoption exceeding the overall growth of the car market by far. We have also been able to experience autonomous technology

in real-driving environment on various occasions during 2017. It is our strongest belief that by 2020, around 50% of all new cars could be equipped with some kind of basic autonomous equipment (see Fig. 15). Our discussions with auto manufacturers across the board also confirmed consumers' willingness to pay for such comfort and safety features. We therefore expect ADAS penetration to increase. Currently, we see ADAS as a **USD 35 billion (EUR 30 billion)** annual revenue market by 2020, **at least doubling to USD 70 billion (EUR 60 billion) by 2025.**

Together, electrification and autonomous driving should translate into multi-billion-dollar business opportunities beyond the classic auto supplier industry. Related industries such as electronics, software (algorithms), hardware, and semiconductor should increasingly gain in importance. The same is true for sensors (see Fig. 16), which will play a major role in an autonomous and connected world. The broad-based application of laser, radar, LIDAR (light detection and ranging, a laser-based radar system), ultrasonic, and cameras should also increase and, together with connectivity, enable mapping as the backbone for the development of autonomous driving (see next section).

Linking things is complex and machine learning (artificial intelligence) will be a game-changer in a future where sensors and AI work hand-in-hand to ensure a smoother and safer ride. This ability will help make car features, such as learning speedbumps and adjusting the shock absorbers or automatically increasing the car's height the next time it approaches a hump, standard in a few years.

Fig. 16: Sensors will be key
The number of sensors i.e. cameras, laser, radar, LIDAR, ultrasonic will increase substantially

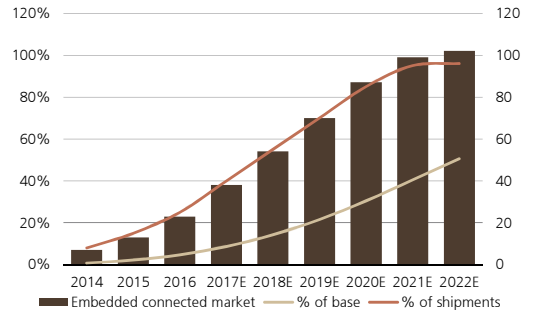


Source: Texas Instruments Inc.

Connectivity

The auto industry is currently undertaking great efforts to link cars with smart devices to cater to the needs of the digital generation and beyond. When it comes to connectivity, linking the music database of a smartphone to the car is only the beginning. Integrating smartphones and watches for last-mile navigation in order to provide multi-modal mobility services, be it by foot, bicycle, or public transportation, is already developed. Furthermore, software updates via the internet rather than by visiting the car dealer are foreseen to be a common feature for new cars in the next five years. We believe connectivity in new vehicles will reach a penetration rate of 100% by 2022, corresponding to nearly 50% of the cars in use by then (see Fig. 17).

Fig. 17: Connectivity on a clear uptrend
Global cars connected to mobile networks, new vehicles sold in million vehicles, share of shipments in %, installed base in %



Source: UBS, as of 20 September 2016

Mapping

In August 2015, Audi, BMW, and Daimler announced their joint purchase of Nokia's HERE digital mapping business. Since then, various other ventures have been announced, including Intel's acquisition of Mobileye, a company involved in camera algorithm and camera-based mapping systems. Combining sensors, cameras, and navigation, the so-called "swarm intelligence" will be of great help to autonomous driving. The

resulting life navigation data will be key to precise localization, and demands a tremendous amount of data (e.g. HERE generates 28 terabytes of data per day; Bosch and TomTom are collaborating to generate cars' exact positions in a lane within a few centimeters and generate maps based on radar signals).

Data is continuously collected and processed to add more safety and comfort features to modern cars. This enables vehicle-to-vehicle communication systems that warn other vehicles of accidents or slippery roads, as well as smart routing and live-traffic information. In addition, it enables intelligent traffic control, i.e. vehicle-to-infrastructure communication, by interlinking cars with traffic lights and speed restrictions. We experienced this technology in person in September. An artificially created incident (car breakdown with hazard lights activated) was registered by the sensors, processed, sent to the cloud, and distributed from the cloud to all connected cars in the area within two seconds. Warning about potential hazards is a big improvement to increase safety on the road.

Data ownership as the basis for future commercial success

But connectivity goes well beyond all that. Based on a current global average car speed of 40km per hour and 16 trillion km (10 trillion miles) of car travel per year, owners spend an estimated 400 billion hours in unconnected cars, and passengers an additional 200 billion hours, according to a study by Morgan Stanley. Based on a range of economic values per hour, time spent inside a private vehicle could translate into an opportunity cost of several trillion US dollars. Embracing connectivity with the possibility of autonomous cars as "the fourth screen" is driving a fast-rising trend in online/internet functions in cars, which could be commercialized by providing media content and advertising. However, this goes beyond the scope of our theme at this stage.

Using more apps on the car's display will generate more data that could be of value to better understanding and "owning" the car consumer. The auto industry is battling the IT giants (e.g. Google, Apple, Microsoft) with its own alternative systems. Owning the mapping and navigation data and, in general, all the data created in the car will become valuable. Hence, both the auto and IT-related industries will try to own and commercialize the large amounts of valuable big digital data created in the connectivity process for their mobility services and beyond. That said, we still believe the proportion of such business to overall sales will be limited during this decade, but might offer additional revenue streams thereafter.

Security issues

Bringing connectivity and autonomous driving together, security and liability concerns become a big issue, affecting also the auto insurance industry, among others. At 180kph (around 110mph) on a German autobahn, a car travels 50 meters (164 feet) per second. At this speed of travel or slower, cyber-crime could become a serious threat. Any interruption or manipulation of the car's hardware or software could have fatal consequences. Hence, (cyber) security and safety will play a crucial role as an indirect way to invest in the autonomous driving trend. We also refer to our Longer Term Investments series *Security and Safety*, dated 18 January 2017.

Car-sharing concepts

The combination of electrification, autonomous driving, and connectivity will play a major role in increasing shared mobility models (MaaS), with autonomous driving being the ultimate trigger. It is debatable if sharing catalyzes the migration to EV/NEV, or if EV/NEV catalyzes the migration to car sharing, but increased utilization of car-sharing concepts (car sharing and car hailing) and ultimately robotaxis should lead to lower costs to consumer and generate a viable business model for providers.

Where we stand

Globally, we have around 1.1 billion cars, and each year around 10 trillion miles (16 trillion km) are driven – a substantial source of revenue for many businesses. So far, the underlying long-term growth in car demand is around 2–3% a year, but the planet is not getting bigger and urban areas are becoming more condensed, supporting car-sharing concepts. Given the low estimated 4% average utilization per car (i.e. around 1% per seat), **car sharing** could in theory replace up to 25 private cars, and **car hailing** an estimated 5–10 cars (see Box 2). This makes privately owned cars an inefficient asset.

However, car hailing or car sharing will not completely replace private car ownership, not least as car-sharing concepts might also face potential bottlenecks during rush hours. This might be partly solved by sharing a trip in the same car at reduced costs, or with the help of algorithms that determine where to best place the vehicle to optimize its use and keep it from running idle, i.e. avoiding "empty trips." Car-sharing concepts will also not end the sale of new cars. Rising car usage will increase the wear-and-tear of shared vehicles. Consumers might want to share in order to reduce costs, but they are probably less willing to compromise, i.e. they do not want to sit in an unkempt, run-

Box 2: Car hailing vs car sharing definition:

Car hailing	=	Chauffeured services like Uber, Lyft
Car sharing	=	Sharing with other drivers/owners, car2go (Daimler)
Robotaxi	=	fully autonomous, driverless vehicle

down vehicle. Hence, the churn for shared vehicles could be 3–4 times higher than private purchaser demand, i.e. they could be replaced roughly every three years, according to various company meetings we attended.

Price reduction will be key

Car-sharing concepts can greatly reduce the price of new technologies on a cost-per-mile basis and hence further spur adoption. It is debatable if car sharing catalyzes the migration to electric vehicles or if electric vehicles catalyze the migration to car sharing. However, what is indisputable to us is that the rise in car sharing, if adopted on a mass scale, could offer better economics to users. Higher capacity utilization from car sharing will spread the initial price/investment of the car over more miles. Lower variable costs to run the vehicle (cheaper electricity vs. fuel, lower maintenance costs), autonomous driving – i.e. replacing the driver in the long run – is key to bringing cost-per-mile down from today's levels. The arrival of robotaxis in particular should reduce costs by around 70%, ending up substantially below private car ownership costs (see Fig. 18). Depending on the number of people sharing a trip in the same car, robotaxis should become even more cost-competitive than public transportation over time (see Fig. 19). However, if robotaxis become a real threat to public transportation, they might also be subject to regulation which might limit individual mobility over time.

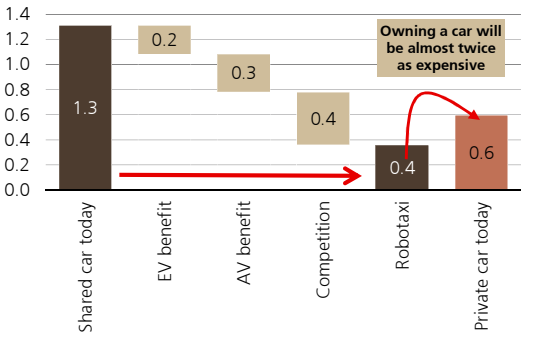
Operators are benefiting as well

The application of the car technologies discussed so far makes the cars more expensive, but competition is one reason we expect car-sharing and car-hailing prices to drop. The ride-hailing industry has a strong interest in replacing the driver with a driverless robotaxi. The above argument about price reduction is valid as well, as it may shorten the payback period for car-sharing concepts to less than three years. This will be key to making MaaS a viable business model. From recent meetings with company executives, we understood that even in today's non-autonomous world, in a city with 500,000 population, a shared fleet of 500 vehicles could be operated with a profit.

Market development

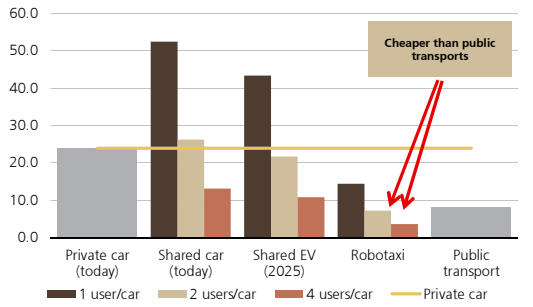
We are just at the beginning of the car-haling/car-sharing trend, and various industry participants and analysts have varying estimates on how many cars will be part of the trend. Given our belief in the trend toward consuming rather than owning a car, we believe that by 2025 around 10–12 million cars, i.e. 8–10% of overall car sales, should be used for car-sharing/car-haling purposes, which may already include some 1–2 million

Fig. 18: Robotaxis will be cost competitive
Electrification, autonomous driving, and increasing competition will bring costs down (in EUR/km)



Source: UBS, as of 28 September 2017
Note: EV = Electric vehicle; AV = Autonomous vehicle

Fig. 19: Robotaxi beats public transport
Daily commute costs in Europe if several passengers share the overall fee (20km driven per leg; 40km driven per day), in EUR



Source: UBS, as of 28 September 2017
Note: 1) EV = Electric vehicle; 2) The cost for private combustion engine stays the same, as the private car owner is unlikely to split the cost by the number of passengers in the car.

robotaxis. By then, we think several concepts will have succeeded and be running in parallel in a smart-mobility world, serving the individual preferences of consumers through combinations of car sharing and car hailing even from the same provider, as well as personalized car sharing, where the car automatically adjusts to the driver's known preferences. Furthermore, private consumers might also get more involved in peer-to-peer car sharing, i.e. renting out their privately owned car during the day, or while they are on holiday. We foresee the main breakthrough happening toward 2030. By then, robotaxis should be gaining traction due to technological progress and their strong cost advantage, and more than 30% of new car sales could be linked to sharing concepts. Especially for urban driving (i.e. geo-fenced areas) and consumers with short-to-medium distance driving needs, robotaxis would make sense. However, the concepts of autonomous driving, robotaxis, and car sharing will likely diverge greatly not only by region but also between urban and rural areas (e.g. New York City versus the US Midwest). Furthermore, as we are still in the early stages of the trend, a lot of the regulatory, liability, and even tax consequences have yet to be addressed.

Who will be the winners?

According to various industry sources, in excess of USD 30 billion has been invested in ride-hailing startups, an asset-light and low-entry-barrier business. In our view, future profitability and returns are not guaranteed, as even the large players continue to post large losses.

So far in ride-hailing businesses, drivers have not only devoted their time but also contributed their own cars. Looking further ahead, in an autonomous driving world, we believe Silicon Valley and similar tech companies are unlikely to aim to be asset-heavy, i.e. they may be less willing to take potentially hundreds of thousands of ride-hailing cars on their balance sheets, and finance, manage, and maintain them. Hence, in an autonomous-driving/robotaxi world, we believe managing the fleet (including the financing, i.e. providing the balance sheet as well as the maintenance and after-sales of the fleet) will be a large business. We see a kind of revenue-sharing model between ride-hailing companies and fleet managers as likely. There is room for new entrants like financial services and car rental companies, but there is also a fair chance of the existing auto industry grabbing a large chunk of this fleet business. Goldman Sachs estimates the global ride-hailing market at USD 36 billion right now, which should grow eightfold to **USD 285 billion** by 2030, likely to be split between ride hailers (**USD 65**

billion) and fleet managers (**USD 220 billion**).

Currently, the gross revenues are split roughly 20–30% for the ride hailers and 70–80% for the drivers as they provide the car and manpower. Hence, of the current USD 36bn stated before, only around USD 10bn can be assigned to car hailers. Looking at the current growth rates of this car-sharing concept, **by 2025** we believe this amount could be **USD 50–100 billion.** The real breakthrough starts with robotaxis. We believe they will increase usage due to their cost advantage, but only in a robotaxi world will 100% of the revenues end up in the hands of car-sharing concepts and fleet managers. This should happen beyond 2025, in our view.

Please see our Appendix for more information and frequently asked questions (FAQ) related to car-sharing concepts.

Link to sustainable investing

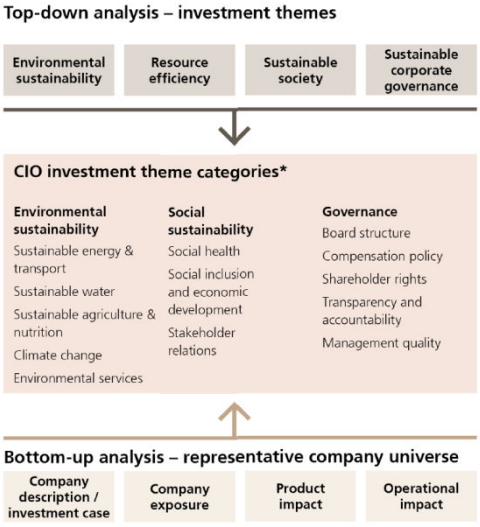
To identify whether a Longer Term Investment (LTI) theme qualifies as a **sustainable investment (SI)** theme, LTIs are assessed whether they match one or more of the sustainability topics within the **environmental, social, or governance (ESG**) categories (see Fig. 20). In general, these themes must contribute to environmental sustainability (e.g. a low-carbon economy), resource efficiency (e.g. energy, water), a sustainable society (e.g. health, education, etc.), or sustainable corporate governance (e.g. gender diversity).

Link to impact investing and UN SDGs

Investing in smart mobility can contribute to three UN Sustainable Development Goals: good health and well-being; sustainable cities and communities; and climate action. One of the goals tied to good health and well-being is to halve the number of global deaths and injuries from road traffic accidents. Sustainable cities and communities rely on access to safe, affordable, accessible, and sustainable transport systems for all, with special attention to the needs of those in vulnerable situations. Climate action is, among other things, focused on greenhouse gas emissions which lead to an increasing global temperature with catastrophic consequences for people and the planet. Investment in smart mobility can contribute to each of these areas, though not all smart mobility investments qualify as impact investments.

Examples of impact opportunities in smart mobility that could

Fig. 20: Overview of LTI topic clusters



Source: UBS

* All topic clusters include several subcategories not included in the graph; e.g. sustainable water includes water utilities, treatment, desalination, infrastructure and technology, water efficiency and ballast-water treatment. Within each subcategory are further specifications; e.g. water treatment includes filtration, purification and waste treatment. In total, we have more than 100 categories (potential sustainable investment themes) in our thematic database.

contribute to the sustainable development agenda include:

- Software to analyze traffic data, with the ultimate goal of developing solutions to reduce death and injury from accidents. This includes real-time traffic systems in order to warn surrounding traffic participants of any hazards, or even early warning systems highlighting specific high-risk locations such as intersections. Demand for these solutions is growing and technological advances facilitate supply.

- Car-hailing and car-sharing models. Cars are one of the top contributors to greenhouse gas emissions. Optimizing vehicle usage would lower overall emissions levels. Increased car sharing will not only reduce vehicle ownership rates, but also have a positive impact on emissions, not least as the search for parking will become unnecessary. Especially in urbanized areas, the use of car-sharing programs will substantially increase in the next 10 years. Many automotive industry players are exploring proprietary car-sharing models, joining a host of startups in this area, with changes in technology expected to create lucrative business opportunities.

- Electrification in general, though not directly a smart mobility investment, also contributes to emissions reduction. Government regulations aimed at reducing emissions are fueling the demand for electric and hybrid vehicles, and the regulatory environment remains highly favorable. Combined with a strong drop in battery prices, electric cars should end up with the majority share of new car sales by 2040 or even sooner.

The greatest impact is likely to be achieved by focusing investment on geographies with particularly high population growth combined with rapid urbanization. These regions experience heightened environmental pollution, threatening the population's health as well as the environment. Their health and safety are also threatened because overwhelmed traffic systems tend to be accident-prone.

Much of the technology behind smart mobility, in particular autonomous driving and shared mobility, is still primarily the domain of private companies. Business models and underlying technologies in these areas continue to evolve rapidly, and many companies that provide pure-play exposure have chosen not to list yet, instead taking funding from venture capital firms or corporations. Uber and Didi Chuxing, both global leaders in the ride-hailing space, are currently the two most valuable

private companies in the world based on last-round valuations of USD 68 billion and USD 50 billion, respectively. Other privately held companies focused on car sharing include car2go, DriveNow, and Zipcar, all of which are backed by venture capital firms or corporations.

Pure-play exposure to this theme is challenging to achieve through listed equities. All of the major automakers and original equipment manufacturers (OEMs) are pursuing autonomous driving technology, but it represents a small portion of their overall business. We believe the best way for investors to gain exposure is through private companies, investing either directly or indirectly through private equity funds. Either approach requires tolerance for years of illiquidity and less frequent, more limited disclosure by the underlying companies.

Smart mobility ultimately should have positive effects on health, city sustainability, and emissions reduction, but not all smart mobility investments qualify as impact investments. The key constraints relate to management and investor motivation and intent, as well as verification that the outcomes were a direct result of the investment.

Andrew Lee, *Head Impact Investing and Private Markets*
James Gifford, *Senior Impact Investing Strategist*
Manon Lüthy, *Impact Investing Analyst*

Investment conclusion

Smart mobility has just started, and we define it as a combination of smart powertrains (electrification), smart technology (autonomous driving), and smart use (car-sharing concepts). Over the next decade, we believe the growth of smart mobility will be substantial. It will not only revolutionize the automobile industry but also the way vehicles are "consumed." Costly technology will be deployed and disruptive forces will force traditional auto companies and auto suppliers either to participate and adapt to those changes, or risk being replaced (at least partly) by new entrants from the tech industry. More favorable regulation pushing alternative powertrains and new smart use/mobility concepts including the introduction of robotaxis will help as well. Fast technological progress and a change in consumer behavior, in which using an asset will be more important than owning it, will drive our smart mobility theme.

We believe smart mobility offers substantial business opportunities. By 2025, we estimate the annual addressable market of our theme to be around USD 400 billion, compared

to an estimated USD 40 billion today out of a roughly USD 1.5 trillion overall global car market per year currently. The individual components and technologies of our smart mobility theme are strongly interlinked with one another. By 2025, we estimate that the electrification of the powertrain will offer USD 75–100 billion of annual revenue opportunities (from less than USD 5 billion today), with the traditional supply chain at risk of losing USD 70–140 billion. Electrification will cannibalize traditional internal combustion engines (ICE). A faster rollout of battery electric at the expense of plug-in hybrids would result in the higher end of the estimated potential loss for traditional powertrain suppliers. The reason is plug-in hybrids still contain ICE, and, hence, even more ICE would be replaced. The battery value chain should stand at USD 100–215 billion (from low-double-digit USD billions today). Autonomous driving should be a USD 70 billion market (roughly quadrupling from today). Car-sharing/car-hailing will be the most challenging. Currently, only 20–30% of the revenues (translating to around USD 10 billion) belong to the car hailer. Looking at the current growth rates, by 2025, we believe this amount could be USD 50–100bn. Only in a robotaxi world would 100% of the revenues end up in the hands of car-sharing concepts or fleet managers; this will happen beyond 2025, in our view.

Our theme focuses on the whole value chain of smart mobility, with a clear emphasis on electronics and electric components related to electrification and autonomous driving. Car-sharing/car-hailing exposure can largely only be invested via private market at this stage. While fleet management related to this could become a large and lucrative business, for the foreseeable future it remains too small to have a meaningful impact on quoted companies, especially in a non-robotaxi world: But this should change over time.

The combination of more favorable regulation, falling costs, and technological advances makes smart mobility attractive for investors with a long-term focus, as the theme is cyclical in nature. Given that we are just at the beginning of this structural change, we think it is not yet fully recognized by the market.

Risks

As we are just at the beginning of the smart mobility trend, risks are manifold. The major ones, in our view, are:

Regulation
For autonomous driving, regulation is still missing, which may limit its broad-based rollout. Data privacy from sharing GPS and mobile-phone data with a number of apps facilitating shared

mobility could raise consumers' or regulators' concerns. Regulatory restrictions or changes of licenses may affect car-sharing platforms, and crowded cities may try to limit individual traffic, including car-sharing concepts.

Technology (batteries, hybrids, autonomous features)
If major developments on the battery side (costs, energy density, shorter charging times) are not delivered, it would hamper the rollout of electrified vehicles, as consumers generally still have "range anxiety" or the fear of being stranded due to an insufficiently charged battery. In premium vehicles, autonomous driving at least to level 3 (conditional automation; "hands-off") already works quite well, but any major setback or reports of serious autonomous-driving-inflicted accidents may cause a loss of trust and could affect the rollout of the technology. Level 4 (high automation; "eyes off") and level 5 ("driver off," "steering-wheel off") will still take some time – any delay will also negatively affect car-hailing companies, who are counting largely on autonomous cars to make a viable business model.

Consumers' acceptance and willingness to pay for technology
Consumers have not been willing to fully pay for the additional costs that electrification technology entails. While some state subsidies might be granted, the incentives might expire over time (e.g. the US's USD 7,500 or Germany's EUR 4,000 subsidies), hindering a faster rollout of electric vehicles.

Raw materials
Raw material prices related to EVs have significantly increased. The auto industry and battery manufactures will look for alternative technologies and materials, not least also due to supply concerns as they come from sensitive regions (e.g. the Congo). Hence, the lack of supply and its consequence of battery prices not coming down as projected could hamper the speed of the battery electric car rollout, and hence the smart mobility theme overall.

Electricity generation, distribution, charging
Burning fossil energy (e.g. coal) to generate electricity to propel EVs is suboptimal and poses a risk for EV penetration. A wide-reaching rollout of charging infrastructure is needed for highways and cities to ensure consumer acceptance. In urban areas, the lack of fixed parking still needs to be addressed to ensure individual charging can take place.

Shared mobility/platform challenges
The growth of car-sharing concepts could be overestimated, and the breakeven point for earning money is in some cases

years away. This could lead to large share price/valuation corrections. So far, platforms are forced to constantly reinvest in pricing strategies and drivers to maintain their network and market share. Replacing the driver with a driverless robotaxi will be key to ensuring a long-term viable business. As they are "platform only," i.e. not owing the fleet, captive auto finance and service subsidiaries might grab a large chunk of the business. Providing a platform might be a good start, but other platforms might arise, consolidating all others.

Appendix

Car-sharing concepts – Frequently asked questions (FAQ)

What's the big picture?
The rise of car-hailing and car-sharing services due to the consumer preferences of millennials, technological advances, and newly created platforms poses additional challenges to the auto industry but also offers great opportunities for others. Car sharing and car hailing are two sides of the same coin in that they raise utilization of private vehicles – the former by sharing with other drivers/owners, the latter by offering a chauffeured service (see Box 2), with the introduction of robotaxis being the ultimate solution the closer we move to 2030.

Will car-sharing concepts bring the new-car market to an end?
No. While car-sharing/car-haling could lead to a substantial reduction in the global car park in the long run, it need not necessarily impact annual global car sales due to rising car usage and the resulting increased wear-and-tear of shared vehicles. Consumers might want to share in order to reduce costs, but they are probably less willing to compromise, i.e. they do not want to sit in an unkempt and run-down vehicle. After an initial rebalancing of new car demand, the absolute level of new car sales should come back as replacement cycles will be shorter. We estimate the churn will be 3–4 times higher than private purchaser demand, as vehicles will be replaced roughly every three years, as we learned from various company meetings we attended.

Will car-sharing concepts end private car ownership?
No. In our view, car hailing and car sharing will not completely replace private car ownership. They will complement it, e.g. for going out in the evening, the same way they will complement public transportation, which will remain an important backbone for peoples' mobility needs. In our recent discussion with Uber, we noted that in London, for example, around one-third of all

Uber trips start or end at a tube (subway) station, confirming the complementary character of the various forms of transportation. Furthermore, car-sharing concepts might also face potential bottlenecks during rush hours, which probably not even robotaxis would be able to solve.

Is there one single car-sharing solution?
No. We believe in the future we will see a combination of car sharing and car hailing, and even a combination of both concepts by the same provider, depending on consumer preferences and, among other things, the parking situation at the point of destination. We will also see personalized car sharing, where upon opening the car via a smartphone app, it automatically adjusts the seats and air conditioning, and plays the driver's favorite radio station. Private consumers may also get more involved in peer-to-peer car sharing, i.e. renting out their privately owned car during the day or while they are on holiday. Car owners would benefit from generating an additional income stream and/or avoid parking costs, while the renter benefits from attractive rental rates. Peugeot Group, in partnership with TravelCar, is bringing to the US a traveler-to-traveler service, wherein car owners make their car available (i.e. share) while they are on holiday.

While peer-to-peer might compete at the same time with professional car-hailing companies, it also enables professional players to "lure" those cars on their platform, earning some additional returns from bringing both sides together. In our view, several concepts can be successful and run in parallel in a smart mobility world, to serve the individual preferences of consumers. However, we are still in the early stages of the trend and a lot of regulatory, liability, and even tax consequences have yet to be addressed, including the broad-based application of robotaxis in the long run.

Why should car sharing lead to substantially lower costs?
It's about spreading fixed costs. Electric and autonomous vehicle technology costs are expensive, and their high upfront battery-related costs are fixed, while variable costs are much lower (cheaper electricity vs. gas, 60–70% less maintenance costs). Utilization is key; higher utilization via car sharing and car hailing will spread out the initial price/investment of the car over more miles. Adding the replacement of the driver in the long run will reduce the payback period for car-sharing concepts to less than three years. This will make mobility-as-a-service a viable business model, and the consumer benefits as well.

Is the traditional auto industry involved?
Yes. Auto manufacturers are also trying to grab the opportunity

and several companies are actively engaged in this field, deploying different approaches to participate in car sharing. Of all leading global auto companies, in our view, Daimler has the leading position in car sharing (car2go). BMW (DriveNow; ReachNow) is also involved. Others have a different strategy and pursue strategic partnerships (e.g. VW/Gett, GM/Lyft, Toyota/Uber), or collaborate (e.g. VW/Zipcar).

So it is already a big business?

No. None of their ventures are commercially relevant or profitable at this stage, although, in the case of car2go and DriveNow, they claim that they are profitable in those cities where they are well established, i.e. enjoy a high utilization rate. For all of them, it is still too far in the future to make it a large enough business to influence the top or bottom line. Being active in the rise of car-sharing services is a good indication of who "owns" the consumer and thus should be able to generate additional revenue streams in the future. The existing players might be better positioned than many believe. Their existing large fleet of sold cars on the road, their increasing willingness to cooperate, and with the help of their own mapping service (HERE), they might be able to commercialize their know-how and data. They might surprise to the upside, putting additional (pricing) pressure on Uber and the like and rearranging the landscape in the long run.

Why is the auto industry collaborating with Uber and the like?

Because it makes sense, in line with our assumption that in the long run we will see a revenue-sharing model between platforms and fleet managers. On the technology side, Volvo Cars runs a project with Uber to test autonomous vehicles. Also, Daimler and Uber announced in January that they are joining forces to bring more self-driving vehicles (robotaxis) on the road. These alliances benefit both parties, in our view. In the last example, the alliance might help Uber command a price premium by offering premium brand vehicles, while for Daimler it is a strategy to keep large car-sharing companies from running only non-branded (white-label) cars, leaving traditional car manufacturers in the role of pure hardware provider. This has happened in the global IT industry, where value is being generated in software while standard hardware becomes a commodity with limited pricing power.

Non-Traditional Assets

Non-traditional asset classes are alternative investments that include hedge funds, private equity, real estate, and managed futures (collectively, alternative investments). Interests of alternative investment funds are sold only to qualified investors, and only by means of offering documents that include information about the risks, performance and expenses of alternative investment funds, and which clients are urged to read carefully before subscribing and retain. An investment in an alternative investment fund is speculative and involves significant risks. Specifically, these investments (1) are not mutual funds and are not subject to the same regulatory requirements as mutual funds; (2) may have performance that is volatile, and investors may lose all or a substantial amount of their investment; (3) may engage in leverage and other speculative investment practices that may increase the risk of investment loss; (4) are long-term, illiquid investments, there is generally no secondary market for the interests of a fund, and none is expected to develop; (5) interests of alternative investment funds typically will be illiquid and subject to restrictions on transfer; (6) may not be required to provide periodic pricing or valuation information to investors; (7) generally involve complex tax strategies and there may be delays in distributing tax information to investors; (8) are subject to high fees, including management fees and other fees and expenses, all of which will reduce profits.

Interests in alternative investment funds are not deposits or obligations of, or guaranteed or endorsed by, any bank or other insured depository institution, and are not federally insured by the Federal Deposit Insurance Corporation, the Federal Reserve Board, or any other governmental agency. Prospective investors should understand these risks and have the financial ability and willingness to accept them for an extended period of time before making an investment in an alternative investment fund and should consider an alternative investment fund as a supplement to an overall investment program.

In addition to the risks that apply to alternative investments generally, the following are additional risks related to an investment in these strategies:

- Hedge Fund Risk: There are risks specifically associated with investing in hedge funds, which may include risks associated with investing in short sales, options, small-cap stocks, "junk bonds," derivatives, distressed securities, non-U.S. securities and illiquid investments.
- Managed Futures: There are risks specifically associated with investing in managed futures programs. For example, not all managers focus on all strategies at all times, and managed futures strategies may have material directional elements.
- Real Estate: There are risks specifically associated with investing in real estate products and real estate investment trusts. They involve risks associated with debt, adverse changes in general economic or local market conditions, changes in governmental, tax, real estate and zoning laws or regulations, risks associated with capital calls and, for some real estate products, the risks associated with the ability to qualify for favorable treatment under the federal tax laws.
- Private Equity: There are risks specifically associated with investing in private equity. Capital calls can be made on short notice, and the failure to meet capital calls can result in significant adverse consequences including, but not limited to, a total loss of investment.
- Foreign Exchange/Currency Risk: Investors in securities of issuers located outside of the United States should be aware that even for securities denominated in U.S. dollars, changes in the exchange rate between the U.S. dollar and the issuer's "home" currency can have unexpected effects on the market value and liquidity of those securities. Those securities may also be affected by other risks (such as political, economic or regulatory changes) that may not be readily known to a U.S. investor.

Appendix

Terms and Abbreviations

Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
A	actual i.e. 2010A	COM	Common shares
E	expected i.e. 2011E	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office