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16.05.2021

Buckle up for the Electric-Vehicle Adoption
Invest in Winning Assets – Moving towards renewables

There are four irresistible bits of momentum behind clean electric mobility:

1. Capital markets are supportive of the generation change.
2. Mass deployment is the market requires new approach to materials.
3. Electric vehicles will help put the brakes on climate change.
4. New mobility + new skills = a new future.

Recent research suggests a very positive view for the electric vehicles industry, i.e., Auto 2.0. Novel technologies will appear and diffuse faster; existing opportunities—either at granular levels, such as individual jobs, or at corporate levels will be disrupted. This will impact industries and communities alike. Paradoxically, the adoption of EV cannot be seen as a singular event; rather the occurrence needs to be seen as global trade, evolution, and movement of people.

As we are at the onset of the secular trend, here are a few key notes you may want to know.

View on Electric-Vehicle Adoption:
The sector outperformed in H2/20 on the back of a strong demand recovery and substantial increases in consensus estimates. For 2021 expect now an evaporation of this catch-up effect.

Demand will fully recover to pre-pandemic levels by 2022 based on a consensus view, but there are headwinds to earnings from rising commodity prices (mainly steel) and temporary parts bottlenecks (chips) near-term.

As 2021 will be a "Year of the EV" with rapidly rising sales penetration globally, we expect companies with winning EV strategies to rerate and outperform the sector. More importantly, the shift away from traditional ICE to EV is occurring much faster than generally assumed. One OEM is aggressively shifting its business model towards EV, and it is assumed that by 2025 they will capture up to 30% of the EV-related Tier 1 auto supplies.

While the automobile market is growing by an annualized average rate of 2%, the shift to EV offers the strongest structural growth over mid-term across any sector and any market.

Key figures to know:

- USD 3’500	Estimated cost for powertrain components
- USD 26 billion	TAM for Inverters – Inverters have the highest profitability pools
- +80% by 2030	EV powertrain equipped cars
- <USD 4’500	Estimated price of low-cost EV
- 14 % (weighted average)	Annual EPS upgrade potential for EV suppliers
- High-voltage connectivity	HV and e-compressors offer the best revenue/profitability opportunities

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The move towards the use of renewable energies

The pandemic of 2020 was probably the turning point of the consciousness of many people towards the broader environmental balance. In fact, ever since industrialization first started, levels of materials consumed and emissions generated have been increasing.

After the Volkswagen diesel-gate scandal, diesel-based on-road vehicles have lost their attractiveness in the market and strict government reforms backed the implementation of sustainable alternatives. In the follow-up, some governments decided to deploy a myriad of benefits to corporations and private households with a view to stimulating demand and minimizing up-front costs for installations and electric vehicles.

Regional developments:

- Germany: The EV charging infrastructure industry will witness commendable growth prospects as a result of stringent policies aimed towards reducing the impact of GHG emissions on environmental and human health.

- Holland: The country is expected to install more than 200k units by 2025; therefore, the Netherlands will have the densest network of public charging stations.

The companies mentioned hereafter address multiple issues, i.e., design, development, and deployment of the EV-Infrastructure. The companies are ordered by attractiveness.

Battery recycling to support a greener e-mobility

Batteries can be far better for the environment than fossil fuels. That will be true once the issue with their significant CO2 footprint is addressed.

In Västerås, a small town in central Sweden, there is an experimental battery recycling plant. The company, Northvolt, has set itself the goal to recover the raw materials from used batteries and reuse them for new energy storage devices. Northvolt was founded in 2016 by two former Tesla managers. If they succeed in achieving a breakthrough in battery recycling, this would—provided it is scalable—be a milestone in overcoming the climate crisis. The plant has been active since the summer and is already producing functioning test batteries. (source Vontobel)

Comparison of Main Battery Recycling Methods Used to Recover Materials:

Hydrometallurgy: It is applicable to any battery chemistry and configuration, flexible in separation and recovery processes to target specific metals, energy efficient in comparison to pyrometallurgy, with high recovery, high purity of products, and no air emissions.

Pyrometallurgy: Smelting is applicable to any battery chemistry and configuration, no mechanical pre-treatment is needed (for consumer electronics batteries, whole packs can be treated), battery types do not have to be separated, and there is a high recovery of metals.

Direct Recycling (supercritical CO2): Almost all battery materials can be recovered.

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Challenges to overcome:

The primary challenges for battery recycling include the lack of a viable collection mechanism for spent batteries, low volume, and uncertainty regarding the full cost. The current lack of environmental regulations, low support from manufacturers, and limited available information on the economics of recycling have resulted in few end-of-life batteries being recycled relative to the number of recycled lead acid and NiMH batteries. Current recycling operations appraise high value materials from cathodes and disregard anodes and other pack components.

Recovered cathode materials could save more than 30% of the total battery pack, with more potential savings achieved by recovering other materials and parts from spent batteries. However, the example of lead acid batteries illustrates that favorable economics may not be sufficient alone, and a regulatory driver may be necessary to develop and maintain a viable LIB recycling industry.

Long-term challenges: Battery recycling primarily revolves around uncertainty regarding the future composition of LIB. If current efforts to decrease the cobalt content of LIB are successful, the economic viability of battery recycling could be threatened. Highly specialized recycling processes could also be rendered obsolete or ineffective if battery chemistries change significantly. Flexible, low-cost recycling processes that recover as many products as possible could be more effective in maintaining a long-term recycling industry.

Addressable market size:

In 2018, the market size for the EV-Infrastructure was in the region of USD 4 billion. TAM is expected to grow to USD 46 billion by 2025; this represents an increase of 41.1% per annum.

This fast advancement is possible due to gradual installations of battery swapping stations and fast charging stations that will reload a battery in less than 15 minutes.

Progressive advancements in battery technology are leading to the gradual installation of battery swapping stations that will strengthen the business landscape. Additionally, improved and efficient charging stations for a faster charging process, in comparison to conventional units, will further boost the business scenario.

Each year since 2017, more than one million electric cars were sold that will generate more than 250’000 tons of end-of-life battery packs. The volume is growing substantially annually which makes recycling more attractive than ever.

Northvolt estimates that by 2023, 50% of the raw materials used to make new batteries will come from recycled materials.

Investment opportunities

Ever since last summer when we stated the benefits of the European Recovery Fund (https://www.irisos.ch/Community/Blog.aspx?blogid=1037&title=A-taboo-lifts--The-European-Recovery-Fund) and the crucial role it will play in the fundamental changes to the alternative energy infrastructure, things have accelerated. Since then, the concerned secular growth trends have gone from strength to strength, with many governments around the world increasingly committing to not only decarbonizing a number of key sectors of their economies but also funding the research and development required to enact these transformational changes. For the EV infrastructure to be deployed properly, many sectors’ activities will interplay, and this will reach out to technology, automobiles, industrials, and materials, amongst others.

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One of the immediate beneficiaries of the EV infrastructure will be technology. Of the USD81 billion that was spent on technology in 2020, nearly a quarter went into fixed visual surveillance, smart outdoor lighting, and advanced public transit, according to the International Data Corporation.

Longer-term opportunities in EV infrastructure will come along with projects such as roads, railroads, water supplies, sewers, electrical grids, telecommunications (including internet connectivity, broadband, and fiber optic access), and self-sufficient skyscraper buildings, amongst others.

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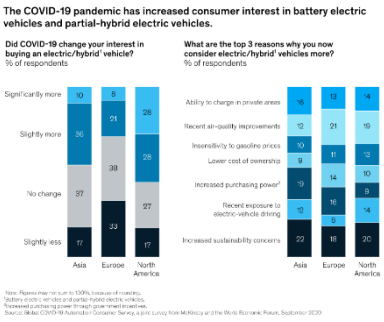
A – Z view for on other topics (not exhaustive):

Advanced energy storage systems:
As EV utilization ratios increase, decentralized electrical grids will integrate batteries, renewable power sources, modular reactors, and charging stations that serve groups of remote EV users.

Autonomous driving (ADAS):
Levels of autonomous driving are ranked from 0 (zero automation) to 5 (full automation). We believe that over the next 10 years, most new cars will reach level 2 to 3, with level 3 ("hands-off") in particular (conditional automation) offering companies profitable opportunities. To quote the head of Daimler's R&D, "horsepower is being replaced by the speed of semiconductor chips." Semiconductors and sensors are key for autonomous driving. By 2020, around 50% of all new cars were equipped with some kind of basic autonomous equipment. We see ADAS as a USD 35-40 billion (EUR 30-35 billion) annual revenue market for 2020, more than doubling to USD 90 billion (EUR 75 billion) by 2025, quadrupling 2017/2018 levels.

- For the detailed list names, please follow this **[link]**

Awareness for change:
The COVID-19 pandemic appears to have increased consumer awareness about the negative effects of travel, including congested roads and heavy emissions, but some barriers remain well in place.



A study from McKinsey suggests that the overall knowledge of EV technology is still relatively low, with many respondents stating they had never heard of AVs or advanced driver-assistance systems (ADAS), or they did not fully understand the meaning of these terms. One of the main things preventing EV adaptation from moving forward faster is the lack of understanding of the technology and its use.

Batteries:
As of today, batteries represent about 30% of the total cost of the vehicle or, expressed differently, about $200 per kilowatt hour. By the end of the present decade, kilowatt hour prices should be settling in the market for substantially below USD 50.

- For the detailed list names, please follow this **[link]**

Charging infrastructure:
Batteries are just half the equation. Having an omnipresent network of charging infrastructure available that allows users to charge to full capacity in under 15 minutes or so is the other. The rate of success of EV adoption will depend largely on the infrastructure available. Having an adequate infrastructure in place is certainly a multi-dimensional issue, and the scientific community is not quite there yet. We believe that one of the inflection points in the EV business will be the roll-out of this infrastructure, and rethinking network issues is a prerequisite for ultimate success. Bringing fast charger stations to the front door will generate a positive impact on the carbon

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footprint. Actually, business segments in the field are going to experience the fastest growth over the next five years.

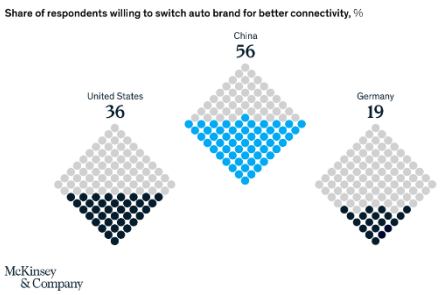
- For the detailed list names, please follow this **[link]**

Clean air and carbon reduction:
The US recently rejoined the Paris Agreement, and the Biden administration has proposed an infrastructure package that includes support for wind, solar, storage fuel cells, and EV infrastructure. With the political backing from across the major nations, these technologies are expected to drive forward the transformation:

1) wind and solar photo-voltaic (PV) energy
2) battery-powered electric vehicles
3) low-carbon and disruptive energy technologies (hydrogen)

Companies engaged in any of these three trends are expected to increase, during the next decade, by 5% - 15% their annual earnings growth.

Connected cars are in high demand in China:
Chinese consumers are willing to pay twice as much as their Western peers for such features. In China, 56% of consumers say they'd be willing to change brands for better connectivity.



Electrification:
The rollout of electrification is underway. We expect growth to be exponential rather than linear from 2020 onwards. We think that by 2025, around 25% of all new cars sold globally could be electrified, and at least 10% of them will be battery-powered full-electric vehicles with the rest being plug-in and full hybrids.

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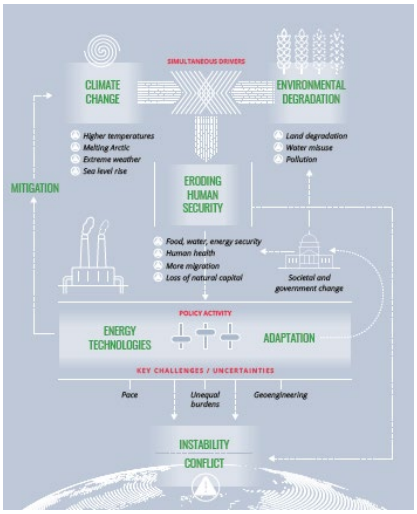
Energy transition is underway:
The range of today's technologies related to EVs will require more or less another 15 to 20 years to become mature. Many of these technologies will contribute to greater energy resilience and self-sufficiency for states.



Focusing on customers:
EVs will be about 35% lower in after-sales costs which is expected to put some pressure on traditional dealer structures.

Green-funding:
Changing consumer sentiment helped drive EV sales by 43% in 2020. The progress of zero-emission vehicles is inevitable en route with the € 1.5 billion European Green Vehicles Initiative supporting the industry. It is expected that by 2035, more than 95% of all cars and trucks on the road will need to be zero-emission vehicles.

Hydrogen:
"Green" hydrogen refers to hydrogen produced via the electrolysis of water, with the electricity used in the process sourced from renewable energy such as wind and solar. This process is considered to produce "green" hydrogen because no greenhouse gas is released as only renewable energy is used. Many electrolyzers (those using the "proton exchange membrane" (PEM) technology), use platinum as a catalyst for the reaction. According to the World Platinum Investment Council, "Platinum's role in the hydrogen economy is crucial both throughout the EU and beyond; it is used in fuel cells for fuel cell electric vehicles, as well as in the production of green hydrogen.

- For the detailed list names, please follow this **[link]**

Impact investing:
Roads and parking spaces use up 15–20% of all city space. Car sharing would reduce parking and road space needed. In 2016, more than 1.3 million people died from traffic accidents worldwide— more than 3,000 per day.

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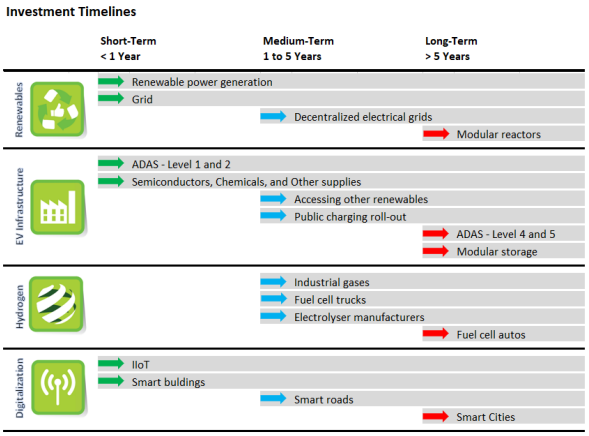
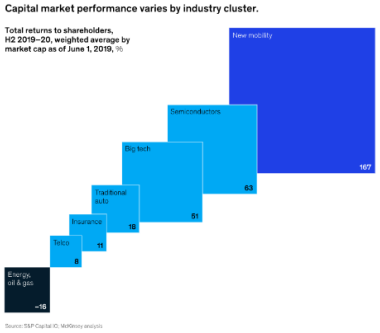
Investment time-horizons:
Investment opportunities in this transitioning economy are expected to occur at different periods. Many of them will offer multi-year opportunities across many industries.



Investment performance of new mobility providers:
Hybrids and EVs have been part of investment portfolios for some time now. Business models that push software first seem to work best.



Market penetration:
Pure EVs have presently a market share of just about 2%. By 2025, this figure will rise to about 7%, and by 2030, the market share of EVs will be about 25% for the US and for the remaining world about 30%.

Materials:
Building batteries is often related to stripping mines, intensive water usage, ubiquitous supply chains, and still limited facilities to recycle outgoing and used items. Improper implementation creates new ESG issues while we are trying to solve existing ones. Recently created research programs focus on sourcing new batteries from recycling circuits, EV-charging infrastructure, urbanization, amongst others. This would lead to greater efficiency and yields, less waste, and for some materials create a closed circuit. We would expect this to be possible within a time arc of 10 to 20 years.

Estimated investments needed to repair highways and bridges in unsatisfactory condition:

- Concrete bridges: USD 398 billion
- Concrete roads: USD 796 billion
- Steel bridges: USD 301 billion
- Asphalt roads: USD 1'693 billion

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Monetizing connected-car data:
Some industry stakeholders are in the process of changing their business model to cope with the changing requirements of the EV field. For instance, insurance companies have tailored insurance rates to driving styles, and some cities use built-in sensory data to assess the quality of the road network. A few media agencies have also increased their advertising reach through new touch points inside and outside of vehicles.

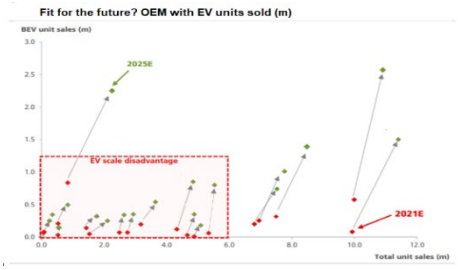
Profitability:
Up till now, none of the infrastructure providers have run a self-sufficient operation. The catch-22 is that most of the present EV users have the luxury, depending on their daily driving range, to select between a conventional car or an electric vehicle so that cars can be, in the absence of a dense charging station network, charged back home.

Given this, and in the hope that people will switch, one has to first create a dense infrastructure. The US administration is considering adding half a million public charging stations across the country by 2030 with subsidies of around $15 billion. The risk is that early movers may build an infrastructure that will have hard to reach profitability.

Pure plays and the disruptors:
The automotive industry is comprised of companies focused on the manufacture of electric cars, trucks, vans, and commercial vehicles, as well as companies that offer electric automobile parts and services. Yet, there are few pure plays; Tesla can be accounted for but as of now it appears to move to a broader eco-system comprising semi-conductors, batteries, electricity generation, and car parts, amongst others.

The electric car industry is young and growing quickly. Other names that can be included are Workhorse Group Inc. (WKHS) and Arcimoto Inc. (FUV), both are expected to experience rapid growth, but the list of challengers is growing.

Future - Who is fit? One can expect that by 2025 the automotive landscape will have changed much. While there is a good number of OEMs that can produce 1m units and more by 2025, only a very small number of OEMs with a full system approach provide evidence now for production scaling, and we would expect the same to be able to benefit best from efficient cost/income ratio, i.e., they will show a higher profit margin.



- For the detailed list names, please follow this [**link**]

Recycling:
When it comes to batteries, recycling is a must. The raw materials that go into batteries come from all over the world. The supply chain is long and complex—mining, refining, transport, assembly, transport, and installation—all this is far from green.

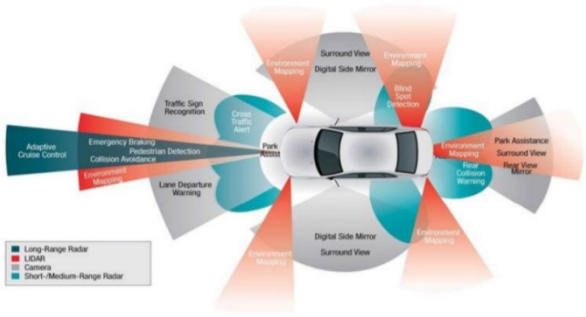
The process of obtaining raw materials and transforming them into battery cells is believed to account for the majority of the ecological footprint of manufacturing an electric vehicle. Batteries

also represent the largest cost component of an EV, so reducing costs through recycling could be an important factor in bringing EV prices down.

According to research obtained, if everything built in 2025 is done as it is today, there won't be enough material that can be injected into the battery supply chain. The good news is that one can recover about 80% of a battery's lithium and up to 95% of other materials such as cobalt, aluminum, graphite, and nickel.

Smart mobility:
By 2025, the annual addressable market of our theme is estimated to be around USD 400 billion, or 8–9 times today's size.

Semiconductors and sensors:
As of today, the automotive industry is a low-tech customer—the total auto industry spend on semis is around $40 billion a year, about a tenth of the global market. Yet tomorrow, the opposite will be true.



Software takes center stage in the new automobile. The automotive software market still has a huge growth potential ahead. The number of sensors, i.e., cameras, laser, radar, LIDAR, and ultrasonic, will increase substantially. It is expected that by the end of this decade, sales growth will be up by approximately 250% from today's levels.

- For the detailed list names, please follow this **[link]**

Shared mobility:
Corporate attention is mainly focused on autonomous EVs that might replace today's internal-combustion vehicles. Public attention is centered around advanced connectivity solutions for EVs so that content can be delivered to the EV user. Based on various research input, such subscription-based business models could generate up to $310 in revenues per car/year by the end of this decade.

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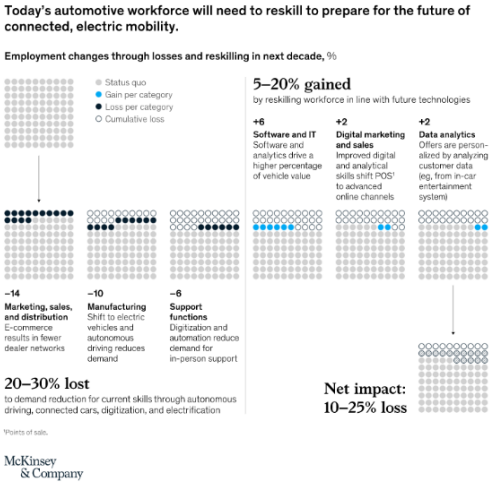
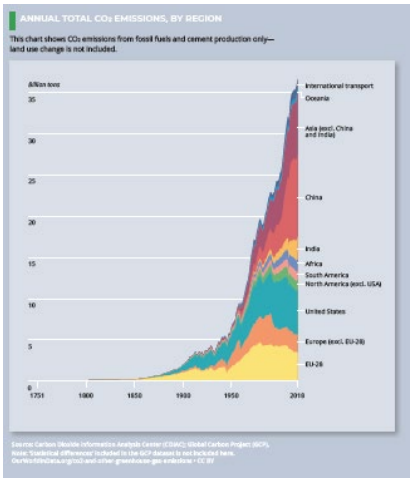
Skills:
Industry settings are changing, and hence the new mobility model requires new kinds of talent. The automobile industry will restructure its actual workforce more and more with digital skills to start with. New skills will be needed, especially in design, car-related software, and data analytics, which will be critical for online sales and marketing channels.



Structural growth:
We believe periods of elevated volatility in growth stocks create an opportunity to build strategic positions in likely structural winners in the decade ahead. We expect "The Next Big Thing" to emerge from industries undergoing tech transformation (e.g., FinTech, healthtech, greentech, or 5G).

Structural impact:
The costs and challenges of EV implementation will be disproportionally high in developed countries. EM countries should be more interested in rapid development of EVs since it will favor their economies industrially by lowering their own total CO2 emissions; Yet, the structural move towards EV remains largely unaddressed.



Transition technology:
Some research suggests that present developments in the field of EV are transitionary and that starting in 2040 different technologies will be mastering the field, in particular hydrogen technology. These developments are pushed forward on the back of CO2 emission standards; when measured throughout the entire life cycle of road transport emissions, these levels cannot be reduced enough with EV only and only new alternative energy models can achieve this. There are challenging times ahead!

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Urbanization:
In 2018 the UN estimated that 55% of the world's population lived in urban areas compared with just 30% in 1950. By 2050, this number is expected to rise to 68%, with nearly 90% of this growth coming in Asia and Africa (source: UN World Urbanization Prospects 2018). In particular, low-cost EVs will have a great future in highly dense urban areas; most them can be found in South-East Asia, Latin America, and Africa.

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