The Future Is Electric: Auto Suppliers And The Emergence Of EVs

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Key Takeaways

- The rate of adoption of electric vehicles (EVs) will be determined by tightening emissions regulations and the level of government incentives, battery costs, range anxiety, and infrastructure suitability.
- We expect the transition to EVs will occur at a faster rate in Asia, followed by Europe and then by the United States.
- Hybrids sales are and will continue to provide a cost effective way for automakers to comply with tougher fuel economy standards.
- EV sales could reach roughly 10% of global light-vehicle sales by 2025. How well-positioned traditional automaker and suppliers are to participate in this emerging market will increasingly have credit implications.
- Rising research and development costs at auto suppliers will pressure earnings for the next couple of years, but will be partly mitigated by cost sharing efforts with original equipment manufacturers.

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The transition of the global light vehicle fleet (car parc) from internal-combustion-engine (ICE) vehicles to that of pure electric vehicles (EVs) is still in its early stages. How quickly the adoption of zero-emissions vehicles will proceed, though, will largely be determined by the level of government support for policies that reduce CO2 emissions to combat climate change and enhance energy security. Governments, of course, can mandate changes in emissions reduction but they also need to play a role in making EVs more attractive in terms of economics and performance if they are to bring about mass adoption.

As the global car parc becomes larger, emission standards for many countries have become stricter and continue to converge. For instance, China has put in place regulations that limit average fleet CO2 emissions to 117 grams per kilometer; the U.S., 119 grams per kilometer; and Europe, 95 grams per kilometer by 2021.

Besides CO2, increasing fears around the consequences of exposure to nitrogen oxides (NOX) penalized the share of diesel in new sales in Europe, thus further accelerating the shift towards other engines, petrol in the first instance but also hybrids.

Still, while tightening emission requirements around the world are a necessary force in promoting EV adoption, they are not sufficient in themselves. This article will review the obstacles to mass adoption, the role of government incentives in removing these obstacles, the expected rates of adoption by region, and an update on how rated global suppliers are positioning themselves as judged by the breadth of their electrified product portfolios, stated strategies, and projections of future business.

Chart 1

Historical, Enacted, And Proposed CO2 Emissions Targets For Passenger Cars

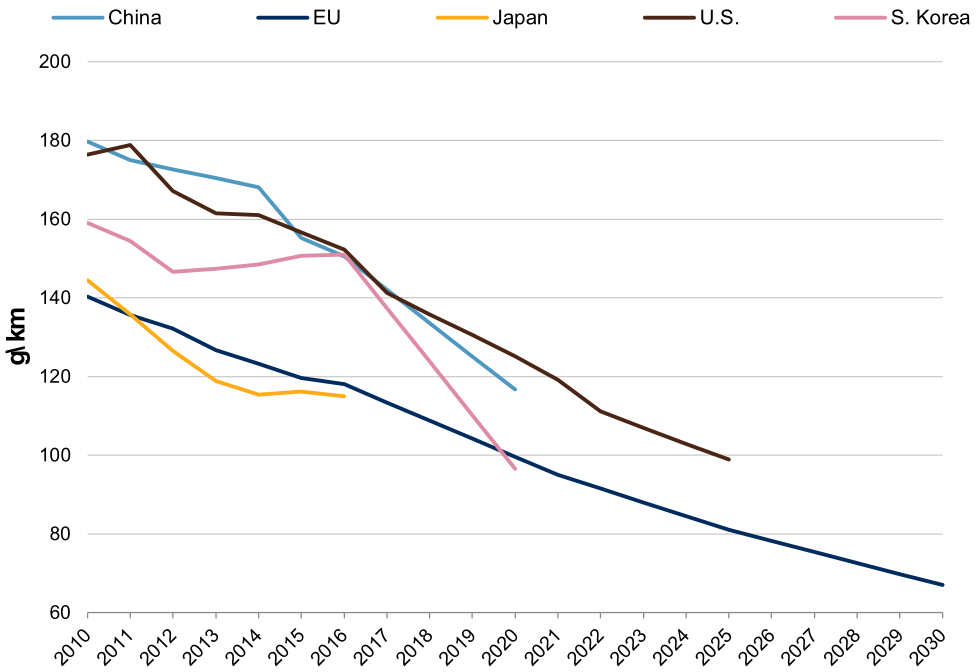
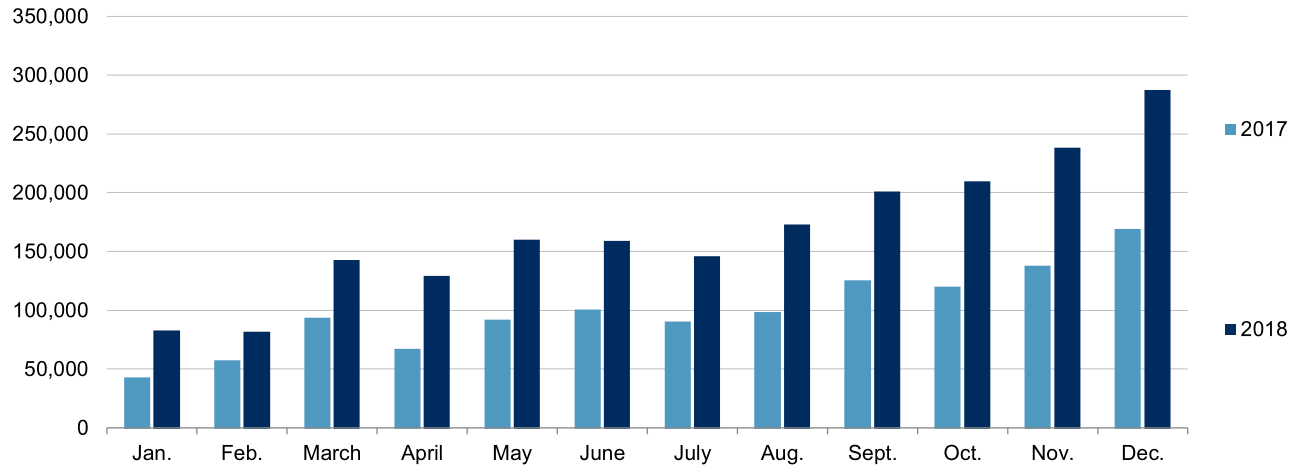


Chart 2

Global Plug-In EV Sales
2.0 million is 2018 versus 1.1 million in 2017



Source: Inside EVs.

I. Obstacles And Incentives

According to the International Energy Agency, the car parc for electric vehicles, including battery electric vehicles (BEV), plug-in hybrid vehicles (PHEV), and fuel-cell electric vehicles, exceeded 3 million in 2017 (1). Moreover, global sales of plug-in EVs exceeded 2 million units in 2018 versus sales of 1.1 million units in 2017. Still, despite vigorous growth, sales of plug-in EVs represented only about 2% of global sales in 2018. In order to jumpstart the market for electric vehicles, a number of obstacles will have to be surmounted before mass adoption can take place among consumers.

Battery costs are falling, but are they falling fast enough?

The high cost of EV batteries remains a major obstacle to mass adoption. Although adjusting the chemistry of lithium ion batteries could improve efficiency, the energy density is relatively fixed. As demand increases for EV, S&P Global Ratings expects to see costs of battery packs falling to more affordable levels due to economies of scale (2) ($100 per kilowatt is considered a breakthrough price for mass affordability). While there may be other technologies showing signs of promise for better performance (i.e. solid-state batteries), we think any alternate approach would need to have substantial advantages to displace the lithium ion battery as the primary technology for EVs in the near and intermediate term, especially given the level of investment in research and development (R&D) and manufacturing capacity to date. For instance, Robert Bosch GmbH, in early 2018, decided against the entry into battery cell production as the company estimated a required investment of about €20 billion to create 200 gigawatt hours of capacity (roughly equivalent with a market share of 20% in battery cell production) (3).

Additionally, Toyota Motor Corp. announced a joint venture (JV) with Panasonic related to automotive prismatic batteries, solid-state batteries, and next-gen batteries. Products produced by the joint venture will be sold to various automakers through, in principle, Panasonic, in an effort to be low-cost. Toyota is forming the partnership with an eye on China, as government policies drive rapid growth in the field. Toyota was initially cautious toward EVs given cost hurdles. Toyota's HEV does not count toward a new quota that China has set from 2019, requiring auto original equipment manufacturers (OEMs) to produce and sell a certain number of EVs or FCEVs. (4)

Coping with range anxiety

Another problem with EVs relates to range. To go farther, more batteries are required. For instance, the standard version of the Model 3 can go up to 220 miles without recharging. The enhanced model can go 310 miles, but at an extra cost of approximately $9,000. On a full tank, a gas-engine vehicle has a range of 300 miles to 400 miles, leaving some prospective EV customers with "range anxiety." To overcome this, EVs will need to be equivalent in terms of range when compared to a combustion-engine vehicle.

Developing the EV infrastructure

The growth of the EV car parc has kept pace with the number of chargers: there are about 3 million chargers in households and work places around the globe; chargers open to the public could be over 300,000 worldwide (5), and fast chargers comprise about one-third of those ("fast charge" currently translates to about 10 minutes per additional 40 miles). More drivers will adopt EVs when fast chargers have wider accessibility, and when charging speeds are comparable to the speed of filling up at a gas station.

To mitigate these concerns, governments have rolled out an assortment of incentives, such as tax exemptions or credits to drivers who switch to EVs, as well as preferential parking, toll rebates, and low-emission zones (6). Governments can also help utilities to increase their electric capacity to supply the growing demand, and improve the grid capacity. This could involve allowing non-utility players to enter the charging servicing market (7). Also, regulations can be targeted to require new or renovated building to be EV-compliant.

We also expect several large automakers to pursue stationary storage as a growth opportunity to lower charging stations' costs over the next 5-10 years. VW's unit Electrify America recently announced that it will install Tesla Inc.'s battery storage packs (which draw power from the grid during off-peak hours and store it for use during peak hours) at several stations across the U.S. to keep costs down for drivers charging electric vehicles.

Public policy can also drive mass adoption of this technology through public transport. This has the added benefit, for carmakers, of increasing the number of vehicles and boosting the scale of the industry.

Finally, governments will have the lead role in enacting laws to encourage the recycling of spent batteries to maximize their residual value and minimize environmental harm (8).

II. Adoption Rates Of EVs By Major Geographies

China

We see the policy push as being strongest in places like China. The government's control of the economy allows it to mandate the adoption rate of EVs for the entire country in order to reduce emissions and improve the air quality of its major cities. Moreover, the focus on quickening the pace of EV adoption could allow it to leapfrog the U.S. and Europe in terms of leadership in production of zero emissions vehicles.

In 2018, Chinese companies made and sold 1.26 million EVs, up 61.7% when compared to 2017 (9). China made up 40% of the global EV car parc in 2017 (10). The Chinese government is targeting new energy vehicles (NEV) sales of at least 7% of domestic market share by 2020 and 20% of domestic market share by 2025 (11).

The Chinese government has also taken an active role in incentivizing EV adoption by, for instance, ensuring the issuance of a license, thereby allowing prospective car buyers to bypass the existing cap for conventional vehicles in tier-1 cities, and granting access to carpool lanes (12). Moreover, the total subsidies from both the central and local governments for EVs with a range of 250 kilometers or more was approximately $7,000 in 2018, although with a declining trend.

As NEV subsidies will become a significant burden, the Chinese government has policies in place that will shift the onus of incentives to the automotive industry by 2020. In September 2017, China mandated minimum production requirements for the auto industry for PHEVs, BEVs, and fuel cell electric vehicle (FCEVs). Automakers will need to earn a minimum level of net NEV credits by making or importing electric vehicles or buying NEV credits from other automakers. Earning credits will depend on the range and energy efficiency of the vehicle and can be limited by vehicle type. Automakers that do not meet corporate-average fuel consumption (CAFC) standards will receive negative credits (12), which these companies will have to offset by its own positive NEV credits, purchasing positive NEV credits from other automakers or potentially decreasing the number of combustion engines vehicles they produce (13).

Japan

Japan has been ahead of the electrification curve for years (14), mainly led by HEV. The government targets a diffusion rate of xEV (EVs broadly, including HEV, PHEV, BEV, and FCEV) of 50% or more (including EV and PHEV of 20%-30% in total) of all domestic passenger vehicles in 2030.

Japanese auto OEMs and part suppliers are preparing accordingly for several scenarios for future penetration of electrification and R&D expenditures. One is that the HEV/PHEV-led market continues, based on the assumption that battery prices remain high and transportation systems hardly change. Another is that the market will suddenly change to a BEV (battery EV)-led one, assuming battery prices decline sufficiently and transportation systems improve dramatically with a huge improvement in range and charging time.

Europe

We think Europe will see a spike in EV adoption in order to achieve greenhouse reduction targets in line with the Paris Climate Agreement. In spite of some resistance from Germany in the latest rounds of negotiations, we believe there is a strong consensus regarding the need to reduce greenhouse emissions among European nations. Representatives of the European Commission, the European Parliament, and the European Council recently agreed on a target to cut CO2

emissions per kilometer for new cars by 15% by 2025 and by 37.5% by 2030, relative to a 2021 baseline. For light-commercial vehicles, a 15% target for 2025 and a 31% target for 2030 were agreed upon. Manufacturers failing to meet these emissions targets will pay a penalty per vehicle for every gram per kilometer (g/km) by which the manufacturer's fleet average CO2 exceeds its target.

European leaders have also set sales targets of zero-and-low emissions vehicles (ZLEV) of 15% of new cars sales by 2025 and 35% by 2030; for comparison, in 2017 the market share of EVs amounted to about 2.0%. These sales targets are nonbinding and exact no penalties from manufacturers not meeting them, but do offer a bonus in the form of higher CO2 emission targets for those manufacturers exceeding them.

The U.K. and France have announced that they will ban sales of light vehicles with combustion engines by 2040.

European leaders have other incentives in place, too. Norway, the market share leader for EVs, has found that value-added tax (VAT) and vehicle registration tax exemptions, free access to toll roads, and circulation tax rebates are most effective in influencing the purchase of EVs (15). In Northern Europe generally, the adoption of EVs has been encouraged by cutting the initial price of the vehicle. As EV adoption rises and upfront costs moderate, regulations and mandates will play a key role in ensuring adoption (16) by shifting the burden of environment compliance to the OEMs.

United States

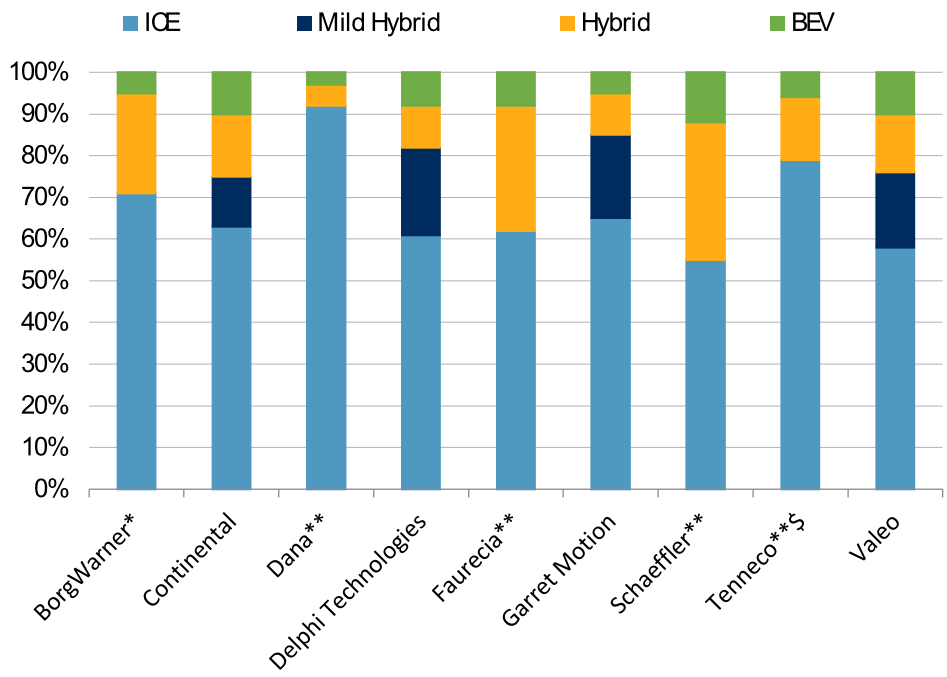
The U.S. appears split on the urgency of climate change and the role regulations should play in addressing greenhouse emissions. In April 2018, the U.S. Environmental Protection Agency (EPA) decided that current emission standards--under which about 5% of new light vehicle sales in 2025 would need to be plug-in EVs--were too strict. We see the Trump administration relaxing current fuel efficiency targets for 2025. The lack of certainty complicates automakers' decision-making regarding long-term investments.

Nevertheless, California, the most populous state in the U.S. and often a trendsetter regarding environmental standards, had in the past been granted a waiver by the EPA and plans to comply with the stricter rules despite any relaxation of federal standards (17). California and 13 other states have adopted requirements on auto companies to meet a level of zero-emissions vehicles sales or buy the ZEV credits to comply. This could be problematic for automakers if the car market is split into two, following a stricter standard from some states and a looser one for others. We believe, though, that automakers are more likely to build fleets that comply with more-stringent emission standards than to split production into two standards, which would increase the cost of manufacturing vehicles by requiring them to make two sets. In addition, there is no guarantee that the Trump administration will remain in office beyond the next election, and that its current policy directives regarding CAFÉ requirements will stay in place.

III. Transitional Phase: Hybrids

Chart 3

Powertrain Mix By 2025



*Mix by 2023; 25% estimate is for all hybrids. **Hybrid percentrage includes mild and full hybrids. $BCG Estimates.

Mild hybrids

According to industry forecasters, plug-in and pure battery electric vehicles will make up less than 15% of light vehicle sales by 2030. Again, consumer acceptance is a wildcard and the speed of acceptance will be substantially influenced by government regulation and incentives. Therefore, mild hybrids and full hybrids (each defined below) will play a meaningful role in the transition to electric vehicles. The industry will employ a mix of these vehicle types to cost-effectively comply with increasingly stringent emission requirements.

Mild hybrids run on combustion engines but are also equipped with electric motors. The electric motor does not propel the car but allows the engine to be turned off when it has stopped or is braking. Mild hybrids can deliver 10% to 15% improvement in fuel efficiency when compared to a normal combustion vehicle (18). A mild hybrid also costs less than a full hybrid, as the latter is a more complex propulsion system. A number of OEMs and suppliers such as Audi, Mercedes, and Delphi Technologies PLC have introduced mild hybrids with 48V electrical architecture (19).

To comply with increasingly stringent emissions regulations, the traditional combustion engine vehicle will have trouble (20) that hybrids will not, though hybrids can be costly. The mild hybrid's 48V technology does not replace the 12V system but is connected by way of a converter (21) and

has four times the power of a conventional 12V system. These systems can offload air conditioning compressors, coolant, and oil pumps that run on the high voltage directly (22). The high voltage also allows the use of better fuel technologies and superchargers (23). This results in better performance and lower emissions.

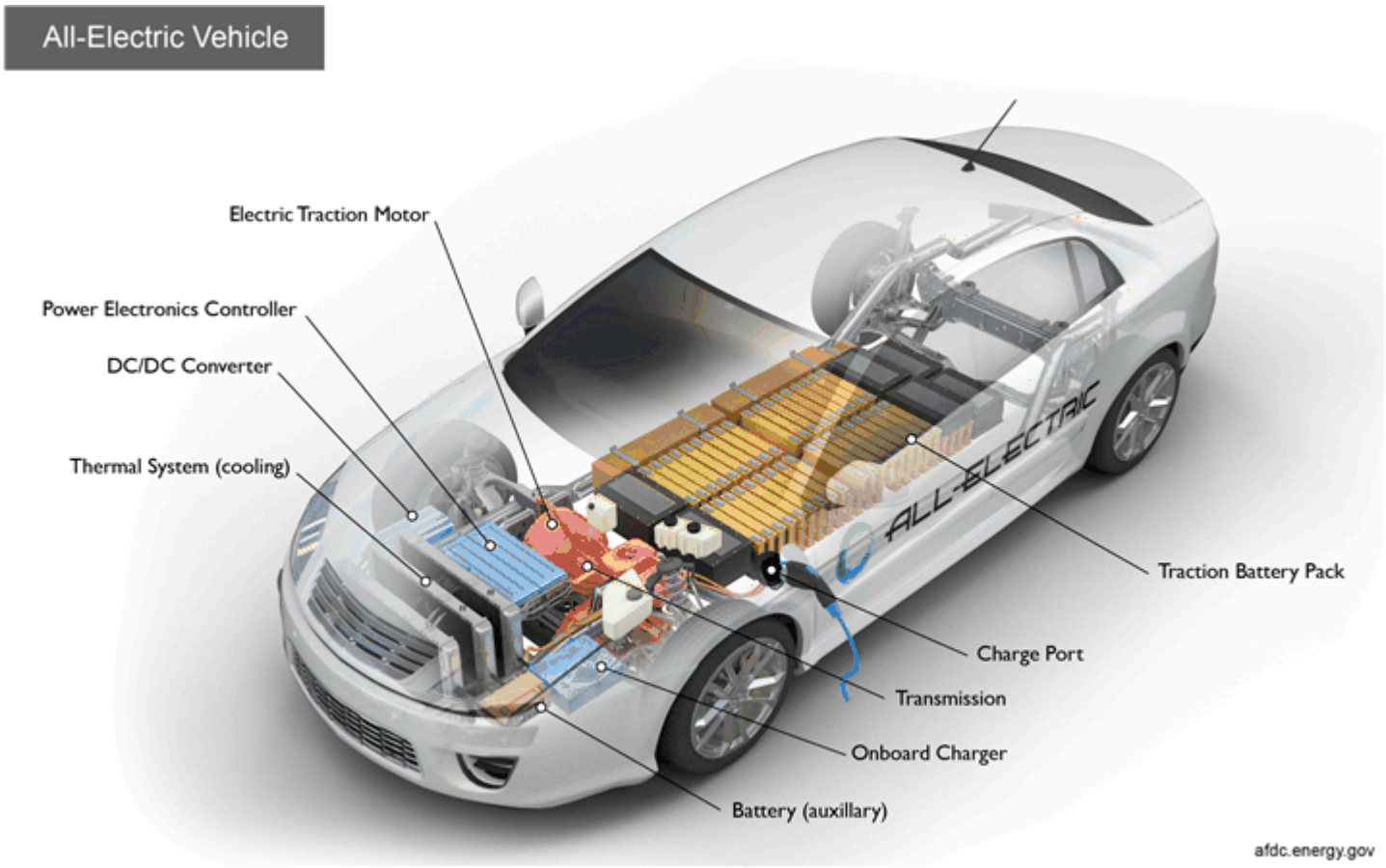
A 48V system can reduce NOx emissions and lower the cost of exhaust after-treatment components (24). Also, the combustion engine can shut off in more situations, yielding fuel savings. It can help reduce engine size without sacrificing performance.

In summary, the benefit of 48V mild hybrid is that it can reduce emissions by 15%-20% but increases the cost of a car by $800-$1,000 (25).

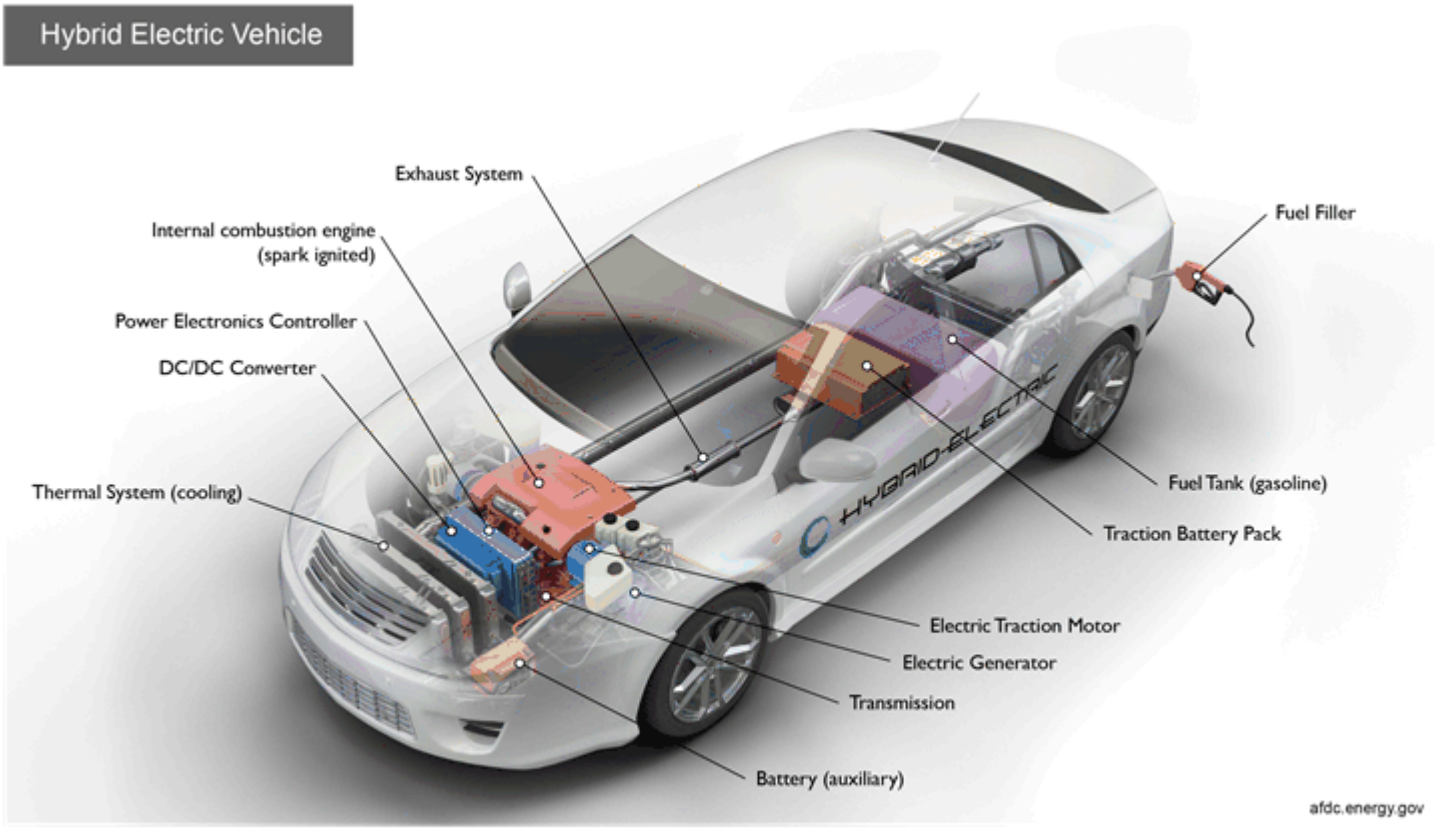
Full Hybrids

A full hybrid has an electric motor with a gas engine. The electric motor is in use while the car is running and uses a big battery for power. A PHEV is similar to a full hybrid but its battery can be charged by an electric outlet at home or in a garage.

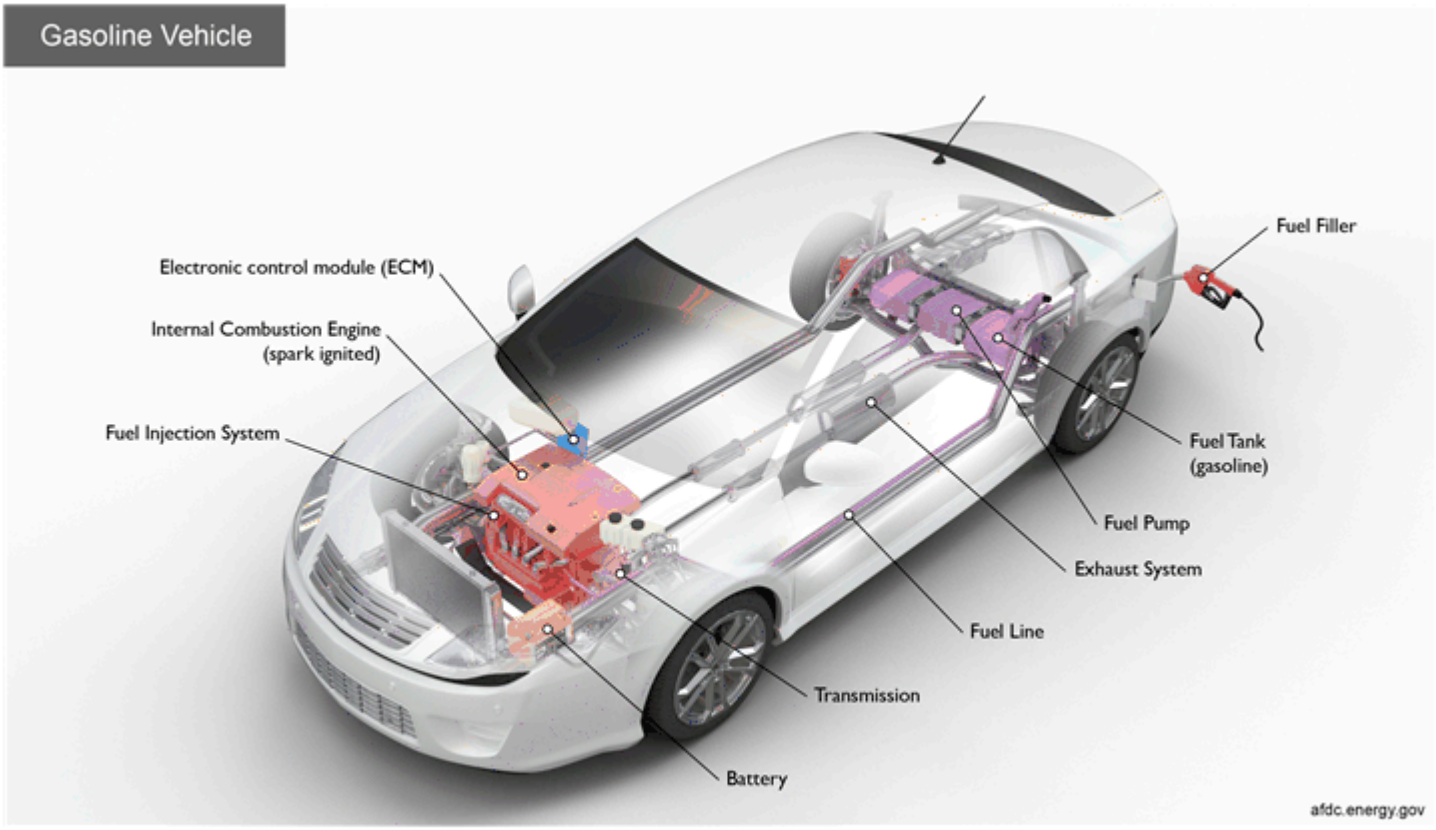
Full hybrids can offer many of the perks of a mild hybrid, including higher miles per gallon (mpg) than conventional gas engine cars. Full hybrids will turn off the car's gas engine when stopped, and then supply energy for accessories while the vehicle idles. Also, the conventional engine can kick in when the car accelerates. Hybrids also store braking energy that can be turned into electricity and help boost performance; moreover, they can equal or surpass the power of an internal combustion engine (ICE) car. And full hybrids can decrease emissions by 30%-50%. However, the price of a full hybrid could be $3,500 more than that of a comparable ICE vehicle.



Source: U.S. Dept. of Energy



Source: U.S. Dept. of Energy



Source: U.S. Dept. of Energy

IV. Credit Consequences

EV sales could reach about 10% of total light vehicles sales by 2025. Major auto parts and component suppliers we rate have enhanced their abilities to develop and market new technologies for EVs. However, as their strategies have become more diverse, R&D costs will rise, at least for the next few years. How well-positioned automakers and suppliers are to participate in this emerging market will increasingly have credit implications.

Chart 4

R&D To Sales 2014-2017

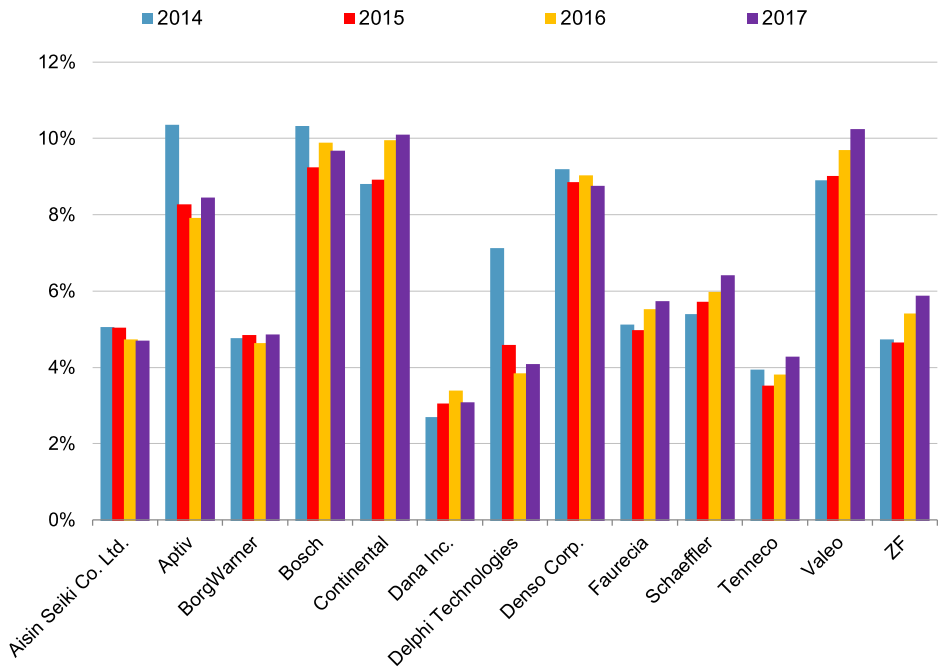
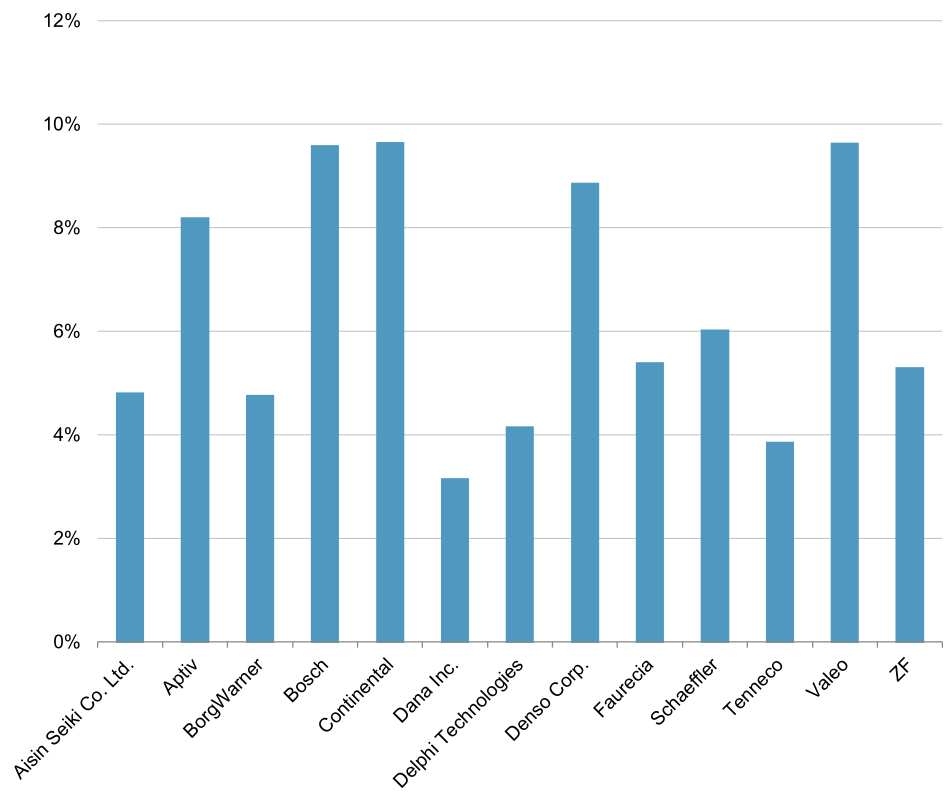


Chart 5

3-Year Average Of R&D To Sales: 2015-2017



Aisin Seiki Co. Ltd. (A+/Stable/A-1)

Aisin Seiki, an Japan-based affiliate of Toyota Motor Corp., is one of the world's largest suppliers of drivetrain-related, brake and underbody-related, body-related, engine-related, and other automobile components. Its drivetrain-related products are particularly competitive, and it holds the leading share globally for automatic transmissions (AT), supplying various global automakers including European premium brands and Chinese automakers. The company derives about 55% of its sales from Toyota companies.

We view electrification as credit positive for Aisin Seiki for the short term but negative over the longer term. The company has captured expanding demand for AT from global automakers, and we expect this demand to remain solid even as markets transition to full-fledged electric vehicles and fuel cell vehicles. Even so, we think a shift or faster-than-expected rise in demand toward electric vehicles without automatic transmissions may be a long-term risk factor for Aisin. We believe the company will partly mitigate this risk by expanding its lineup of electric drive units consisting of motors and speed reducers. The company has already delivered one-motor HEV transmission units, and expects to be ready for mass production in January 2019. In addition, the company is developing a large-capacity type "eAxle" electric 4WD unit for use in large SUVs and minivans.

Aptiv PLC (BBB/Stable/--)

Aptiv designs and makes components, connectors, wiring assemblies and harnesses, cable management, electrical centers, and hybrid high voltage and safety distribution systems (26). Recent acquisitions such as KUM and Winchester continue to strengthen its global position in electrical architecture and next-generation technologies, such as high-speed connectivity and autonomous driving (27).

Increasing electrification will provide opportunities for higher content per vehicle. Low voltage combustion content per vehicle is about $500 (28). For full hybrid vehicles, the anticipated content per vehicle would be $600 to $800, including internal battery connection, 12V battery monitor, high voltage shielded cable, and high power/voltage connectors (29). For plug-in hybrids and full electric vehicles it would create content per vehicle of $900 to $1,100, including internal battery connections, 12V battery monitors, high voltage shielded cables, high power/voltage connectors, charging inlets and cables, and on-board chargers (30).

In 2018, revenue for electrification was about $300 million (31). High voltage electric sales jumped 55% in the fourth quarter and over 60% in fiscal 2018 (32). The company expects this amount to increase to over $1 billion by 2022 (33).

BorgWarner Inc. (BBB+/Stable/A-2)

BorgWarner has a portfolio of products that improve the efficiency of combustion engine vehicles (34). Its engine business makes turbochargers, "eBoosters," timing systems, emissions systems, and gasoline ignition technology (35) products that improve fuel economy, decrease emissions, and lead to better performance.

BorgWarner also produces drivetrain technologies for combustion, hybrid, and electric vehicles. Products include rotating electrical components, power electronics, clutching systems, control modules, and all-wheel drive systems.

With the acquisition of Remy International and Sevcon, the company has added a suite of products and expertise for a variety of propulsion systems. By 2023 the company believes it will generate $14 billion in revenue, about 1/3 of which will come from hybrid and electric vehicles (36). At the same time, the company is targeting EBIT margins in the lower 13% area and $1 billion in free cash flow (37).

The company has three drivers of growth: it invests 4% net of customer reimbursement of R&D (38); it has a merger and acquisition (M&A) strategy to ensure it stays on the cutting edge of technology (39); and it invests venture capital funds to understand industry developments and track promising technologies (40) to meet the needs of potentially 26 million hybrids in the market by 2023 (41).

There are a number of hybrid architectures, and BorgWarner has products for all of them (42). P0 architecture puts the electric motor in front of the vehicle and next to the internal combustion engine (43). P2 puts it between the engine and transmission (44). P3 couples the electric motor to the output shaft of the transmission. With P4 it is in the back of the vehicle next to the axle (45). This comprehensive design expertise should help it win new business as the pace of hybridization hastens.

By 2023, the company's content per vehicle on an ICE engine will be $210, on a hybrid $275, and on a battery electric vehicle $340 (46). The company is projecting that close to 50% of the car parc will have BorgWarner content by that year.

We believe BorgWarner's expertise in the full EV architecture places it well competitively. We see a lot of leeway in differentiating electric motors and power electronics and therefore the opportunity

to expand margins. (47)

Robert Bosch GmbH (AA-/Stable/A-1+)

Bosch is the leading global automotive supplier. Its Mobility Solutions business, which generated about €47.4 billion of revenues in 2018, includes powertrain solutions, chassis systems control, and electrical drives (48). Its above-industry-average R&D spending--averaging about 10% of sales over recent years--largely targets automation, electrification, and connectivity. It has a wide product offering for emissions-free transportation, such as light commercial vehicles and light and heavy vans (49), which should allow the group to leverage its technology across a larger number of applications.

At the beginning of 2018, Bosch combined its Gasoline Systems and Diesel Systems businesses with its electric mobility unit, creating a new Powertrain Solutions division (50). This division today has a very broad product portfolio, including fuel-injection systems and exhaust gas management systems targeting emission reductions for internal combustion motors.

Bosch also develops and manufactures a wide range of systems and components for an electrified powertrain, such as electric motors, power electronics, and battery systems, as well as a new 48V battery for hybrids and an e-axle for electric vehicles (51). This "eAxle" is an all-in-one electrical powertrain that combines the electric motor, power electronics, and transmission in one system, making it more efficient and cheaper (52a). The company signed a strategic partnership for automated and electric driving with the Chinese electric car manufacturer, NIO, in July 2018 and will start production in China of the e-axle in 2019 (52b). In sum, we believe Bosch's EV products can help its customers manage the shift away from ICE, while its gasoline and engine technologies can remain competitive over the coming decade.

Bosch aims to increase its sales in electro-mobility to a total of €5 billion by 2025. Similar to other auto suppliers, the group continues sourcing battery cells from dedicated suppliers, having discontinued its research into cell technology and production in 2018 (53).

Continental AG (BBB+/Stable/A-2)

With about €44 billion of revenues in 2018, Continental is the second-largest global auto supplier. The group offers products across combustion, hybrid, and electric engines through its Powertrain division, which was carved out as a separate legal entity in July 2018 (54). This separation should allow a clearer focus on automobile electrification over the coming years, and the company shall be prepared for a partial initial public offering not before mid-2019. In the first nine months of 2018, powertrains generated about €5.8 billion or about 17% of group's sales, with an EBITDA of €457 million or about 10% of the group EBITDA.

The group is well positioned across combustion, hybrid, and electric propulsion systems, including 48V solutions, plug-in hybrid solutions, DC/DC converters, power electronics, battery management systems, and thermal management components. The company announced in 2018 that the potential content per car in comparison to a combustion engine could be about 1.6x-3.6x in HEV-related offering, and about 4x for BEV cars. This is somewhat lower than what some competitors expect, owing to the group's already high content with its extensive product offering (55).

Despite the growth potential that a shift to hybrids and BEV offers Continental, we expect to see continued margin pressure in the next few years given extensive upfront development costs that the group will need to absorb until electric vehicles achieve sufficient scale.

Continental founded a joint venture for the production of 48V battery systems from its Chinese partner, CITC (though its subsidiary, CALB) (56). Continental's management has indicated it will likely come to a decision on whether to produce battery cells internally only after 2020 (57).

Dana Inc. (BB/Stable/--)

Dana is a global supplier of axles and driveshafts for the light vehicle, commercial vehicle, and off-highway markets (58). It also makes sealing solutions, such as gaskets, seals, and heat shields; thermal-management technologies, such as transmission and engine oil cooling, battery and electronics cooling, and exhaust-gas heat recovery; and fluid-power products, such as pumps, valves, motors, and controls (59).

The recent acquisition of TM4 and the pending acquisition of Oerlikon Drive Systems fill out Dana's product portfolio regarding combustion, hybrid, and electric propulsion systems. Oerlikon will enhance Dana's capability in hybridization and electrification and adds manufacturing capacity in India and China (60). TM4 is involved in combining the electric motors, inverters (converts direct current (DC) to alternating current (AC)), e-gear boxes, and thermal management product into a unified system (61) and, according to Dana, offers a complete e-propulsion design and manufacturing network (62).

Delphi Technologies PLC (BB/Stable)

Delphi Technologies provides combustion engine, hybrid, and electric products for light-vehicle and commercial vehicle propulsion systems. Delphi Technologies' product portfolio targets ICE, hybrid, and pure electric propulsion systems and therefore, in our view, is a positive feature of its business risk as it allows the company to adapt and cater to the type of vehicles demanded by consumers.

The company offers gasoline direct injection technology, diesel fuel injection systems, and a variety of powertrain products such as variable valve timing, sensors, and ignition products(63). Moreover, it provides electronic control modules and power electronics solution for all levels of electrification, including supervisory controllers and software, DC/DC converters (circuits that convert direct current to a different voltage), and inverters (64).

The need for software is doubling every three years, processing speeds are 36 times faster than they were 15 years ago (65), and systems integration has become more complex with more devices to connect. To address this, Delphi Technologies has tasked over 30% of its 5,000 engineers with developing software and systems (66). The company ships over 10 billion lines of code per day, and we expect this amount to increase by 5x over the next three years (67). Its teams design in a graphical user interface that converts the design into code (68) that can determine, for example, how efficiently the energy from the battery is used (69). Higher efficiency means more range and lower battery cost (70).

Delphi Technologies also has significant systems expertise in motor control using their inverters, DC to DC converters, and battery charging and control. According to the company, its key differentiators are its power electronics portfolio, its patents, and its 35 years of engine management experience (71).

Delphi Technologies has stated that its 48V hybrid will reduce C02 emissions by 15% and provide an incremental content per vehicle of $450 (72). A full hybrid will reduce CO2 emissions by 25% an increase content per vehicle by about $1,200 (73). A plug-in hybrid will reduce CO2 emissions by 50% and increase content per vehicle by about $1,500 (74). An EV will reduce CO2 emissions by 100% and increase content per vehicle by about $1,500 (75).

Denso Corp. (AA-/Stable/A-1+)

Japan-based Denso generates about 45% of its sales from Toyota, although it has a solid record of supplying auto parts to many other automakers and plans to expand its sales to Chinese OEMs. Its track record in joint development with Toyota for hybrid electric vehicles and plug-in hybrid electric vehicles, which Denso has been engaged in since the early 2000s, makes electrification a

credit positive for Denso: we believe the company has a head start on auto parts for HEV and PHEV and will be able to spend sufficient R&D costs for advanced driver assistance systems (ADAS) and mobility as a service (MAAS).

Denso has particular expertise in car air-conditioning systems, components for hybrid vehicles, small electric motors, gasoline fuel-injection systems, and thermal management systems, which will remain one of the key items for EV period. Moreover, it has increased new business in the fields of control systems and software used to integrate autonomous driving capabilities with existing fundamental functions in automobiles. With this, we expect Denso to maintain a strong competitive position and certain pricing power against OEMs both in the environmental and safety technology sectors supported by its technological expertise in developing new products and sufficient funding capacity.

Faurecia S.A. (BB+/Stable/--)

With about €17.5 billion of revenues in 2018, Faurecia operates in three business segments: seating (42.5% of revenues in the first nine months of 2018), interiors (31.2%), and clean mobility (26.3%), which develops and manufactures anti-pollution systems for internal combustion engines, which would not be required for an all-electric car. Thus, demand for its clean mobility products will decrease with the increasing number of pure electric vehicles. Nevertheless, such systems will remain necessary for hybrids, which use a combination of an internal combustion engine and an electric motor. Faurecia estimates that pure BEV will account for about 8% by 2025; implying that 92% of new cars will still require anti-pollution systems.

Pure BEVs will not meet the needs of a significant part of the market (for instance, outside mega-cities and in developing countries), both in terms of autonomy and costs. Faurecia still sees growth opportunities in exhaust after-treatment systems, which are lighter, more compact, and cost-competitive. Besides, the tightening of emission standards in Europe, China, and India will also require more efficient anti-pollution devices for commercial vehicles and, therefore, increased content per vehicle.

Even though Faurecia does not expect a decrease in the number of ICE-equipped vehicles in the near or intermediate term, thanks to the global growth of the automotive market, it has launched a new division called Zero Emissions, through which it is developing a range of battery-related products and working on weight reduction and volume performance in order to improve vehicle range and energy efficiency. It targets an average content per car for battery electric vehicles of above €600, as compared with an estimated content of exhaust systems for hybrid vehicles around €300 in 2025.

Faurecia is also investing in fuel cell technology, with the goal to halve the cost of the fuel cell stacks to make them a more attractive option for automakers to integrate into their electric vehicles. It is currently co-developing fuel cell stacks with the French atomic energy commission, and won its first contract for composite hydrogen tanks for a fleet of light commercial vehicles in Europe. The potential content per car could reach up to €6,000 per FCEV.

Faurecia's manufacturing capabilities and long-standing relationships with OEMs represent key assets for developing cost competitive products and becoming a credible supplier for low or zero C02 emissions cars.

Schaeffler AG (BBB-/Stable/--)

Schaeffler's Automotive OEM division provides mechanical components and systems predominantly for internal combustion engines, with annual revenues of €9.1 billion in the 12 months ended Sept. 30, 2018. With relatively high exposure to ICE technology, we expect Schaeffler will need to offer alternative electrified products in the coming years. With recent

product developments, it now offer complete powertrains with electric motors and transmissions, while it continues to supply individual components to other auto suppliers (76). Schaeffler is expecting a gradual transition to 70% electrified powertrains by 2030, of which 40% will be hybrids (12% BEV and 33% HEV by 2025) (77). For EVs, the company is already developing the e-axle transmission for the new Audi e-tron (78).

As of the third quarter of 2018, Schaeffler's new E-Mobility business division, which encompasses its products and systems for hybrid and battery-electric vehicles, represented only 5% (€349 million) of its Automotive OEM division's revenues. Still, this was up 12.2% over the same period in 2017.

The company has the scale and financial flexibility to make larger investments and bolt-on acquisitions, as it did with the recently announced acquisition of Elmotec Statomat, a supplier of machines for the production of stators for electric motors, alternators, and generators. We factor in €0.5 billion of bolt-on acquisitions per year for Schaeffler in our current base case. While such action would initially reduce profitability, we believe the failure to ramp up its electrified product offering could weaken Schaeffler's competitive position and growth prospects over the long term.

Tenneco Inc. (BB/Stable/--)

Tenneco operates globally in two segments: Clean Air (70% of 2017 revenue) and Ride Performance (30%). Its 2017 revenues were $9.3 billion. But as a result of the October 2018 acquisition of Federal-Mogul, Tenneco's pro forma 2017 revenue was about $17.1 billion.

In the second half of 2019 Tenneco plans to separate into two independent companies: aftermarket and ride performance ($6.4 billion in revenue), and powertrain technology ($10.7 billion). The new powertrain company will focus on engine performance, tightening emissions regulations, and light vehicle hybridization. By 2030 the company expects full battery electric vehicles to comprise just 13%-15% of light vehicle production (79); consequently, combustion engine vehicles and hybrids will continue to be an important means of transport.

In 2017, Tenneco was involved with 17 hybrid programs in production (80). In 2018 it participated in 11 hybrid program launches (81). In addition, it has won nine hybrid program awards in 2018 as of the third quarter of 2018. These wins will help drive future growth.

One concern investors have is Tenneco's lack of product portfolio to capitalize on the trend towards EVs. Tenneco is considering a few options: wait for the dominant EV technology to emerge and make key investments at that time (82); further consolidation (83); or invest in the commercial vehicle space, which is less susceptible to electrification and generates strong cash flow (84).

Valeo S.A. (BBB/Stable/A-2)

Valeo is a group structured around four businesses: comfort and driving assistance systems (19% of sales in H1 2018), powertrain systems (27%), thermal systems (24%), and visibility systems (31%). In 2017, the group reported revenue of around €18.6 billion and invested about 12% of its original equipment sales in R&D.

Valeo is among the major suppliers for 12V and 48V electrical systems globally. One in every three cars worldwide is fitted with a Valeo electrical system (including the stop-start system it invented in 2004). Valeo's content per car is significantly higher for hybrid cars than for traditional ICE-powered cars, and the group expects content by car to increase by a factor of 2x to 3x for mild hybrids, and a factor of 7x to 9x for PHEV and BEV. The company expects that by 2026, mild hybrid cars as well as BEVs, which also use 48V systems, will account for about 18% of new cars compared with less than 2% currently.

In January 2018, Valeo unveiled its two-seater electric vehicle, developed in partnership with

Shanghai Jiao Tong University in China, as China is the largest market for these low-speed vehicles (which have a maximum of 100 km/hour and can go 150 km between charges). It is the first vehicle powered entirely by Valeo systems. Valeo had previously designed all the components needed for powertrain and drivetrain operations, but it had never before designed the engine itself. The 48V technology is particularly well suited to the short journeys and low speed of urban mobility. It is also relatively affordable, with pricing expected at around €7,500.

Through its joint venture with Siemens, which started in December 2016, Valeo expanded its product portfolio towards higher voltage solutions (above 60V) including inverters, DC/DC converters, generators, on-board chargers, and electric motors. As of June 2018, the Valeo Siemens JV had booked a cumulative order intake of €10.8 billion, with an objective to reach sales of €2 billion by 2022, demonstrating the high growth potential that comes with electrification. Similar to peers with e-mobility products that are yet unprofitable due to their relatively low scale and high R&D requirements, Valeo's management expects the JV will report total losses of about €200 million in 2018, a smaller loss in 2019, and reaching breakeven in 2020 (85).

ZF Friedrichshafen AG (BBB-/Stable/--)

ZF Friedrichshafen AG (ZF) is a global leader in driveline and chassis technology as well as active and passive safety technology, serving manufacturers of passenger cars, commercial vehicles (including buses and heavy trucks), and industrial drives (including construction and agricultural machinery).

ZF offers a wide range of electrified products for passenger cars, such as E-plug-in hybrid transmissions, hybrid modules, as well as electric drives for electric vehicles. By making systems that can be extended to an electric or to standard powertrain modules, the group accrues benefits to scalability and flexibility in the production process (86). The group recently announced an investment plan for which €12 billion of R&D expenditures and capex is earmarked for electrification and autonomous driving over the period of 2019-2024 (87). While these significant investments will pressure the group's profitability and free cash flow, we believe they will ultimately translate into a competitive advantage.

For 2017, the E-Mobility division that encompasses components and systems for battery electric vehicles generated about €924 million of revenue (or 2% of group revenues). The division grew 9% organically over 2016 with further growth posted in the first half of 2018, a trend that we expect to continue. ZF expects hybrid drives (that is sells through its Powertrain division) in production will increase tenfold over the next few years, from 5% to 50% (88).

Footnotes

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