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White Paper

# The Global Transformation of the Automotive Market

## Abstract

In this white paper, we evaluate in detail several of the trends impacting the automotive marketplace around the world, focusing on market changes in China, the European Union (EU), and the United States. We also discuss how the dynamic research and development (R&D) and production landscape can further complicate the process of obtaining regulatory approval for automobiles and automotive technologies, systems, and components, and the steps that automotive companies can take to reduce these homologation challenges.

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## TÜV SÜD Expert



### **Stefan Merkl**

#### **Head of Mobility Industry, TÜV SÜD Auto Service GmbH**

Stefan Merkl is the Head of Mobility Industry at TÜV SÜD. He holds a Master's degree in Systems Engineering & Management. In his 11+ year career at TÜV SÜD, he has successfully led local and global teams and driven several customer projects, as well as developed and managed internal global projects and strategies across multiple different countries. He has lived in Germany, China, and the United States for several years and built an extensive network in industry and government institutions around the world. His current responsibilities include the fields of connected and automated mobility, global homologation of vehicles, systems and components as well as vehicle remarketing and mobility consulting business.

# Introduction

Increased market complexity creates new challenges for vehicle homologation.

During the past three years, the coronavirus pandemic and other factors have hastened the transformation of the global economy as producers and suppliers scrambled to meet unprecedented challenges amidst critical material shortages, supply chain inefficiencies, and labour issues. But, as we emerge into a post-pandemic world, a new economic dynamic is taking hold. One in which participants in every industry are re-examining their priorities and seeking ways to better position their capabilities to match current and emerging market opportunities.

This dynamic is clearly at play in today's global automotive market, where original equipment manufacturers (OEMs), component and device producers, and material suppliers are aggressively working to navigate the current R&D and production landscape, while simultaneously seeking ways to best position their companies to take advantage of future emerging markets. These trends are most visible in China, the EU, and the United States, which combined account for more than half of all global automotive production. But they are playing out in other countries as well, such as India, Japan, and Brazil,<sup>1</sup> and indeed across the entire value chain.

These trends offer major new opportunities, both for nations and for automotive companies seeking to expand their global footprint. But with these changes come additional challenges. Such a dynamic landscape also effects the approval process for vehicles and components through increased complexity. This is because on the one hand additional requirements of new markets need to be considered, and on the other hand there may be language barriers or longer communication channels. This can potentially lead to unforeseen delays in bringing new products and technologies to market. Clearly, overcoming these homologation challenges is a top priority for every participant in the global automotive market today.

# The current state of the automotive market around the world



**Fig. A** Worldwide revenue from automotive manufacturing and production activities (Source: Statista)

Despite unprecedented challenges and setbacks during the past three years, global automotive production has exhibited remarkable resilience. According to recent data from online research firm Statista, worldwide revenue from automotive manufacturing and production activities has now climbed back to pre-pandemic levels. Revenue in 2022 was projected to reach \$2.95 trillion (USD), nearly equal to the \$3 trillion in global revenue achieved in 2019, and up almost 10% from the pandemic low of just \$2.71 trillion in 2020.<sup>2</sup>

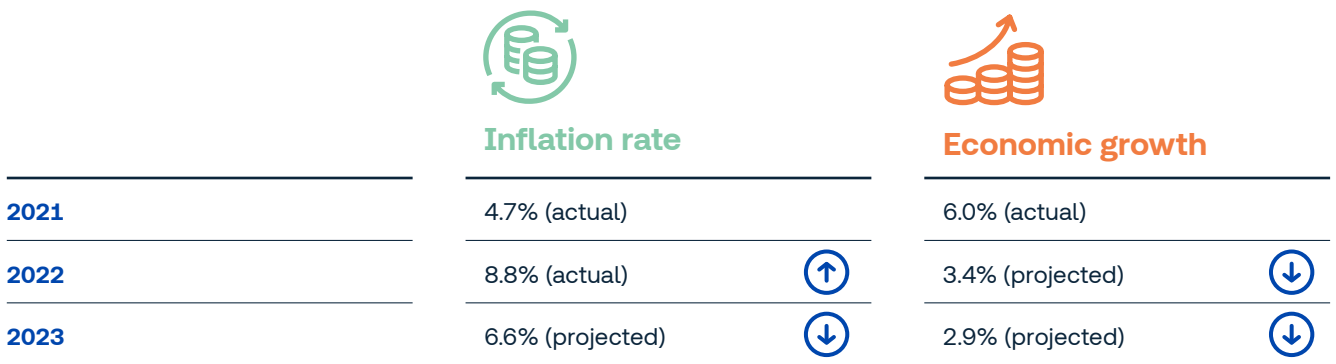
While most sectors of the automotive industry are enjoying the benefits of this post-pandemic rebound, it appears that certain types of vehicles and vehicle technologies are seeing the biggest boost. Specifically, electric vehicles (EVs) seem to be gaining the most traction in terms of increased sales. Consulting firm BrandFinance

reports that 6.4 million plug-in EVs were sold in 2021, more than double the number of EVs sold in 2020.<sup>3</sup> And the International Energy Agency, in its most recent “Tracking Green Energy Progress” update, projected that total EV sales would increase again in 2022, accounting for 13% of all light-duty vehicle sales globally.<sup>4</sup>

Looking ahead, a recent report by New Research Insights projects that the global automotive market economy will increase by a cumulative average growth rate (CAGR) of 7.57% over the next five years, growing from \$2.598 billion (USD) in 2022 to \$4.025 billion in value by the year 2027.<sup>5</sup> Regarding EVs, a separate report by Allied Market Research projects that the global market for EVs will realise a CAGR of more than 18% over the next decade, achieving a total valuation of more than \$823 billion (USD) by the year 2030.<sup>6</sup>

These and other trends paint an optimistic picture of the future of the automotive industry worldwide. The projected growth also opens the door for startups and other nascent industry players to introduce new and innovative technologies that can further transform the industry, while also providing a foundation for economic resilience and sustained growth for the foreseeable future.

# Factors that are impacting the global automotive industry



**Fig. B** International Monetary Fund (IMF) Projections

In the context of this strong economic outlook for the future of the global automotive market, it's also important to recognise and understand the trends and factors that have influenced the automotive industry in the past few years, or that are likely to create new challenges in the future. The following sections summarise some of the most impactful issues which influence the automotive sector.

### Macroeconomic trends

Since the beginning of 2022, the global economy has experienced an unprecedented spike in the cost of goods and services. The International Monetary Fund (IMF) has projected that the global inflation rate in 2023 will reach 6.6%, down from 8.8% in 2022. This increase slowed global economic growth from 6% in 2021 to an estimated 2.9% in 2023. Even with the anticipated drop in the rate of inflation to 6.5% in 2023, the IMF still projects a 2.7% decline in economic growth in 2023.<sup>7</sup>

Some attribute the current inflationary environment to pent-up commercial and consumer demand following the end of most pandemic-related shutdowns. But regardless of the cause, the impact has meant dramatic increases in prices across the board for suppliers, producers, and end customers. In the automotive industry, prices are increasing for critical raw materials, components and parts, especially those in short supply. Costs are also increasing for the energy needed to power plants and laboratories, as well as for labour. In the end, these increases result in higher vehicle prices for consumers who are already struggling with the impact of increased food and energy costs, as well as other basic needs.

### Supply chain challenges

Many of the challenges facing the automotive industry in 2020 and 2021 were attributable to supply chain issues, including increased commodity prices, product

shortages, shipping and transportation delays, and higher shipping rates. Most critical among these challenges has been a shortage of semiconductors, microchips and other electronic components, all essential to the operation of automated and connected automotive technologies.

# 11%

According to the J.D. Power U.S. Initial Quality Study (IQS) published in June 2022, the automotive industry experienced an 11% increase in reported quality problems for every 100 new 2022 model-year vehicles purchased or leased by consumers.

These challenges have directly resulted in a marked decline in the quality of new vehicles. According to

the J.D. Power U.S. Initial Quality Study (IQS) published in June 2022, the automotive industry experienced an 11% increase in reported quality problems for every 100 new 2022 model-year vehicles purchased or leased by consumers (a record high in the 36-year history of the Power Study). In many cases, this happened due to supply chain disruptions caused by chip shortages. Consequently, OEMs have been forced to ship their new vehicles without key features installed.<sup>8</sup>

The quality problems identified in the Power Study most directly impacted premium vehicles, rather than vehicles destined for mass market appeal, with infotainment systems identified as the most problematic area. In addition, owners or lessees of battery-electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) cited more quality issues than owners/lessees of traditionally powered vehicles.

#### Labour issues

One of the key reasons behind the supply chain challenges just discussed is labour shortages that have significantly impacted almost every manufacturing industry,

including the automotive industry, over the past three years.

Shortages of labour are nothing new, and nearly all employers routinely complain about the challenges of finding qualified workers in an ever-increasing competitive economy. But the pandemic had an outsized effect on the labour market. It opened up work-from-home opportunities for employees in many professions, led many older workers to prematurely exit the workforce, and provided others with higher-paying opportunities in less physically demanding jobs.

The advanced technologies that are driving automotive industry growth in this century are also setting a new baseline for the technical knowledge and experience required of those directly involved in automotive production and servicing. Successfully launching new EV programmes requires specialised skills in electrical and battery-driven technologies that may be beyond the scope of current programme managers. This then creates a new hiring and recruiting challenge for automotive companies.

The industry-wide demand for automotive professionals with advanced technical skills may well exceed the number of available candidates.

Further, the industry-wide demand for automotive professionals with advanced technical skills may well exceed the number of available candidates. For example, a 2021 estimate indicated that the demand for technicians involved in automotive aftermarket service and repair-related services was five times the number of technicians then available.<sup>9</sup>

The seemingly insurmountable gap between the number of employees with specific skills and those that are needed is all too common in industries focused on new and rapidly evolving technologies.





### **Government regulations**

In the midst of these post-pandemic challenges, governments and regulatory agencies around the world are continuing to push for more stringent automotive regulations. While increased oversight of automated and autonomous vehicles may be getting most of the headlines, it is the push to reduce overall automotive greenhouse gas (GHG) emissions that is having the greatest impact on the automotive industry now and in the immediate years ahead.

Many regulatory jurisdictions have established or are considering firm timelines for automotive manufacturers to switch their production partially or fully to 100% zero-emissions vehicles. In the EU, for example, the deadline for total 100% zero-emissions compliance is 2035,<sup>10</sup> although combustion engines using E-Fuels have been allowed beyond this date. The U.S. government has adopted a comparable goal for all government-procured vehicles,<sup>11</sup> while China has set a target for EVs to represent 40% of all new vehicle sales by 2030.<sup>12</sup>

Such regulations are setting the stage for manufacturers to shift greater percentages of their overall R&D and production to new energy vehicles such as EVs or EV variants (HEVs, PHEVs, etc.) and fuel cell or hybrid vehicles. This shift would increase reliance on batteries to store the power needed to support performance and ensure acceptable driving ranges. But it is also likely to result in new regulations and requirements on the reuse or disposal of batteries at the end of their anticipated useful life.

In an industry dependent on the introduction of new and evolving technologies, ever-changing regulations and regulatory oversight are a given. The challenge for regulators will be to find a path that supports the development and deployment of these new technologies while continuing to ensure the safety and security of vehicle operators, passengers, and the general public.

### **Consumer demand**

Perhaps the most important factor, and the most difficult to predict, facing the automotive industry is consumer demand for their products. As we discussed previously in this paper, the industry is poised to regain the sales momentum lost during the years of the pandemic and to finally climb above the level of global sales it achieved in 2019. In addition, the projections for future industry growth appear strong.

At the same time, in the current economic environment, consumers are likely to experience higher prices for both new and used vehicles due to inflation. Further, some consumers may have concerns regarding vehicle quality and reliability attributable to supply chain challenges. These and other issues may lead some buyers to delay planned vehicle purchases or look to less-expensive used vehicles that meet their immediate needs.

# The global automotive market shift



**Fig. C** Three major shifts in the global automotive markets

Even before the onset of the pandemic in 2020, manufacturers and producers in almost every industry had actively explored ways to better align their capabilities with emerging market opportunities in the global economy. These efforts included the adoption of just-in-time inventory models, expanded and extended supply chains for critical materials and parts, and leveraging labour and other resources in developing countries.

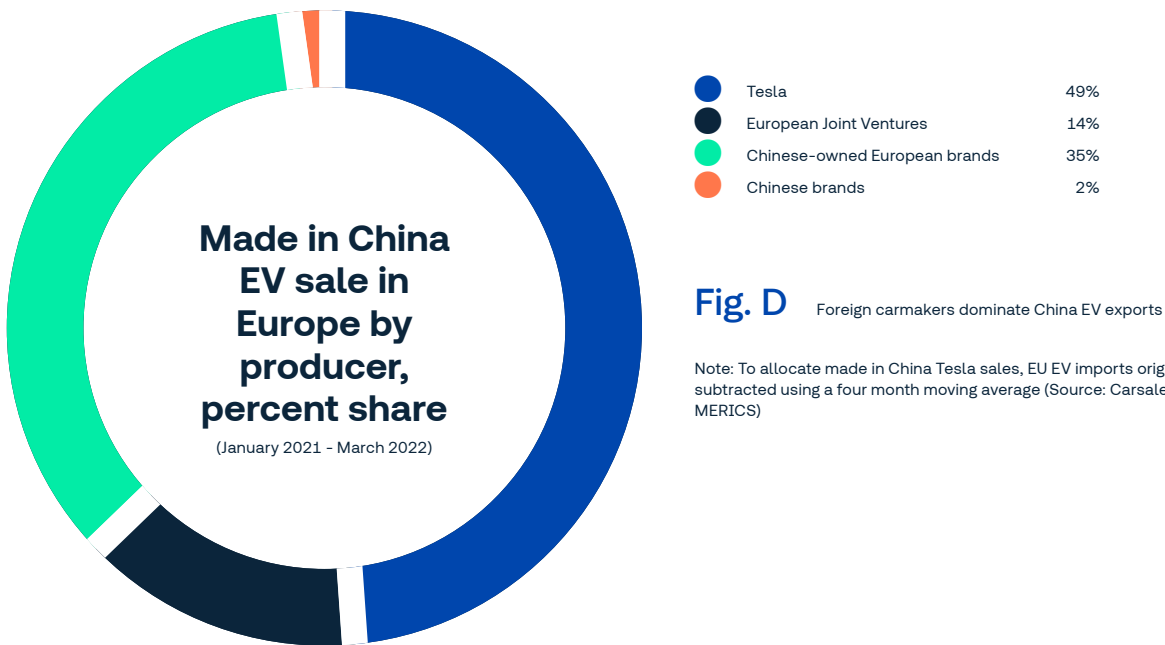
Over the past three years, the pandemic has shed new light on many of these practices, uncovering significant

weaknesses and vulnerabilities in business models that failed to account for a variety of unknown factors. But many automotive manufacturers have quickly adapted to this “new normal,” and are finding ways to build more resilient capabilities that are better positioned to capitalise on new and emerging opportunities, while also being able to withstand unanticipated events and market shifts.

In the following sections, we discuss three emerging global trends that reflect this new dynamic in the automotive industry.



# 01 | China re-emerges as a global automotive production hub



Global automotive companies are increasingly looking to China for current and future development, and production of EVs and other energy-efficient vehicles, as well as critical materials and parts. For EU-based companies, the shift to China is reportedly due to inflated costs and energy shortages in EU countries, attributable in part to the war with Ukraine. But China also offers automotive manufacturers a more stable and complete industrial supply chain for essential components. For example, China reportedly accounts for 76% of global automotive battery production, compared with just 7% by the EU.<sup>13</sup>

Potentially even more important, China has recently become an attractive investment option for many automotive companies. The country previously limited foreign investment in China-based entities to a maximum of 50%.<sup>14</sup> But, as of January 1, 2022, the government

lifted foreign-ownership limits on all automotive entities, paving the way for significant investments by global automotive leaders in current state-owned ventures, as well as future automotive companies.

Automotive giant BMW is just one of several recent examples of companies making major production investments in China. At the beginning of 2022, the company announced the production of an all-new X5 model vehicle in China, through its partnership with China carmaker Brilliance China Automotive Holdings Ltd. (BBA). The announcement followed BMW's decision to extend its joint venture contract with BBA until the year 2040, and to invest an additional \$4.4 billion (USD) to increase its share of the joint venture from 50% to 75%.<sup>15</sup>

In a separate development, the Ford Motor Company recently announced the launch of a China-based

subsidiary that will focus on the development of smart electric vehicles and driver-assist technologies. The new entity will also sell directly to consumers and will open more than 100 sales outlets across the country, with the first location having recently opened in Shanghai.<sup>16</sup>

These and other investments are clear indicators of the automotive industry's confidence in the long-term viability of China as a global development and production hub for the automotive industry. Expect to see further investments in both current production and new and emerging technologies in the decade ahead.

## 02 | Chinese companies increasingly enter the EU market

As global automotive companies are creating new and expanded capabilities in China, a concurrent effort is underway to expand market access for China-produced vehicles. According to one estimate, China's global EV exports more than doubled in 2021 to just over 2 million vehicles, making it the third largest exporter of vehicles in the world, behind Japan (3.82 million vehicles) and Germany (2.3 million).<sup>17</sup> And China's vehicle exports in 2022 are reportedly up almost 74% over 2021's record numbers, placing it second only to Japan.<sup>18</sup>

The EU represents a particularly lucrative target for automotive exports from China, especially

exports of EVs. It is estimated that about 40% of China's global EV exports are destined for EU buyers, representing approximately 10% of total EV sales in the EU. Future growth in the EU market for China-produced EVs will reportedly be further driven in part by low trade barriers in the EU, EV purchasing subsidies that extend to both domestic and imported vehicles, and a robust EV charging network.<sup>19</sup>

For now, it appears that the main target for EV exports from China is at the mass market end of the pricing spectrum, where China's lower-priced but full-featured EVs command more attention than lesser-equipped EVs produced in

the EU. However, China's Zhejiang Geely Holding Group currently owns majority stakes in several of the EU's signature brands, including Volvo, Lynk, and Polestar, each of which currently produces their EVs in China. In addition, Geely also has a controlling stake in Lotus, as well as a 10% holding in Mercedes-Benz.

The connection between these highly visible EU-based companies and EV production in China means that it would require little effort to enlarge market outreach in the EU to also include high-end EVs produced in China.<sup>20</sup> Such a shift could potentially lead to explosive growth in the production and export of China-produced EVs.

## 03 | The U.S. strengthens the automotive industry

Perhaps the most consequential developments impacting global automotive production are occurring in the U.S. where government leaders are working to implement laws and regulations that encourage the further development of the country's domestic manufacturing and production infrastructure. These initiatives are intended to lessen the country's dependence on goods produced outside of the U.S., while also strengthening the country's industrial economy, thereby increasing work opportunities for millions of citizens.

The most recent example of these efforts was the passage of the Inflation Reduction Act (IRA), which was signed into law by President Joseph Biden in August 2022. Among the key provisions of the IRA are targeted tax incentives for U.S.-sourced and manufactured products. Under the provisions of

the IRA, buyers of EVs manufactured in the U.S., that incorporate batteries and other essential components processed, recycled, or assembled in the U.S., are eligible for up to \$7500 in tax credits. Tax credits earned for the purchase of a qualified EV can then be transferred directly from the consumer to the automotive dealership as a down payment, thereby lowering the overall cost of the vehicle.

The provisions of the IRA applicable to EVs is expected to significantly expand the demand among U.S. consumers for U.S.-produced EVs. In turn, automotive manufacturers in the U.S., which include some of the country's largest employers, are likely to expand their domestic production of qualified EVs to support the increased consumer demand.

For example, automotive producer

Rivian has started construction of a massive new vehicle assembly plant in Georgia, where the company is expected to begin EV production by 2024. Once completed, the 20 million square foot facility will produce up to 400,000 vehicles per year, employing more than 7,500 workers.<sup>21</sup> Separately, EV start-up Fisker is reportedly exploring options to manufacture EVs in the U.S. beginning in 2024.<sup>22</sup>



# The impacts of the automotive market transformation

As the previous sections of this white paper illustrate, the landscape for the global automotive market represents a multi-faceted dynamic with each aspect subject to constant change. Economic conditions, supply chain issues, workforce considerations, and government oversight all play a critical role in industry decisions about which automotive products are most likely to align with consumers' needs and interests, which geographic markets provide the greatest potential for growth, where best to position production facilities to leverage the necessary talent and skills, and what regulatory factors are likely to have the greatest impact over the immediate future.

In the context of all this complexity, successfully navigating the homologation process for vehicles is not an easy task. However, here are some suggestions to consider as you plot your homologation process:



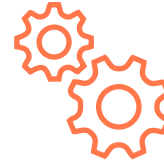
## **Get familiar with applicable regulations in key target markets**

Begin by researching the regulations and requirements that are applicable to automotive products in the key markets you want to target and determining how those regulations apply to your products. Even seemingly similar requirements in different jurisdictions may have subtle differences that need to be considered.



## **Research the homologation processes specific to each key market**

Despite global efforts to harmonise the homologation process, there are still important differences in the product review and approval process applied by regulators in different jurisdictions, differences that can significantly impact the time required to gain approval.



## **Integrate homologation considerations early in the product design process**

Ensure that the information you have developed about the homologation process and the technical requirements applicable to your product are considered at the earliest possible stages of the product design process.



## **Communicate actively with industry players**

Do not operate in a vacuum. Actively communicate with industry partners, outside regulatory experts, and even regulators when appropriate, to benefit from their experience and perspective on how best to navigate the homologation process.



## **Stay always up-to-date**

Finally, change is a constant. Over time, the homologation process and applicable regulations are subject to changes, often minor but sometimes major. Stay informed about any changes that may impact your own homologation activities.

# How TÜV SÜD supports automotive OEMs and suppliers to achieve global homologation

As an expert partner to the automotive industry, we support OEMs and suppliers in their efforts to successfully address relevant requirements in the dynamic global markets, and to navigate through the applicable homologation process for their vehicles, systems and/or components. This process can be quite challenging due to different country regulations, but our experts have gained extensive knowledge in various global homologation projects with the world's top OEMs and suppliers. Regardless of where you are based, TÜV SÜD has the global presence to provide full-service support in your local market.

Specifically addressing the market trends of this white paper, we provide a deep understanding of the Federal Motor Vehicle Safety Standards (FMVSS), which address specific mandatory minimum safety requirements in the U.S. for the design, construction, performance, and durability of vehicles, as well as regulated automobile safety-related components, systems, and design features. These federal vehicle standards are the U.S. counterpart to the UN Regulations developed by the World Forum for Harmonization of Vehicle Regulations, which are recognised to varying degrees by most countries other than the U.S.

For all automotive vehicles and components sold in the European Economic Area (EEA), compliance with relevant EU/ECE directives and regulations is mandatory. We offer a

comprehensive range of e-Mark certification services for vehicles and components that demonstrate compliance with EU/ECE requirements.

In China, the CCC Mark (China Compulsory Certificate) is a mandatory requirement for both domestically manufactured products and products imported into China. TÜV SÜD can partner with you through the CCC certification procedure, which involves testing the product itself, as well as factory inspection and the creation of documentation.

To ensure efficiency and short time-to-market when entering global automotive markets, TÜV SÜD offers a multi-regulation management framework, an approach that considers various homologation requirements at the same time during one project. Working in partnership with our technical experts, this framework enables automotive OEMs and suppliers to better understand country-by-country regulations and the certification process that is applicable in their target markets. It also helps us to identify potential overlaps among different regulations, supporting the development of a testing plan that eliminates duplicate testing and saves both time and costs. In addition, we support the preparation of technical documentation as required by regulators and provide complete project management

**TÜV SÜD has the global presence to provide full-service support in your local market.**

oversight of the homologation process.

Our homologation services help to ensure the most efficient and cost-effective approach to achieving global homologation for your EVs and other vehicles, systems, and components. This allows you to bring new and innovative products to diverse markets, and take full advantage of current and emerging market opportunities.



# Conclusion

After three years of navigating unprecedented challenges, the automotive industry is on the cusp of a major transformation.

Across the industry, manufacturers, producers, and other industry players are bringing new and innovative technologies to market that will help speed up the transition to more efficient and sustainable mobility and transportation solutions. At the same time, automotive companies are actively exploring opportunities to expand their research and production capabilities in new and emerging markets around the globe, while also targeting broader consumer demand.

In this dynamic and continuously changing environment, mastering the challenges of vehicle homologation is central to achieving success on the global stage and should be a priority for every automotive company. Thankfully, by taking advantage of the knowledge, experience, and support of trusted industry partners like TÜV SÜD, automotive companies can best position themselves to overcome homologation obstacles and achieve global market access for their products in a streamlined and efficient manner.

# Glossary

## Glossary of acronyms

<b>BBA</b>	Brilliance China Automotive Holdings Ltd.	<b>HEV</b>	Hybrid electric vehicle
<b>BEV</b>	Battery-electric vehicle	<b>IMF</b>	International Monetary Fund
<b>CAGR</b>	Cumulative average growth rate	<b>IQS</b>	Initial Quality Study
<b>CCC</b>	China Compulsory Certificate	<b>IRA</b>	Inflation Reduction Act
<b>EEA</b>	European Economic Area	<b>OEM</b>	Original equipment manufacturer
<b>EU</b>	European Union	<b>PHEV</b>	Plug-in hybrid vehicle
<b>EV</b>	Electric vehicle	<b>R&amp;D</b>	Research and development
<b>GHG</b>	Greenhouse gas	<b>USD</b>	United States Dollar

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## **TÜV SÜD AG**

Westendstr. 199  
80686 Munich Germany  
+49 89 5791 0  
[www.tuvsud.com](http://www.tuvsud.com)