

Future Mobility in Germany

ISSUE 2019/2020



Germany is recognized the world over for its outstanding automotive industry and excellence in engineering. From Asia to the Americas, German cars embody highly cherished values of innovation, reliability, safety, and design.

The World's Automotive Hub

The automotive industry is the largest industry sector in Germany, generating turnover of EUR 423 billion in 2017 alone. It is also the strongest and most export driven industry in Germany, with an export volume of more than EUR 271 billion. Innovation spending of almost EUR 22 billion in 2017 makes the automotive sector responsible for around 35 percent of total domestic research and development (R&D) expenditure. All told, German automotive companies are responsible for around one third of global auto industry R&D investment.

Innovation Leader

Germany is by some distance Europe's leading production and sales market. The country's world-class R&D infrastructure, complete industry value chain integration, and highly qualified workforce create an internationally peerless automotive environment. It enables companies to develop cutting-edge technologies that perfectly address tomorrow's mobility needs.

Changing Mobility Market

Worldwide, the auto industry is in a period of radical transformation; resulting mainly from e-mobility and connected and automated driving technologies. Germany's impressive auto industry figures pay testimony to the fact that, more than 130 years after inventing the automobile, the country remains the world's automotive innovation hub – leading the way forward into a new automobile era.

→ Visit our website: www.gtai.com/automotive

Germany's Automotive Industry in Numbers

Manufacturing Leader

20%

of total domestic industry revenue generated by automotive industry

5.5 million

passenger vehicles produced in 2017 (making Germany Europe's leading production site)

Auto R&D Nation

+60%

R&D growth in Europe created by German automotive sector

1/3

of global automotive R&D spending made by German OEMs

Export Success

1 in 5

cars that roll off the international production line are German OEM made

78%

of cars manufactured in Germany in 2017 destined for export markets

Source: statista.de

Electric Mobility in Germany

Germany's internationally leading automotive industry is showing the electric mobility way ahead. The sector is responsible for around one third of all electric mobility and hybrid propulsion patents globally. These developments are helping increase electric vehicle acceptance levels as vehicle range and performance levels increase and vehicle total cost of ownership continues to fall.

Electric Mobility Lead Provider and Market

Accounting for over 30 percent of all passenger cars produced in Europe and 20 percent of all cars registered, Germany is Europe's biggest automotive market. This important market is now turning to electric mobility as part of the country's goal of becoming a lead market and provider for electric mobility by 2020 as part of its long-term zero emission vision. Demand for electric vehicles is picking up quickly as range and performance improvements drive uptake levels and battery costs continue to go down. The cumulated number of all new electric vehicle registrations has reached 200,000 – supported by an infrastructure of around 7,900 AC and more than 1,400 DC charging stations. By 2022, the construction of 70,000 normal charge points (AC charge points) and 7,100 fast charge points (DC charge points) is expected. Electric vehicle registrations have more than doubled in 2017 (compared to 2016 levels) and industry experts expect the cumulated number of registrations to reach 1 million by 2022.

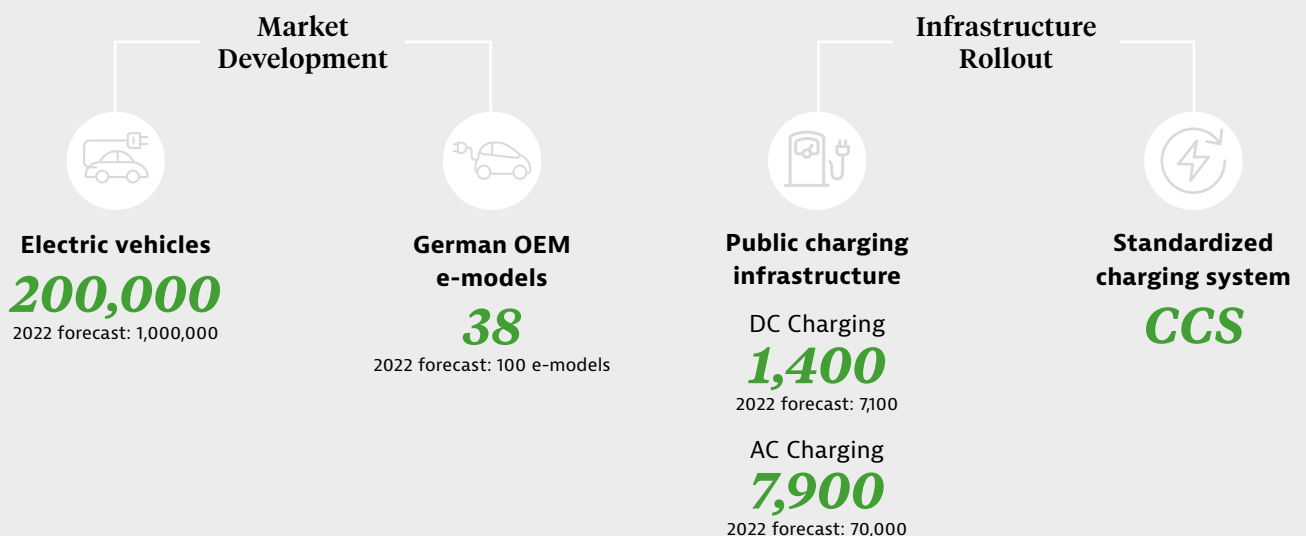
Electric Mobility Innovation Leader

Germany is a global electric mobility technology leader. Significant efforts are also being made in the area of battery and cell research; particularly in the area of material and process technologies for lithium-ion systems that will lead to a new generation of high-energy and high-performance battery systems. By 2020, the industry alone will have invested around EUR 40 billion in electric mobility development. This will see German automotive manufacturers more than treble their range of available electric vehicles from over 30 to 100 models. The federal government supports e-mobility R&D activities with funding of around quarter of a billion euros annually.

Electric Mobility Policy Support

Germany's electric mobility-friendly policy environment is making a significant contribution to increasing the value proposition of electric driving. In 2016, industry and Germany's federal government approved a EUR 1.2 billion electric vehicle subsidy program to stimulate uptake in the electric vehicle market. As part of the direct support scheme, battery electric vehicle (BEV) purchases are subsidized by a bonus of EUR 4,000 – half paid by the government and half by the vehicle manufacturer. Plug-in hybrid vehicle (PHEV) buyers can claim a bonus of EUR 3,000 towards vehicle purchase. The scheme is open to all vehicle manufacturers providing vehicles with a list price up to EUR 71,400 (including VAT).

Electric Mobility Advances in Germany



Source: GTAI Research 2019

The government will also invest a further EUR 300 million into the expansion of public charging infrastructure up to 2020. Legislation like the Electric Mobility Act already grant special privileges to electric vehicles – including the lowering or waiving of fees and exemptions from certain access restrictions – to normalize the owner structure of the electric passenger car market. Passenger electric vehicles also enjoy motor vehicle tax exemption for a period of 10 years. The tax rate for employee private usage of company cars was halved to 0.5 per cent.

Battery Technology Improvements

Battery performance is critical to market acceptance. The battery system determines vehicle efficiency and counts as the single vehicle element with the greatest wealth creation share (direct share of value added of up to 40 percent). Around 60 to 70 percent of this value can be directly attributed to the battery cell – making it a key element in the value chain as well as the central element of the vehicle. Battery technology developments are having a significant effect on electric vehicle total cost of ownership as R&D and production costs fall. This is helping to increase the attractiveness of electric vehicles as the cost-competitiveness gap between ICE vehicles is dramatically reduced. Developments made to date in first- and second-generation cells and battery systems have helped create energy density levels of around 200 Wh per liter for today's battery packs. Energy and power density

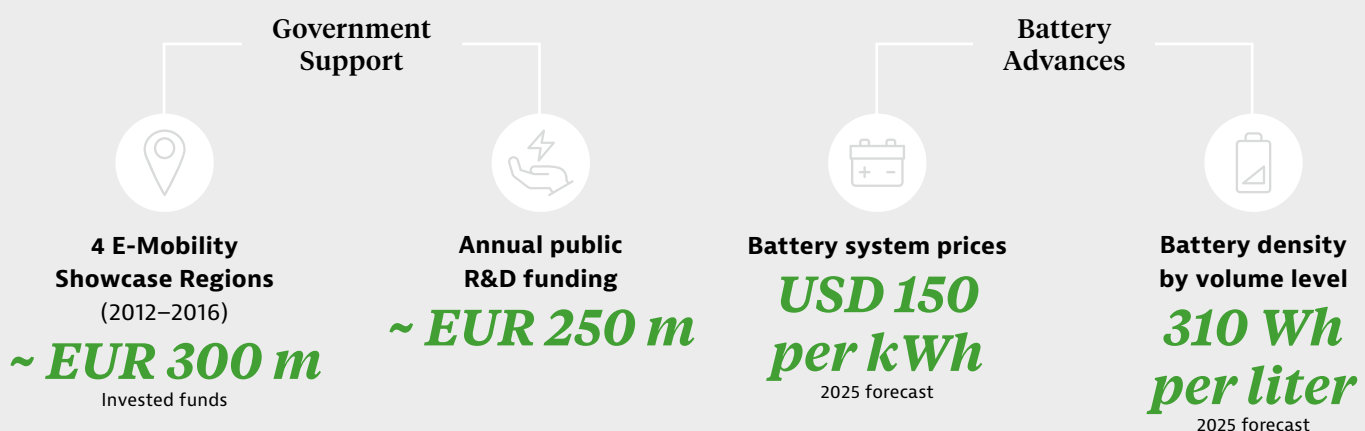
levels will continue to improve, with further marked developments expected in terms of safety (crash resistance) and service life.

Government R&D Support

The federal government supports e-mobility R&D activities with around a quarter billion euros annually. The further improvement of battery technology and recycling remains one of the country's main e-mobility areas of R&D activity. As part of the technological development of third- and fourth-generation batteries, battery density by volume levels of 310 Wh per liter are predicted by 2025. In combination with expected economies of scale, battery system prices are predicted to fall below USD 150 per kWh.

New Lightweight Materials from Germany

Lightweight construction is a key enabling technology for manufacturing the cars of tomorrow and addressing the challenges of digital transformation, electric mobility and energy and resource efficiency. McKinsey reports that vehicle manufacturers will need to increase lightweight component levels from 30 percent to 70 percent by 2030 in order to compensate for electric drive weight increases, more efficient engine technology and CO₂ reduction goals. Germany, like no other country in Europe, boasts a lightweight construction cluster network that covers the complete industry value chain.



Automotive Industry Trends

Car Connectivity

The car of the future will be significantly shaped by the developments made in the "Internet of Things." Vehicle connectivity will significantly change the industry into previously unheard levels of automation, vehicle management and in-car entertainment – or car-to-X communication to be more precise. Analysts from PwC forecast that the market potential for connected car applications will almost quadruple by 2020 based on 2015 figures. By 2020, connected car market potential is expected to amount to around EUR 113 billion, growing at an average annual rate of around 29 percent.

Tomorrow's Autonomous Technologies

Safe and autonomous drive technologies and applications are major factors driving the connected car market. A new generation of radar, camera and lidar sensor technologies monitoring the car's environment enable the vehicle to react in a swift and independent fashion. Increased deployment of autonomous technologies will see collision avoidance, danger warning, and independent parking system solutions as well as "well-being" functions like driver drowsiness detection increasingly become standard. Real-time traffic and highway assistant solutions will develop over time to become pilots, thereby paving the way towards highly automated (2025) and autonomous cars (2030). It is expected that highly and wholly automated and autonomous cars will enjoy market share of around 20 percent by 2035.

Smart and Comfortable Driving

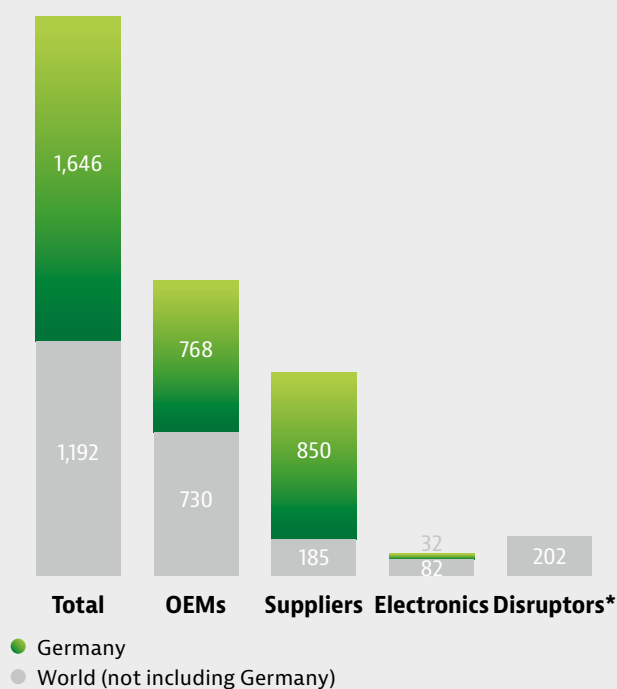
The advent of individual vehicle intelligence and safety is complemented by smart interaction and communication with other road users and real-time data servers. These mobility management developments support increased driver awareness and more fuel-efficient driving. Enhanced vehicle management solutions (e.g. monitoring and reporting) help reduce utilization costs while entertainment and home integration functions (e.g. head-up display and voice control applications) effectively transform the car into a living room on wheels.

Energy Efficiency

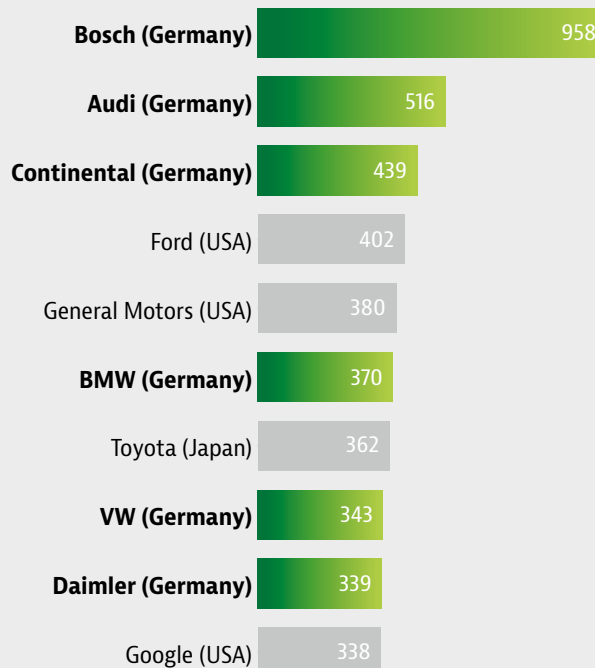
The transformation of mechanics to mechatronics is essential to fulfill the 95g CO₂/km target set by the European Union for 2021. Key automotive electronics fields of activity are electronic control units including motor control units to regulate fuel supply, cylinder activity, and exhaust control. The use of electronic x-by-wire technology components (e.g. e-brakes) help reduce weight and fuel consumption and reinforce the importance of cutting-edge wiring harness developments. Start-stop systems, e-micro-, mild-, full hybrids, and tire pressure sensors also further reduce car fuel consumption levels. By 2020, energy efficiency experts forecast a total annual spend of around USD 80 billion on increasing the efficiency of passenger light duty vehicles.

Autonomous Drive Technology-Patents 2010–2017

by company group



by leading patenting companies



*Disruptors, e.g. Google, Apple
Sources: PATENTSCOPE (2016); IW Köln (2017)

Best Practice Example: CATL

Germany Trade & Invest provides a range of inward investment services to international investors. After careful consultation with the individual investor, a support program of consultancy and information services is drawn up to help set the stage for investment success. Here we provide a typical example of the services provided to a recent investment project.

“By bringing the most advanced lithium-ion battery technology to Germany and developing the local production capacity, CATL is offering even better product solutions and faster response times to our customers.”

Dr. Robin Zeng, Founder of CATL
www.catlbattery.com

Company Information

Established in 2011 in Ningde, Fujian Province, China, Contemporary Amperex Technology Ltd. (CATL) focuses on R&D, production, and sales of battery and energy storage systems. CATL went public in 2018 and generates revenue of almost EUR 2 billion with 15,000 employees. With 12 GWh of shipments it is the leading lithium-ion battery supplier for automotive applications and has established numerous contracts with German OEMs. Together with support from Germany Trade & Invest (GTAI), CATL sought a cell and battery production site in order to satisfy growing demand from European markets.

Germany Trade & Invest Support

GTAI was involved from the point of site identification, having prior involvement with CATL in the establishment of offices in Munich in 2014 and the opening of an R&D facility in Berlin in 2017. GTAI's experts provided the full range of services including practical advice on a number of labor, energy, and logistics cost-related issues as well as tax and incentives information. GTAI also established specific location proposals according to CATL's specific criteria, provided site analysis support and organized site visits.

Location Factors

The most important criteria for the site selection in Germany were the availability of qualified and loyal labor, secure investment environment, excellent infrastructure, proximity to the customer base and the energy transition towards renewable energy sources thereby facilitating more sustainable cell production. It is the company's first factory outside of China and Germany was in competition with a number of other European countries for this significant factory investment. CATL's EUR 240 million investment decision for the German state Thuringia will result in the creation of one of

CATL Project Specifications

Company	Contemporary Amperex Technology Ltd. (CATL), China
Industry	Battery production and energy storage
Investment objective	Construction of manufacturing facility to realize global expansion strategy
Investment location criteria	<ul style="list-style-type: none">• Highly qualified and loyal workforce• Secure investment environment• Excellent infrastructure• Proximity to customers• Energy transition
GTAI support	<ul style="list-style-type: none">• Full range of GTAI services including strategic advice, advice on labor, energy, and logistics costs• Tax, legal and incentives information• Location proposals• Site visit organization
Selected location	Erfurter Kreuz, Thuringia
Investment volume	EUR 240 million
Company formation	September 11, 2018

the largest lithium cell factories in Europe, creating some 600 jobs in the region over the next four years. It is the largest single foreign direct investment project supported by GTAI and the largest Chinese greenfield investment project in Germany to date.

Location Advantages

CATL's decision to settle in Germany will bring it closer to German and other European carmaker brands, providing a major boost for the region and the further development of electric mobility in Germany. CATL Chairman Dr. Zeng believes the investment will increase opportunities across industry for CATL products and provide a strategic customer relations boost. As customer inquiries are picking up quickly, CATL is currently considering expanding the planned production capacity of 14 GWh to more than 100 GWh.

→ **Contact our mobility specialists to explore the individual investment opportunities available to your business in Germany's fast-moving electric mobility sector.**

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OUR SERVICES

About Us

Germany Trade & Invest (GTAI) is the foreign trade and inward investment agency of the Federal Republic of Germany. The organization advises and supports foreign companies planning to expand into the German market and assists German companies seeking to enter foreign markets.

Investment Location Germany

GTAI provides close-to-market information to international companies looking to enter German markets. Our specialist industry teams prepare all of the relevant information essential to business success in Germany. GTAI's comprehensive range of information services includes:

- Market and industry reports
- Market entry analyses
- Business and tax law information
- Business and labor law information
- Funding and financing information

Business Location Services

GTAI supports international companies from market entry to business start-up in Germany. Expert project teams advise and assist in the business establishment phase. GTAI's range of free services includes:

- Legal and tax-related project support
- Funding and financing advisory services
- Site visit organization
- Local partner and network matchmaking
- Public and private partner coordination

All investment-related services are provided entirely free of charge. Our specialist industry teams have hands-on experience in their respective industries and treat all investor enquiries with the utmost confidentiality.

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Notes

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