Government regulations in particular are promoting electric mobility. A meta-analysis on electrified vehicles market development shows the impact this will have on the international automotive industry and the urgent need for action. The PEM of RWTH Aachen University expects especially the supplier industry for battery cells to develop into a competitive market.

The electrified powertrain system plays a fundamental role in achieving the CO₂ targets. While global new passenger car registrations declined for the second year in a row in 2019 [1], the number of new registrations of electrified vehicles (xEVs) is still growing. In the European region alone, growth of 45 % was observed compared to the previous year [1]. Even during the Coronavirus pandemic, xEV sales continued to grow in 2020 [2]. The crucial question is how the market will develop in the future.

Based on studies of annual new registrations of various types of powertrains, a forecast can be derived as well as the resulting effects on the supplier industry. These results are elementary for the future strategic product and production design of all companies involved in the value chain, and they give a unique opportunity to address this growing market.

**MARKET DEVELOPMENT UP TO 2030**

A meta-analysis was carried out as the basis for forecasting the development of the automotive market up to 2030. For this purpose, three scenarios for the development of electric mobility were formed: optimistic, moderate and pessimistic. Over 700 individual forecasts from more than 80 studies were considered. The powertrains are divided in ascending degrees of electrification into Internal Combustion Engine-powered Vehicles (ICEVs), full or mild Hybrid Electric Vehicles (HEVs/MHEVs), Plug-in Hybrid Electric Vehicles without and with range extenders (PHEVs/REEVs), Battery-electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs). Light duty vehicles which include passenger cars and light commercial vehicles are considered in this study. In addition, both a global and continental (Europe, USA and China) view of the most important markets is taken.

Based on the meta-analysis, an examination of the implications for the supplier industry is conducted. Assuming a theoretical continuation of the trend of weak market development between 2010 and 2019, a market share of 93.2 % for ICEVs can be predicted in 2030. However, due to the global promotion of electric mobility, a strong market growth of xEVs in the coming years [3] is more likely. The results of the meta-analysis underline this trend and show a signifi-
cantly faster increase in xEVs over the next ten years.

HEV/MHEV AS A TRANSITIONAL SOLUTION

Accordingly, 54.3 % of all vehicles will already be electrified globally in 2030 instead of 6.8 % if the trend continues, FIGURE 1. HEVs/MHEVs will account for the largest share of xEVs, followed by BEVs and PHEVs/REEVs. The latter two powertrains show stronger growth from 2025 onwards so that a larger share of BEV can be assumed if growth continues beyond 2030. HEVs/MHEVs serve as a transitional solution between ICEVs and BEVs.

In addition to political regulations, the main reasons for the increasing growth of electrified vehicles are decreasing Total Cost of Ownership (TCO) as well as higher energy densities of batteries, which enable a higher range [4]. For OEMs however, the trend of electric mobility also poses some challenges. Two examples are the increased investments due to the introduction of new electrified models and the reduced employee requirement of about 30 % compared to conventional vehicles [5]. By using hybrid vehicles, a more systematic and slower transition of technologies and the associated know-how within the automotive companies is possible.

STONG DEVELOPMENT OF ELECTRIFIED DRIVES

A similar development can be observed in Europe. The total share of all xEV will even be slightly higher in 2030 at 59.5 %, FIGURE 2. The strong development of electrified powertrains in Europe is favored in particular by strict CO₂ regulations. A limit of 95 g CO₂/km per fleet applies. In comparison, the values in Japan (105 g CO₂/km), China (117 g CO₂/km) and the USA (121 g CO₂/km) are higher [6]. In addition to EU regulations, there are individual countries that are planning an absolute ban on the sale of ICEVs to further promote electric mobility. Norway is considered a pioneer of electric mobility in Europe and is planning a sales ban from 2025, Ireland, the Netherlands and Slovenia from 2030, and France and the UK from 2040 [7].

Based on the studies, ICEVs will continue to dominate the US automotive market in 2030 with a share of 56.4 %, FIGURE 3. The weaker development of electrified vehicles can be explained by the long distances between cities, the preference for larger vehicles...
especially SUVs) and the low fuel prices [8].

**CHINA AS A PIONEER OF ELECTRIC MOBILITY**

China is considered a global pioneer of electric mobility. This is also reflected in the forecast for 2030 with a total share of xEVs in new registrations of 60 %, **Figure 4**. In contrast to the other regions considered, BEVs are the leading alternative to ICEVs in 2030. In China, the greater development of electrified vehicles is favored by lower electricity costs and, at the same time, higher fuel prices, so that the TCO of xEVs is lower compared to that of ICEVs [8]. Moreover, New Energy Vehicles (PHEV, BEV, and FCEV) have been promoted with the help of a national subsidy program for a decade [9]. As a result, the market share of New Energy Vehicles is expected to exceed 50 % by 2035 [10]. Additionally, more restrictions on the sale of ICEVs are planned in China in the future – especially in major cities – to further promote the development of electric mobility [11]. Overall, the meta-analysis shows a strong increase in demand for electrified vehicles in all regions. This also results in higher demand for the necessary components such as battery cells and electric motors. In all three scenarios, global demand for battery cell capacity grows by about ten times between 2020 and 2030. This increase can be justified not only by the strong rise in demand for electrified vehicles, but also by the average increase in battery capacity per BEV. In 2030, 87 % of the total capacity demand is attributable to BEVs.

**BATTERY CELL SUPPLY**

For the supply of battery cells, the production plans of more than 100 different suppliers and OEMs with 170 different production sites – 118 of which are located in China – up to 2030 were examined. Europe’s share of global production is currently still very low and leads to underproduction, but the construction of numerous production sites is planned for the coming years. How
ever, it has been shown that the construction of a plant can be delayed or even fail [12]. Since such potential announcements on future plants can burst, for example due to unresolved financing issues, this creates uncertainty about the development of the supply. Assuming that the number of vehicles produced in Europe has been 8.3 % higher on average than the number of new vehicles registered over the last ten years and that this trend continues, this results in a slightly increased demand for battery cell capacity. When comparing this demand in the optimistic scenario and the supply of firmly planned plants in Europe, it is expected that demand can be met from 2025, **FIGURE 5**. According to the forecast, however, underproduction may occur again from 2027. **FIGURE 5** also shows the development of supply if both the firmly planned and the potentially announced plants can be realized. In this case, an oversupply of about 175 GWh can arise in 2030, which can be used to equip an additional 3.5 million BEVs with an average battery size of 50 kWh.

**INDEPENDENCE FROM CELL MANUFACTURERS**

With high demand and low supply, it can be very advantageous for OEMs to invest in their own production. On the one hand, this would reduce their dependence on cell manufacturers and strengthen their know-how in one of the key components. On the other hand, it would generate high investment costs. Tesla, for example, has decided to establish its own battery cell production in Grünheide near Berlin (Germany) [13]. Since the construction and commissioning of such a battery production facility takes a certain amount of time, it is already imperative to address this issue today.

A competitive market is emerging for battery cell manufacturers, particularly due to the predicted oversupply in the
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