

**HITACHI**  
Inspire the Next

Hitachi High-Tech Analytical Science

Materials analysis in automotive:  
What you need to know to stay ahead



[ ESSENTIAL GUIDE ]

A close-up, high-angle photograph of a car's interior, focusing on the dashboard and air vents. The image is in grayscale, with a dark, moody atmosphere. The air vents are prominent on the right side, showing their circular design and slats. The dashboard and other components are visible on the left and in the background, with soft lighting highlighting their textures and curves.

The automotive industry and its supply chain need to work collaboratively to deliver new innovations, including new raw materials to make cars lighter.

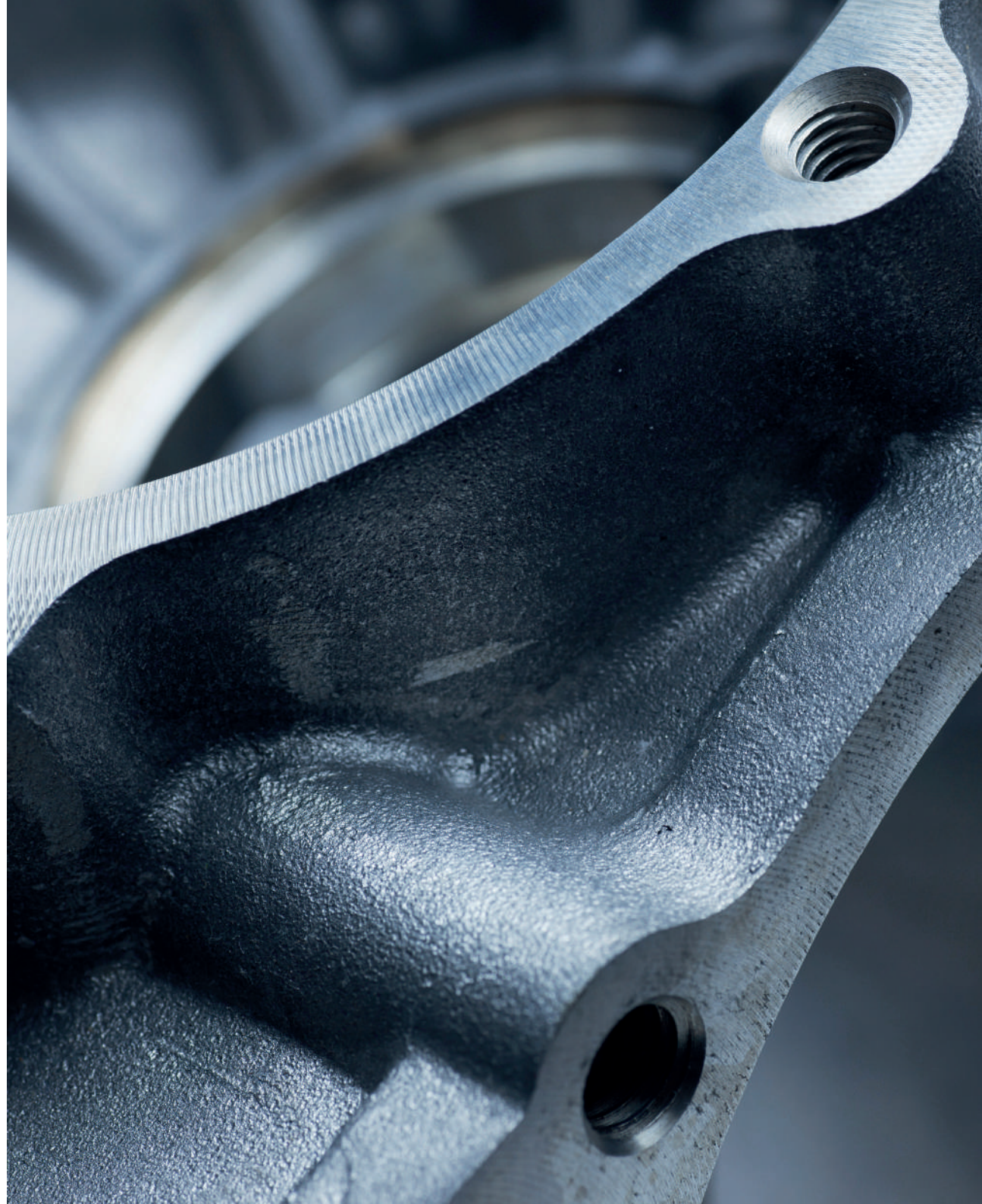
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# Introduction

The automotive sector is in a state of flux. The drive to cut carbon emissions and fierce competitiveness are causing rapid change that affects all elements of the supply chain: foundries, fabricators, plating and coating facilities, electronic component manufacturers, battery producers, vehicle manufacturers and recycling plants.

As a supplier to many facets of the automotive industry, we're in a unique position to see how this change affects everyone in the supply chain – especially when it comes to materials analysis and quality control. In this guide we examine what effects environmentally driven legislation and technological innovation are having on the automotive industry right now and how our solutions could help. We also take a look at specific issues that are affecting different key regions in the world and how our solutions can play a role in powering good.



# 1: The driving force behind change: regulations and standards

It's no surprise that the big driver behind automotive regulations is the environment. Current legislation – from manufacturing to recycling – is aimed at reducing emissions, improving health and safety, and sustainability. And it's the regulations and new standards that are, to a certain extent, driving the innovation in the raw materials used for car components. Here we summarize where we are and what's coming up in the next couple of years:

## Carbon emissions, Euro 6 and beyond

Car emissions are held responsible for much of our air pollution and greenhouse gases. According to the United States of America (USA) Environmental Protection Agency (EPA), motor vehicles collectively cause 75% of carbon monoxide pollution in the country.

The exhaust of a typical combustion-engine powered car contains nitric oxide and nitrogen dioxide (NO<sub>x</sub>), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>) and particulates (among other substances). NO<sub>x</sub> causes smog and acid rain, CO can cause heart damage, whilst CO<sub>2</sub> is a potent greenhouse gas and accepted as a major factor in climate change. Particulate matter has been linked to respiratory conditions.

For the first time in more than 40 years, the largest source of greenhouse gas pollution in the USA isn't electricity production but transport – cars, trucks, planes, trains and shipping. The Trump administration, however, halted many of the plans of the previous administration to address this. In January 2020, the EPA announced that it's working on new rules to significantly decrease emissions of smog-forming NO<sub>x</sub> and other pollutants from heavy-duty trucks. It's currently undertaking public consultation and we will be keeping an eye on the situation, but the reality is, cars in the USA will be getting lighter too, following what's happening in the rest of the world.

## Euro 6

To combat increased pollution, the European emissions standards began in 1992 and have gradually become more challenging. The current regulation, Euro 6, came into force in September 2015. The most dramatic change of Euro 6 over its predecessor Euro 5 is the reduction of the NO<sub>x</sub> limit for diesel cars: from a limit of 180 mg/km to 80 mg/km.

There's been a large focus on reducing CO<sub>2</sub> emissions. The CO<sub>2</sub> target is 130 g/km, and many manufacturers already met this target ahead of the 2015 deadline. We're about to enter the next set of regulations, where average CO<sub>2</sub> emissions of new cars must be a maximum of 95g/km by 2021. This has resulted in most manufacturers working to reduce weight and developing electric powertrain technology.

But we're not done yet. In December 2018, the EU set CO<sub>2</sub> emissions reduction targets of 15% by 2025 and 37.5% by 2030. What does this mean? The automotive industry and its supply chain need to work collaboratively to deliver new innovations, including new raw materials to make cars lighter.

## Light vehicle test procedure

Stringent regulations will only make a real-world impact if they're enforced. And to ensure that new cars are meeting the Euro 6 standard, the EU has introduced a new test. The World Harmonised Light Vehicle Testing Procedure – or WLTP – came into effect in September 2018. This new test is designed to more closely reflect real driving conditions when assessing CO<sub>2</sub> emissions from new cars.

## China 6

The National Stage I Emission Standard was introduced in 2001 and since then, the standards have been getting more stringent. China 6a, compliant with European emission standards, is set to come into force in 2020, with a further standard following up in 2023. The standards will be verified under the WLTP and the target is to reduce CO<sub>2</sub> emissions by over 90%.

The answer to meeting the tough legislations on carbon emissions? Get more out of every drop of fuel by reducing the weight of the vehicles.

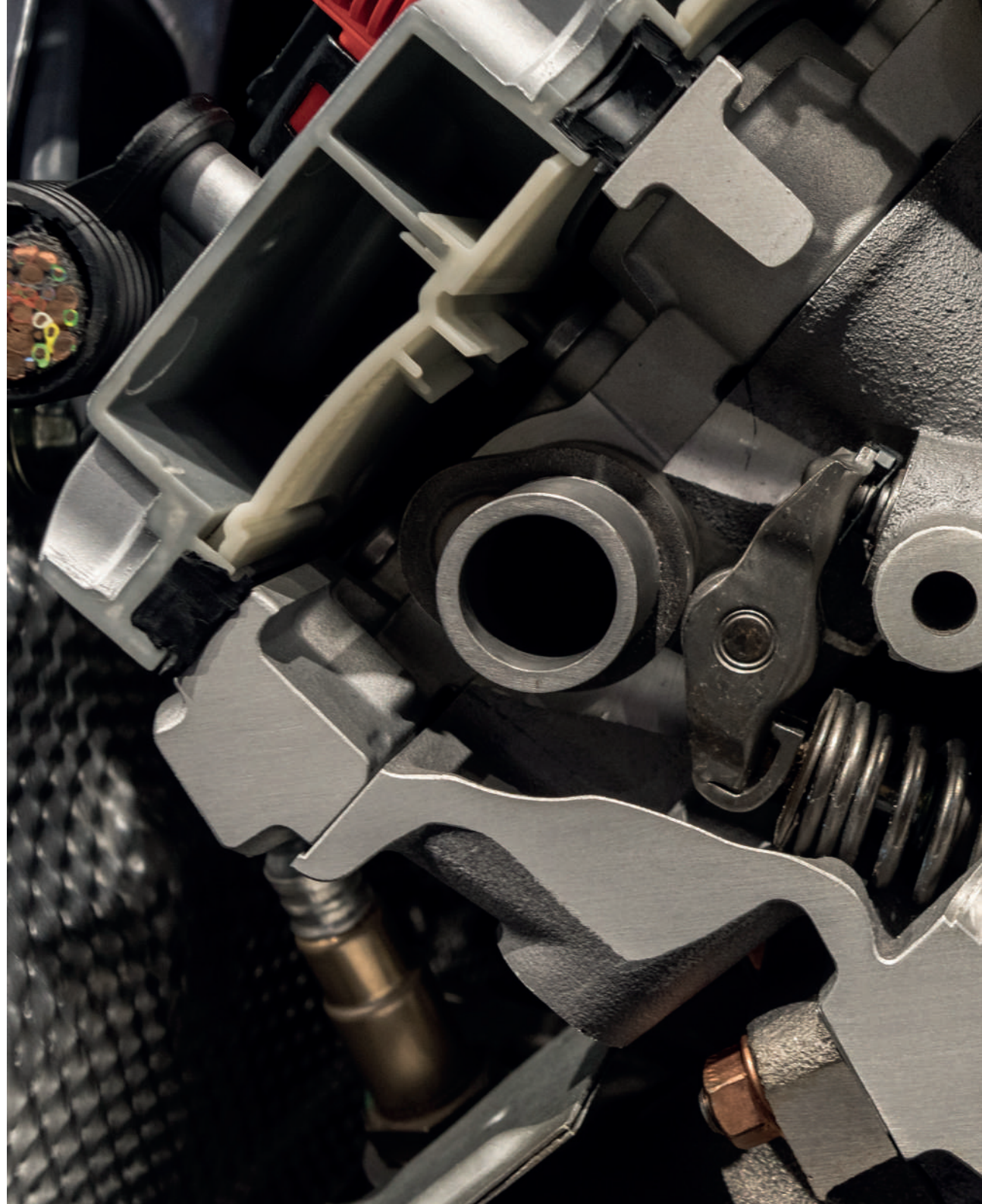
The answer to meeting the tough legislations on carbon emissions? Get more out of every drop of fuel by reducing the weight of the vehicles. We explain more about this in part 2 of this guide.



## The New Automotive Quality System Standard

Published in October 2016, the TS 16949 merges standards from across the EU and USA. The flip side is that now, to sell into automotive in Europe or North America, you have to be TS 16949 compliant. From the perspective of analysis, this means ensuring your equipment is properly calibrated and maintained.

Hitachi High-Tech analyzers are easy to calibrate, many contain self-checking software that ensure results are accurate and they offer advanced, cloud-based data management that ensures you can demonstrate compliance when audit time comes around.





# Recycling

Recycled metals are a huge part of the metals industry, with scrap metal being increasingly used as a base material in foundries. In the EU, end of life vehicles (ELV) are covered by Directive 2000/53/EC. The directive puts the responsibility for the recyclability of a vehicle firmly on the shoulders of the manufacturer and states that they have to ensure that all new vehicles are reusable and/or recoverable to a minimum of 95% by weight per vehicle.

However, at the time of writing, the European Commission has launched a public consultation on Directive 2000/53/EC. Of concern is the 95% recycling target – a target that is proving difficult to meet - and the changing nature of cars is leading to discussions on how to classify the increasing numbers of electrical components in cars. Ultimately, pressure to recycle end-of-life vehicles falls to recycling facilities, not manufacturers. When faced with a ton of scrap and tough recycling targets to meet, fast yet thorough analysis is essential to make sure the right material goes to the right place and as much of the vehicle can be recycled as possible.

The increased use of scrap metal as feedstock for foundries means that we may see more unfamiliar elements introduced into melts which means both scrapyards and foundries will need to be extra vigilant with their testing processes, something we are starting to notice more and more, especially with foundries rejecting trucks where the scrap metal hasn't been sorted correctly. It also highlights the importance of checking incoming materials throughout the supply chain so material with the right specification is used.

## Catalytic converters

Probably one of the trickiest, yet lucrative parts of a vehicle to recycle is the catalytic converter. Palladium, rhodium and platinum can be extracted for re-use in electronics, jewellery and catalysts again.

For catalytic converter recycling, Hitachi's X-MET8000 handheld XRF (X-ray Fluorescence) analyzer offers a simple point and shoot operation, and comes pre-loaded with car catalyst calibration as an optional extra. It's designed to automatically compensate for different compositions that make up the honeycomb core of the converter. This makes it very easy to use even when switching between converter types.

Change is inevitable. Whilst the focus is on carbon emissions now, it will be something else next as new regulations and standards are introduced. The material testing you do today to meet external regulations and your own internal quality policies will need to change as time goes on.

Whilst none of us can predict the future, more complex supply chains with raw materials changing hands many times and further steps to protect the environment mean data management to demonstrate compliance with each regulation will become essential. In many cases, getting the most from your quality control equipment now and in the future is about choosing the right type of analyzer for your application from the available technologies, whether it be LIBS, OES, TA or XRF.

## 2: The need to shed weight

We know that tough legislation on carbon emissions is forcing manufacturers to get more out of every drop of fuel. As CO<sub>2</sub> emissions fall by 8.5g per 100km for each 100kg lost, cutting vehicle weight is high on the agenda.

EV (electric vehicle) manufacturers also have a weight problem. The heavier the vehicle, the fewer miles you get from a single charge. You could add battery capacity but that gives diminishing returns; batteries are expensive and add hugely to the vehicle's weight. Ultimately, the answer is to reduce weight by using lighter components wherever possible across the entire vehicle.

This is why, no matter which powertrain technology you're working with, reducing weight is huge across the sector. From body panels to the tiniest screw, the industry is looking at shedding weight in any way it can. Replacing steel with lighter weight materials makes the most difference.

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### The rise of lighter-weight metals

The automotive industry has very exacting requirements for components – perhaps second only to aerospace. Safety is obviously a huge issue and many components must be ductile to absorb energy on impact. Other components must be structurally rigid, so strength is more critical. This makes the development of new alloys a very exacting science and analyzing the melt chemistry down to the ppm level is crucial to avoid residual elements, which can have strong effects on mechanical properties of the alloy being developed. So, the need to identify and quantify is important to keep the impact of residual elements within acceptable limits.

Aluminium and magnesium alloys have won favor in the industry because they are light, relatively low cost and give many of the properties needed. They can be formed into complex shapes including engine components, gearbox housings and structural parts. In fact, the global market for these parts is predicted to grow at a CAGR of almost 7%, which estimates a market size of around \$48 billion by 2021. There are also developments to add higher concentrations of aluminium to steel and cast-iron grades to make these materials lighter.



## Vulcan Optimum+

The Vulcan Optimum+ model has been optimized for analyzing aluminium alloys. It features a high-performance spectrometer enabling the measurement of lithium in aluminium alloys and it's also capable of measuring boron-aluminium alloys. Boron and lithium are both elements that cannot be measured with any handheld XRF analyzer. If you need concentrations of boron lower than 5ppm, you should choose an OES analyzer.



## Aluminium

Weighing about a third less than steel, aluminium's use in cars has sky-rocketed in recent years. By 2022 the average car is expected to contain almost 100kg of aluminium as a replacement of heavier parts. This means that the automotive industry will make up a quarter of all aluminium consumption - that's 30 million tonnes by 2025.

Car manufacturers are still working to replace more steel parts with aluminium. In 2018, BMW won an award for a concept to reduce the weight of the tailgate in its 5 Series model. By using aluminium in place of deep-drawn steel sheets, BMW can bring the tailgate weight down from 24.6kg to an impressive 11.6kg.

However, to substantially increase the strength of aluminium, you need to add in lithium. The third generation of Al-Li alloys which are currently being worked on could become integral to various components of luxury cars thanks to their excellent combination of low density, high strength, high stiffness, and excellent damage tolerance.

For most, the preferred choice for fast aluminium alloy analysis is handheld LIBS whilst OES can do very low levels of Li in Al analysis, down to 0.0005%, in addition to phosphorus which some may need. Phosphorous is normally added to improve machinability. However, it can have a detrimental effect on corrosion resistance so needs to be added in small amounts.

## OE750

Hitachi's range of mobile and stationary OES analyzers are designed for melt and raw material analysis, including the recently launched OE750. This brand-new spark spectrometer allows you to analyze all main alloying elements and identify exceptionally low levels of tramp, trace and treatment elements in metals. Fast measurement times, high reliability and low operating costs mean the OE750 is invaluable for everyday analysis and total quality control, with performance on a par with larger and more expensive stationary OES spectrometers.

From measuring nitrogen in steel and iron to phosphorus in aluminum, this analyzer gives you the comprehensive metals analysis to meet today's tough specifications.

The OE750 includes state-of-the-art semiconductor detectors and a new optical concept (with four patents pending). This gives the Hitachi OES analyzer high optical resolution, so you don't have to choose between high performance and low cost. Innovative use of dynamic CMOS detectors and direct coupling of the optics to the spark-stand ensures the best luminosity together with a wavelength range of 119 nm to 766 nm. This covers all elements, from hydrogen to uranium, for complete metals analysis\*. This performance is usually only available with high-end quality control instrumentation, yet the OE750 keeps costs down through innovation, low argon and power consumption. The OE750 gives you maximum flexibility for element selection, making your operation fit for the future

\* Depending on the application, for further details request our application reports.

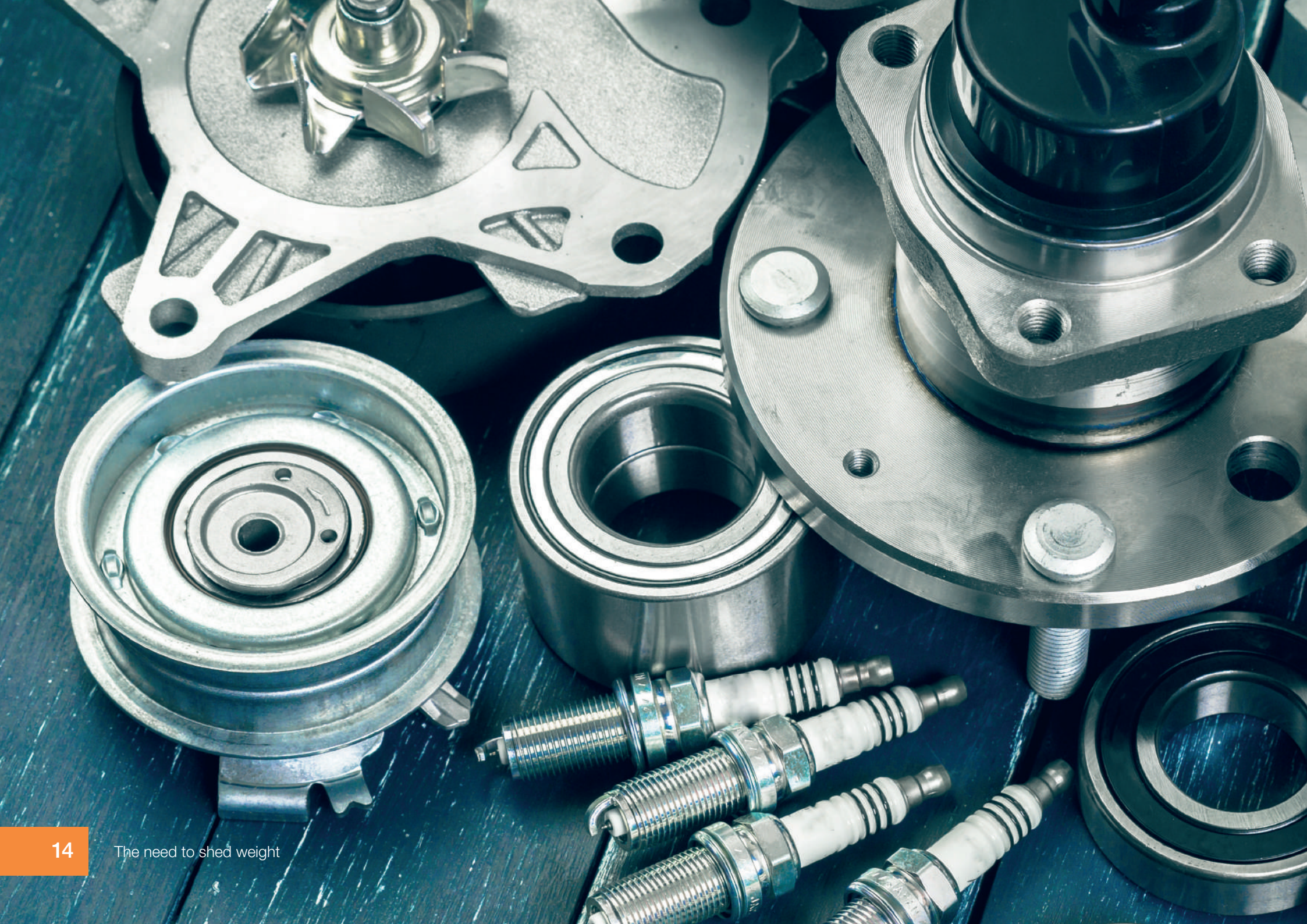


## Magnesium

Magnesium is even lighter than aluminium and has the highest strength to weight ratio of all the structural metals. It's abundant and easily recyclable, so it's not surprising that since its early use for wheels, magnesium has replaced steel and aluminium in housings and space frames and been used extensively in alloys with aluminium. Opel has used magnesium in the Vectra model for the dashboard support; in comparison with the steel tube previously used, the weight saving was 5kg and the manufacturing process simplified.

However, magnesium does have a few drawbacks. It's brittle and doesn't have the creep resistance of aluminium. Innovations in the next couple of years could see that problem go away. A team at Monash University in Melbourne, Australia have created a process that changes the microstructure of magnesium. This means that pure magnesium can be shaped and compressed to any shape at room temperature without cracking. Another team in the USA Department of Energy have developed a process that improves the energy absorption and ductility of magnesium, making it more feasible for a larger range of car parts.

The quality of new alloys being developed stems from having the right tools to help you from the start. From making sure the right material is used to controlling the metal melt, investing in an analyzer that provides results fast and accurately for decision making is crucial. For quality control analysis of alloys to the ppm level, Optical Emission Spectroscopy (OES) is the technology that will give the most precise results as the technology covers the complete spectrum of elements in metal, including phosphorous, sodium and boron and many other trace elements which can't be measured at all or with the necessary detection limits with either a handheld LIBS or XRF analyzer.



## Handheld analyzers

Handheld XRF and LIBS by Hitachi give you the ability to verify material grades in seconds with just a pull of a trigger. Our Vulcan LIBS and X-MET8000 handheld analyzer ranges deliver reliable and accurate results. The Vulcan is ideal for incoming material inspection and inventory checks thanks to its 1-second measurement time and as it's a laser, there are no X-rays. The X-MET8000 XRF analyzer enables non-destructive testing, which is great when you need to verify and assure quality of end product. Both instruments can be used all day long without fatigue as they're lightweight and ergonomic with batteries that last all day.



## Steel poised to make a comeback

We're working with many steelmakers who are developing super-lightweight steels that are stronger, cheaper and almost as lightweight as aluminium in a bid to regain market share. And they are just about there, with new products expected to arrive on the market in 2021, if not earlier.

It's going to be hard to resist the allure of better strength and lower cost, so the predictions based on a growing aluminium and magnesium market could be upset if steel raises its game as much as is suggested.

Fast forward five years and it's likely that vehicles will use a larger range of materials than ever before. Of course, the need to use the right material for the right component is paramount and verification of material grade composition is essential.

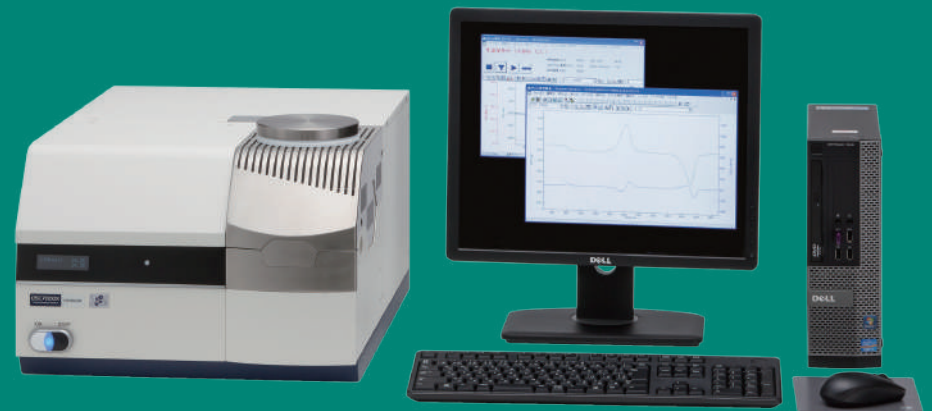
Many foundries already use an analyzer at the time of dispatch. As your supply chain becomes more complex, we can help to ensure you have the tools you need to keep up.

## Composites as an alternative

Using composites is another route to reduce weight and improve fuel economy in cars. 30% lighter than aluminium and 25% the weight of steel, the durability and their ability to be moulded into variety of complex shapes without the need for high-pressure tools has meant cost savings, reduced cycle time and improved production efficiency. The great news is that virtually all thermal analysis techniques can be used for quality control and research and development within the automotive industry.

## DCS, NEXTA STA, TMA and DMA

We offer a wide array of thermal analysis systems/calorimeters. Our world-class, high-sensitivity thermal analyzers give reliable measurements and are optimized to capture the tiniest of reactions. DCS can be used for glass transition, crystallisation behaviour, reaction enthalpies and kinetics, and the influence of fillers. TMA can be utilized to study the expansion or shrinkage of materials. DMA is best method for characterizing the frequency, force and amplitude dependent mechanical behaviour of materials.





## Lubricating oil

The third way to cut weight is by increasing engine efficiency. Generally, the higher the engine compression, the better the fuel efficiency. These high-performance engines need high-performance lube oil to keep them running. We've seen engine oils become more high-tech; with very specific blends being created to achieve just the right level of performance.

XRF analysis is a well-established technique for lube oil specification control. Using an XRF analyzer provides a simple process to verify lubricating oil blend compositions for every batch within your facility.

XRF analysis tells you very quickly which elements are present in the sample, and by using a calibration, you can find out how much of an element is present. Invaluable during blending, XRF analyzers are compatible with the standard test methods ASTM D6481 and D7751 and can be used to control additive levels and trace elements to ensure lube oils meet specification.

The electrification of cars will have an impact on the metal casting industry. With fewer forged parts needed, companies will either need to diversify to stay in business or alternatively, ensure they are prepared for the future. As new alloys are developed to meet the needs of the automotive industry, our view is that detection limits of below 10ppm or >1 ppm (depending on the application and element) across the board are essential for today's metals quality control. To fully understand and investigate effects on melt chemistry and material properties, it's necessary to analyze the full composition at very low detection limits. If you go down the route of composites or lube oil, they will need to be analyzed to ensure quality control and specification verification throughout the production process.

## LAB-X5000 and X-Supreme8000

Hitachi High-Tech's benchtop XRF analyzers LAB-X5000 and X-Supreme8000 are designed for the stringent requirements of the lube oil testing environment. They're ideal for measuring precise levels of additives in the lubricating oil blending process. They're able to measure a wide range of elements in oil, including Mg, P, S, Cl, Ca, Zn and Mo. The analyzers easily meet the precision requirements of international test methods such as ASTM D6481 and D7751.



### 3: The technological revolution

Since Henry Ford popularized the mass production line, the automotive industry has been at the forefront of manufacturing technology. Automation, Industry 4.0, and revolutionary new concepts in automobile design are taking us to the world of connected vehicles and clean energy. That means analysis technology also needs to adapt to support the new innovations.



## Connected Car

As of 2019, there were an estimated 64 million cars produced that had connectivity capability, with statistics forecasting that 18% of households in China will have a connected car by 2023. With a focus on the premium market, the possibilities for innovation once a car has connectivity are huge. Some projects are designed to help the driver and their passengers, such as in-car entertainment, real-time congestion information, car wear and tear monitoring, and navigation aids. Others are more about using data collected to tackle larger issues, such as reducing CO<sub>2</sub> emissions.

Possibly the most revolutionary change is autonomous vehicle technology, utilizing sensors, software and artificial intelligence (AI) to connect vehicles to each other and to traffic management systems to enable automobiles to transport passengers without the need for a driver. Either way, connected cars are a real opportunity for electronics manufacturers.

As circuit board volumes increase, high throughput analysis can help ensure quality is maintained. XRF analysis offers a long-term solution to address the challenge of achieving consistent and accurate coatings analysis in miniaturized electronics. The XRF analyzer you choose can mean the difference between success or failure. As electronics coatings become thinner and are applied to smaller features, you want to invest in technology that is effective today as well as future-proofed for tomorrow's operations.

## FT160

Hitachi's range of coatings analyzers help to analyze the coatings on circuit boards and electronics components. This new benchtop XRF analyzer has been designed to address the challenge of ultra-thin coatings, such as those found in today's shrinking electronic components. The FT160 produces fast, accurate and repeatable results, increasing productivity and reducing costs of out-of-specification coatings on PCBs, semiconductors and micro connectors, etc.

The high throughput offered by the FT160 is possible because of the polycapillary optic and high-precision leading edge XRF detector inside. A large sample table, wide opening door and substantial observation window make it easy to load parts of varying size and to focus on measurement spots. Newly-designed controller software enables enhanced and precise testing and results conveniently captured in a database for export.



## Modern Electric Vehicles: The new kids on the block

The origins of electronic vehicles (EVs) have been around since the 1800s. However, the modern EVs have most definitely arrived. They are silently making their way along our streets, charging up at dedicated parking spaces and helping to cut particulate emissions that are a risk to health in our planet's major cities. China is leading the way in the adoption of new energy vehicles (NEV), a Chinese term for vehicles that are partially or fully powered by electricity, hoping to achieve a sales target of 25% of all cars in 2025.

But it's been a lot of work. EVs contain a myriad of complex components and new material specifications, much like hybrids. Yet EV manufacturers are under the same pressure to reduce circuit board and electronic component coating thickness waste, tramp and trace elements, and re-use scrap material as everyone else.

Comprehensive analysis must be an integral part of verifying material specifications right across the board. In addition, to quality control programs, another area that's of concern is the control of substances hazardous to health. XRF analysis provides accurate, fast detection of these substances to ensure components meet the stringent RoHS directives.

## EA1000 Series

Specifically designed for RoHS (Restriction of Hazardous Substances) the EA1000AIII and EA1000VX XRF analyzers have been trusted for over 15 years to deliver consistent results for businesses who need to conform to this directive. With easy and quick measurement of hazardous substances you can ensure you will be able to meet the requirements for environmental regulations.



## Making batteries safe

Right from the beginning, the issue with electric cars was range. Currently the Tesla Model S Long Range claims a 375-mile run between charges. The only batteries that are up to the job and commercially available today are lithium-ion batteries.

Yet, despite being established technology, lithium-ion batteries have major drawbacks – they can explode. The reason for this is metal contaminants within the cell can migrate through from the cathode to the anode, causing a short circuit which leads to local overheating.

This makes it essential to control the size and distribution of metal particles within the cell. Larger particles near the central separator are more risky than smaller particles nearer to the cathode current collector. There are two main analytical techniques for quality control: X-ray transmission that allows battery manufacturers to see the size and shape of the metal particles within the cells, and X-ray fluorescence that tells you exactly what those particles are. You'll want to look for high-speed analysis, so you can afford the time to take measurements early in the manufacturing process to rectify problems before it gets too costly or late.

The technological revolution means that your analyzers also need to evolve to meet the changing demands. Whether its miniaturized electronics, complex components in EVs or lithium-ion batteries, specialized analyzers are available that meet the applications to help you maintain quality across production.

Interested to read our take on some of the key automotive regions? We highlight key topics and how we are supporting local companies to meet the new challenges.

## EA8000

The EA8000 X-ray analyzer for fast and efficient quality control in lithium-ion battery production. Combining X-ray transmission imaging with X-ray fluorescence analysis in a single instrument, the EA8000 rapidly detects and identifies metals contaminants that are so detrimental to lithium-ion battery (LiB) performance. Suitable for raw material testing, process control and failure analysis, the EA8000 is a powerful tool in ensuring LiBs' quality and performance.



## 4: Regional considerations

When it comes to metal production and fabrication, we know end-to-end quality assurance and control has never been more critical. Changes within the automotive sector are having profound effects across the globe – and region-specific priorities and developments are, in turn, having a profound effect on the automotive sector. Here we take a look at the main issues within automotive across four regions, all where we have presence too: USA, Germany, Asia and China.

### Automotive dominates in the USA

The automotive sector is the largest manufacturing sector in the USA, making up a huge 3% of GDP. In the past five years, car manufacturers have exported more than \$692 billion in cars and car parts. When it comes to purchasing American products and materials, the sector purchases colossal amounts of steel, iron and semiconductors.





## American car makers forming global alliances

It would seem, on a business level, US automotive companies are keen to work collaboratively with companies across the globe. Ford Motor Company has entered into collaborations with Indian Mahindra Group. With a focus on powertrain and connected cars, they are working together to develop electric vehicles and telematic control units.

With technology advancing at an amazing pace, manufacturers are working together rather than metaphorically reinventing the wheel. US-owned Intel and Italian-US Fiat Chrysler Automobiles are working with German BMW, Canadian Magna International and Israeli Mobileye in a truly international collaboration on self-driving vehicles.

The automotive industry is seeing other unlikely alliances that change the driver experience for good. Jaguar is partnering with PayPal to offer in-car payments and Ford are working with Medtronic to develop an in-car medical monitoring system. And USA companies are heavily involved, if not leading the way in IT-related innovation.

We're seeing a trend towards 100% PMI (positive material identification) and more companies investing in tools to improve quality control processes in the pursuit of 100% quality.

We're seeing a trend towards 100% PMI (positive material identification) and more companies investing in tools to improve quality control processes in the pursuit of 100% quality. In the case of raw materials and metal components, we are seeing that companies are relying less on supplier certificates and investing more in analyzers. Given the critical and increasing role of electronics in demanding markets like automotive as well, reliability and accuracy in production and quality control are paramount for safety, with many switching their analysis in-house, which we can support with.





## Germany: Europe's biggest automotive producer

When it comes to automotive design and manufacture, Germany is synonymous with quality. The automotive sector is huge, creating 20% of total domestic industry revenue. And with 5.5 million passenger vehicles produced in 2017, Germany is Europe's leading manufacturing site and sales portal for cars.

However, it will come as no surprise that while German manufacturers do produce high volume, they are very much focused on the premium market. Of all premium-branded cars produced, over 70% have a German badge. Much of this is because German cars have such a stronghold in Europe where premium vehicles make up a significant part. This puts German manufacturers in a very strong position as the outlook is that the global premium market automotive segment will grow at a much faster rate than the total passenger segment in the next few decades.

Premium also demands quality assurance and control throughout the production process, starting from the raw materials to final product inspections.

Premium also demands quality assurance and control throughout the production process, starting from the raw materials to final product inspections. With each component supplier meeting the standards too. This means having the right spec analyzers to match each part of the production process from foundry, fabrication to end product is crucial.

We also design, develop and manufacture our OES instruments in Germany. We believe that keeping control of manufacturing at our own site, and using our own experts, is crucial for maintaining the high quality of our instruments.

### Huge focus on R&D

The reason for Germany's high-quality automotive dominance can surely be traced back to a widespread commitment to research and development. A huge one third of global automotive R&D spending is from German manufacturers. And it's a trend that's set to continue with R&D budgets set to rise.

The continued pursuit of technological innovation is paying off, with German automotive engineers at the heart of sustainable mobility projects. Improving energy efficiency of traditional engines, development of electric vehicles and research into new lightweight materials are all on the R&D agenda to support challenging carbon emissions targets. Those targets are also being supported at the Government level with smart traffic management and the electric mobility initiative.

Whether creating new alloys to support component redesigns for strength and weight reduction, or studying coating thickness compositions on doors or electronics, our instruments analyze metal properties and provide valuable insight for research and development teams to help with product innovation.



## Leading the connected car revolution

As we have seen, the connected car is here and set to increase. Predictions suggest that by next year one in five cars will be connected to the internet, with 50% of these in the premium market, where Germany is right at the forefront of automotive innovation.

Along with the European Commission (EC), the German government is racing to accelerate large-scale battery production in Germany and across Europe, with a €1bn fund available to German companies and an additional €500m to support research into both existing and next-generation EV batteries. This is all as part of a bold bid to take 30% of global market share by 2030.

In summary, the German automotive market, built on innovation and premium products, is set to stay strong. A robust domestic market and healthy export levels, building on a justified reputation of quality, means the future is looking good for German-badged cars. With our OES manufacturing based in Germany, we work with many beta customers in Germany to ensure that our instruments are future-proofed for their operations.

## Asia – Thailand

Thailand's automotive industry ranks 12th in the world, with a diverse production portfolio of cars, commercial vehicles, motorcycles, construction equipment, and auto parts and accessories. The pinnacle of the country's production to date was in 2012/2013, when it produced just under 2.5 million units, placing Thailand 9th on the global production leader board.

Within Southeast Asia, Thailand is the largest car manufacturer with 23 car assembly plants, eight motorcycle plants, 386 tier 1 auto part producers and 1,700 tier 2 and tier 3 auto part producers. The majority of passenger cars produced are low-cost, affordable vehicles aimed at Thailand's middle-level earners.

This focus on affordability over high-tech has meant that the region is just starting to focus on electric vehicles but has some time to make up. Rather than focus on underlying technology, Thailand may focus its R&D efforts on its healthy auto parts sector, focusing on developing high-tech components for global export. Nonetheless, those venturing into the electric vehicle production market can be assured that our expertise will be there to support them to ensure quality control.

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### Moving up the value chain

The Thai government switched to policies to build the strength of automotive sector in turn developing the domestic production of vehicle parts. This has strengthened the supply chain of the entire automotive sector. Over 80% of all parts used in the manufacture of vehicles are now sourced domestically. Material identification and verification has never been more critical. Our fast, reliable, accurate analyzers provide reassurance throughout the quality assurance and control processes.

## Asia – Vietnam

2019 was a landmark year for Vietnam's automotive industry as the country entered the automotive market with its own brand – VinFast. With an aim to be the first Vietnamese company to compete with established brands such as Toyota, Ford and Honda, VinFast produced their first units in mid-2019. The company plans to produce 500,000 vehicles a year and begin exporting in 2020.

The first two production vehicles – a hatchback and a sedan – are based on Opel and BMW frames. However, moving forward VinFast are working on developing a wide range of vehicles, including EVs, city cars, electric buses and electric scooters. And with six new automated factories supported by a Government keen to boost private sector, VinFast could shake up the regional competitive landscape. And ensuring quality control will be vital for all car parts. Our range of instruments has been optimized for this application.

## Asia – Indonesia

Indonesia is the second largest car manufacturer in Southeast Asia. However, the country is strongly dependent on foreign investment. Japanese manufacturers in particular have about a 50% market share in the country's automotive production capacity. With expectations for Japanese automotive manufacturers to maintain their reputation for building reliable cars, it does mean that rigorous quality control processes need to be in place.

## Low Cost Green Car

The Indonesian Low Cost Green Car (LCGC) was developed in 2013 in response to government tax incentives to car manufacturers that met fuel efficiency targets. The LCGC offered the population an affordable and environmentally-friendly vehicle and was well received; it makes up almost 25% of total domestic car sales.

However, Indonesia is the world's largest emitter of greenhouse gases, a situation that has seen the government pledge to cut emissions by 29 - 41% by 2030. And with global emission standards getting ever tighter, the LCGC lags behind by meeting only the Euro 2 emission standard. The Indonesian government has a target of 20% electric cars in the country by 2025 and has already added a luxury goods tax to the LCGC of 2% compared with a zero-rate tax for EVs.

With more and more affordable analyzers available on the market from leading manufacturers that offer low cost of ownership, increased throughput, ease of use and performance of much more expensive instruments, doing analysis in-house has never been so easy.

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## Asia – India

Perhaps the most disruptive element of India's automotive industry is also the most necessary – safety. In April 2019 a whole new set of safety regulations for vehicles were released for vehicles produced in India. The main focus is to prevent fatal and severe road accidents, which are at very high levels in India and ever increasing.

OEMs will be forced to re-engineer their models and this spells the end of some models, with older vehicles being scrapped. It means material standards and quality control need to improve too, making sure they meet stringent specifications to keep people safe. Our range of instruments help you to meet standards, avoiding potentially devastating results for your customers, your company and your reputation.

### Greener vehicles

India has introduced an emission standard, BS-VI, that is in line with European 6 standards, ensuring that Indian vehicles can compete on a global level. Plus, the Indian government have put about \$1.4billion behind electric vehicles and related infrastructure under the FAME II (Faster Adoption of Electric Vehicles) Scheme. The main focus of FAME II is to give consumers incentives to buy, such as tax deductions on interest paid on loans for EVs and establishing a charging infrastructure. Customs duty is also being exempted on certain parts for EVs and for parts required for their manufacture.

With compliance and cost pressures throughout the production and manufacturing process, this puts more and more demands on instrumentation. That's why you need a trusted partner – one that can deliver accurate results fast.



## Made in China

The 'Made in China 2025' (MIC 2025) initiative, published in 2015, has ambitious plans for a country that has traditionally had the reputation of the globe's low-cost manufacturing base. With a focus on innovation, high value products, and services, the initiative is attempting to position China as a global leader in several key industries, such as robotics, IT and clean energy. In essence, it's a blueprint to upgrade the manufacturing capabilities of Chinese industries to counter emerging economies. So, improving quality control should feature high on the agenda.

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### China economy slowing...

China's economy has been in decline for years. In the second quarter of 2019, the economy grew by 6.2%, slightly less than 2018 performance. In a country that enjoyed double digit growth in the early 00s, this is relatively slow. This year, exports fell by 1% over last year and retail sales are falling.

### ...however, there's opportunity in the after-sales market.

The Chinese automotive aftermarket is doing relatively well. Spurred by a strong used car sales market in part, the sector is expected to see a CAGR of 7.7%, reaching over \$523 billion in 2025. After-sales channels are expected to change, however, with eCommerce platforms increasing their share of retail, repair and maintenance services to 40% by 2025. It's the aftersales market where we see the need for increased analysis to ensure that counterfeit parts aren't introduced into cars. Using counterfeit car parts carry a risk to drivers, passengers and other road users. We know that the automotive industry is working hard to remove counterfeits from online and offline outlets and as this market is on the increases in China, there's a lot that local companies can do to ensure quality and manage risk, including reputation. The handheld X-MET8000 for example is an affordable option to minimize this risk as you're able to do non-destructive testing on most car parts to ensure they're genuine.

## Impact of those trade wars

The introduction of tariffs, together with a slowing Chinese economy and tough emissions targets, have resulted in a month-on-month drop in new car sales over a period of just over a year. To put this in context, sales of sedans, utility vehicles, minivans and multi-purpose vehicles fell by 3.9% from the previous year to 1.53 million units. This drop in sales will add cost pressures throughout the production and manufacturing process.

Whilst talks are ongoing as we write this, the phase one trade deal has been signed in Washington. Of course, this has an impact on other national economies. China is the most important market for German manufacturers, and the current slowdown in the German economy is linked to its huge automotive market. In 2018, German cars made up almost a quarter of all cars sold in China, with BMW and Daimler selling more than a third of their total car sales in the region. However, possibly as a result of tariffs on exports from the US to China, BMW has started to manufacture vehicles in China. And they are not the only ones.

Tesla has also built a manufacturing facility in China. Named 'Gigafactory 3', it's the first electric vehicle factory owned by a foreign manufacturer in the country. In a shrewd move, Tesla now has a huge market right on its doorstep. The new factory openings mean opportunities for suppliers who'll need to ensure they can demonstrate quality control of the components and parts manufactured. No doubt Tesla will equally be looking to manage any quality control issues which may arise.

## China 6 Emissions Standards

If China is racing to keep up with manufacturing technology, it's also keeping up with emissions regulations. The National Stage I Emission Standard was introduced in 2001 and since then, the standards have been getting more stringent. China 6a, compliant with European emission standards, is set to come into force in 2020, with a further standard following up in 2023. The standards will be verified under the WLTP and the target is to reduce CO<sub>2</sub> emissions by over 90%. This means ensuring the right processes and tools are in place for melt and raw material analysis as metals are getting lighter.

China is making waves, yet still experiencing steady growth, with an environmental strategy that's completely in line with European and USA targets and companies continuing to invest in their quality assurance and control programs. With a shift to 'Innovated in China, increased R&D spend, and quality control featuring high on the agenda, we've got a range of tools that will help companies keep up with the changing pace.



# 5: Conclusion

The field of materials analysis has been rapidly changing in recent years as it keeps up with new regulations, standards and innovations in the industry. The continued development and application of technologies like OES, XRF, LIBS and Thermal Analysis is making analysis easier for companies across a whole range of industries.

One of the biggest drains on profitability is the supply chain. To purchase raw or scrap material, and then have it sitting in the warehouse or scrapped because you can't verify its composition, eats into your working capital. And if you have used a material with an unacceptable level of impurity because you couldn't test for it then replacing a part or even compensating a customer, is costly and potentially harmful to your reputation.

When it comes to electronics components analysis, it can be a challenge. The most obvious hurdle is that the features are so small. This itself means that you need an ultra-high precision instrument with a small spot size. And although the features may be small, the PCB or wafer may be quite large. This can mean that simply finding the feature you want to measure can be time-consuming.

Whether it's for quality assurance/quality control processes (QA/QC), material sorting, positive material identification (PMI), coating thickness, scientific or high sensitivity thermal analysis, products are available that enable you to test materials on-site, and on the move. However, the best analyzer for your application depends on the kind of analysis you are doing, the level of accuracy you need and what type of components or material you are analyzing.

Often, there might be more than one solution that meets your needs as well. In other cases, you might want to combine the advantages of portability and extreme accuracy, and select complementary instruments that use LIBS, XRF, OES and Thermal Analysis respectively. What makes Hitachi High-Tech different is that we offer solutions that use all four technologies, which can be used individually or together to cover your analysis needs.

Whilst the easiest option is to talk to our experts who can help you decide the best solution for your needs, here's some key considerations to think about when selecting the right tool for the job.

## Do you need:

- A portable device that can be taken to the material for testing, rather than the other way around?
- Accurate readings that can be taken in seconds by non-technical operators?
- Automatic recording and storage of large numbers of readings?
- Robust design suitable for a production environment that's reliable?
- Low cost of ownership?
- Connectivity for fast data transfer?
- Fast response service agreement from the supplier to minimize downtime?

At Hitachi High-Tech, we work directly with foundries, electronics suppliers, recycling facilities, fabricators and metal component producers, ensuring their analysis keeps with changing demands. And we ensure our own products are also keeping up with the changing times. The new stationary OES analyzer OE750 that's breaking new ground in metals quality control and the FT160 ultra-high precision for electronics components, both demonstrate how we are continuing to deliver trusted and reliable instruments to support the challenges faced by the automotive industry.

It's an exciting time to be in the automotive industry, and no matter where in the supply chain you fall, we intend to continue to support by developing analytical equipment that's ready for what's to come.

# 6. References

## 1: The driving force behind change: regulations and standards

<https://www.autoexpress.co.uk/car-news/consumer-news/90816/euro-6-emissions-standards-what-do-they-mean-for-you>  
<https://www2.frost.com/frost-perspectives/european-emission-regulations-will-stringent-emission-regulations-choke-automotive-industry-or-will-oems-find-their-way-out/>  
<https://www.vehicle-certification-agency.gov.uk/fcb/wltp.asp>  
[Hitachi App Note 16: X-MET for analysis of catalytic converters](#)  
<http://qualitymanagementsystem.com/what-is-iso/ts16949-the-new-automotive-quality-system-standard/>  
[https://www.bsigroup.com/en-GB/iatf-16949-automotive/?gclid=Cj0KCQjw3JXtBRC8ARlsAEBHg4n-F3dqq9jipQ9ITyapSPISFedsNT1TIP5pHfXdI03DIRe2bxD3-EaAo\\_SEALw\\_wcB](https://www.bsigroup.com/en-GB/iatf-16949-automotive/?gclid=Cj0KCQjw3JXtBRC8ARlsAEBHg4n-F3dqq9jipQ9ITyapSPISFedsNT1TIP5pHfXdI03DIRe2bxD3-EaAo_SEALw_wcB)  
<https://www.scrapcarcomparison.co.uk/car-recycling/>  
<https://www.letsrecycle.com/news/latest-news/eu-opens-elv-directive-review/>  
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3A121225>  
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM:n26102>  
[https://ec.europa.eu/environment/waste/oil\\_index.htm](https://ec.europa.eu/environment/waste/oil_index.htm)

## 2: The need to shed weight

[https://agronomy.emu.ee/wp-content/uploads/2017/04/Vol15SP1\\_Berjoza.pdf](https://agronomy.emu.ee/wp-content/uploads/2017/04/Vol15SP1_Berjoza.pdf)  
<https://www.autonews.com/article/20181018/OEM05/181019603/steel-getting-stronger-lighter-to-compete-against-aluminum-s-rise>  
<http://www.manufacturinglounge.com/materials-used-lightweight-cars/>  
<https://www.totalmateria.com/page.aspx?ID=CheckArticle&site=ktn&NM=246>  
<https://www.totalmateria.com/page.aspx?ID=CheckArticle&site=KTN&NM=248>  
<https://www.assemblymag.com/articles/94095-new-manufacturing-processes-could-spur-demand-for-magnesium-in-automotive-industry>  
<https://www.thebalance.com/metal-profile-magnesium-2340142>

[https://www.autoblog.com/2009/10/29/greenlings-how-does-weight-affect-a-vehicles-efficiency/?guccounter=1&guce\\_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMmNvbS8&guce\\_referrer\\_sig=AQAAABLp1hBFF0tVI6-IKMOXUg6w9X4niN5G1so9Nqpi1L\\_xA\\_HtV2C4RczQCKiAwLVNwWRtloRbUk5rR8Kz1yOfNI1vyhHBjsAm8cHRUqrcrhccW5K8Wfw7z1KSbcRDpSqpa-0ZV4h4\\_WZ1UaP6Nk96FMskGgSpFA7msc2xLw565V](https://www.autoblog.com/2009/10/29/greenlings-how-does-weight-affect-a-vehicles-efficiency/?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlMmNvbS8&guce_referrer_sig=AQAAABLp1hBFF0tVI6-IKMOXUg6w9X4niN5G1so9Nqpi1L_xA_HtV2C4RczQCKiAwLVNwWRtloRbUk5rR8Kz1yOfNI1vyhHBjsAm8cHRUqrcrhccW5K8Wfw7z1KSbcRDpSqpa-0ZV4h4_WZ1UaP6Nk96FMskGgSpFA7msc2xLw565V)  
[http://www.drivealuminum.org/wp-content/uploads/2017/05/Ricardo\\_FD807-electric-vehicle-component-sizing-vs-vehicle-structural-weight-report.pdf](http://www.drivealuminum.org/wp-content/uploads/2017/05/Ricardo_FD807-electric-vehicle-component-sizing-vs-vehicle-structural-weight-report.pdf)  
<https://www.spotlightmetal.com/future-oriented-solutions-for-the-automobile-industry-a-660882/>  
<https://www.spotlightmetal.com/the-future-of-foundries-is-aluminum-a-789106/>  
<https://www.spotlightmetal.com/lightweight-design-with-steel-promising-combination-a-833544/>

## 3: The technological revolution

<https://www.daimler.com/innovation/case/connectivity/industry-4-0.html>  
<https://www.groupe-psa.com/en/automotive-group/industrial-performance/>  
<https://www.groupe-psa.com/en/automotive-group/innovation/connected-car/>  
<https://www.digitaltrends.com/cars/xnrgi-develops-ev-battery-tech-that-extends-range-to-700-miles/>  
[https://www.cms-lawnow.com/ealerts/2019/04/netherlands-to-issue-gdpr-regulation-to-protect-car-and-driver-data?cc\\_lang=en](https://www.cms-lawnow.com/ealerts/2019/04/netherlands-to-issue-gdpr-regulation-to-protect-car-and-driver-data?cc_lang=en)  
<https://www.fleetnews.co.uk/news/fleet-industry-news/2016/05/03/new-eu-data-regulation-aims-to-protect-driver-privacy>  
<https://electrek.co/2018/05/03/tesla-model-3-battery-cells-rare-data-energy-density-cobalt/>  
<https://www.statista.com/topics/1918/connected-cars/>  
<https://www.ericsson.com/en/press-releases/2019/9/ericsson-automated-smart-factory-operational-in-china>  
<https://www.visualcapitalist.com/extraordinary-raw-materials-in-a-tesla-model-s/>  
[https://agronomy.emu.ee/wp-content/uploads/2017/04/Vol15SP1\\_Berjoza.pdf](https://agronomy.emu.ee/wp-content/uploads/2017/04/Vol15SP1_Berjoza.pdf)  
<https://www.power-technology.com/features/inside-germanys-e1-billion-battery-fund/>

## 4: Regional considerations

### Automotive dominates in the US

<http://www.americanautocouncil.org/sites/aapc2016/files/2018%20Economic%20Contribution%20Report.pdf>  
<https://www.reuters.com/article/us-usa-trade-tariffs-factbox/tariff-wars-duties-imposed-by-trump-and-u-s-trading-partners-idUSKCN1UR5YD>  
<https://www.bbc.co.uk/news/business-49906815>  
<https://www.counterpointresearch.com/automotive-consolidations-and-alliances-the-next-wave/>  
<http://www.americanautocouncil.org/automotive-standards>

### Germany: The biggest automotive producer in Europe

[https://www.gtai.de/GTAI/Content/EN/Invest/\\_SharedDocs/Downloads/GTAI/Industry-overviews/industry-overview-automotive-industry-en.pdf](https://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Industry-overviews/industry-overview-automotive-industry-en.pdf)

### Asia – Thailand

<https://www.bangkokpost.com/business/1606570/automotive-industry-at-a-turning-point>  
<https://www.bangkokpost.com/auto/1668000/the-man-behind-thai-auto-policy>  
[https://ec.europa.eu/trade/policy/countries-and-regions/development/generalised-scheme-of-preferences/index\\_en.htm](https://ec.europa.eu/trade/policy/countries-and-regions/development/generalised-scheme-of-preferences/index_en.htm)  
<https://www.bangkokpost.com/auto/1597442/fti-sees-stagnant-car-output-in-2019>

### Asia – Vietnam

<https://www.bangkokpost.com/business/1606570/automotive-industry-at-a-turning-point>  
<https://europe.autonews.com/automakers/ford-toyota-face-new-rival-vietnam-17000-vinfast-hatchback>  
<https://www.lexology.com/library/detail.aspx?g=e686c06e-b99d-4159-b99f-8624097db4a0>

### Asia – Indonesia

<https://www.carbonbrief.org/the-carbon-brief-profile-indonesia>  
<https://en.tempo.co/read/1184285/govt-to-apply-luxury-goods-tax-for-low-cost-green-car>  
<https://www.indonesia-investments.com/news/todays-headlines/indonesia-s-low-cost-green-car-not-as-affordable-as-planned/item6796?>  
[https://www.jetro.go.jp/ext\\_images/indonesia/pdf/automotiveseminar\\_29Jan2019/presentation\\_kemenperin.pdf](https://www.jetro.go.jp/ext_images/indonesia/pdf/automotiveseminar_29Jan2019/presentation_kemenperin.pdf)  
<https://www.indonesia-investments.com/business/industries-sectors/automotive-industry/item6047?>

### Asia – India

<https://www.counterpointresearch.com/yet-another-set-automotive-regulations-comply-india/>  
<https://www.weforum.org/agenda/2019/10/auto-component-industry-growth-outlook-india/>  
<https://www.thehindubusinessline.com/economy/budget/finance-minister-gives-rs-10000-cr-ev-push/article28293641.ece>

### Made in China

<https://thediplomat.com/2019/02/made-in-china-2025-explained/>  
<https://www.china-briefing.com/news/made-in-china-2025-explained/>  
<http://www.europe-to-china.com/china-6-emission-standard/>  
<https://www.scmp.com/economy/china-economy/article/3022428/chinas-historic-car-market-decline-continues-trade-war-and>  
<https://think.ing.com/articles/germany-what-role-does-chinas-automotive-market-play-in-the-current-economic-slowdown/>  
<https://www.bbc.co.uk/news/business-49791721>  
<https://electrek.co/2019/09/16/tesla-preparing-expansion-gigafactory-3/>  
<https://www.prnewswire.com/news-releases/china-automotive-aftermarket-report-2018-2025-300772340.html>  
<https://roboticsandautomationnews.com/wp-content/uploads/2017/06/Rising-Opportunities-in-China's-Automotive-Independent-Aftermarket.pdf>

## About Hitachi High-Tech

For over 45 years, Hitachi High-Tech has specialized in high-tech analysis solutions designed to meet the tough challenges of a rapidly evolving industrial sector. Today, we're helping thousands of businesses streamline their costs, minimize risk and increase production efficiency.

Our range of laboratory-based and robust high-performance in-field testing instruments deliver materials and coatings analysis that adds value throughout the production lifecycle, from raw material exploration to incoming inspection, production and quality control to recycling.

Working in close collaboration with our customers, our in-house experts have developed customised testing methodologies for hundreds of industrial applications, delivering simplicity of operation for even the most demanding applications.

We transform the latest technological advances into analysis solutions that drive business success.



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