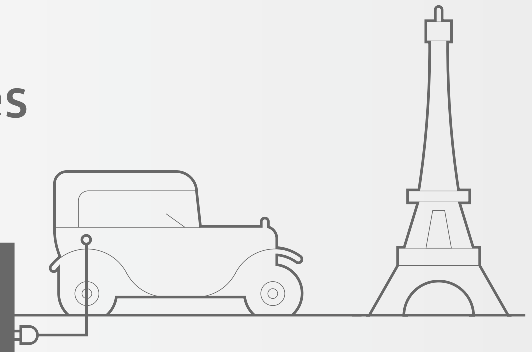
KUKA

KUKA Robotics and E-Mobility

Head start in the joining and welding of aluminium for electric vehicles

Facts & Figures



1881

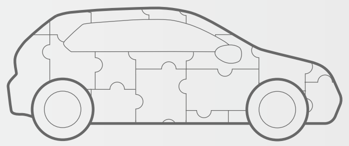
The French electrical engineer and inventor Gustave Trouvé presented an electric car at the International Exposition of Electricity in Paris. Seven years later, a machine factory in Coburg, Germany produced the Flocken Elektrowagen, the world's first four-wheeled electrically-powered passenger car.

2030

By 2030 electric and fuel cell vehicles may comprise 58 percent of total car and light truck sales under the International Energy Agency's Sustainable Development Scenario (SDS).

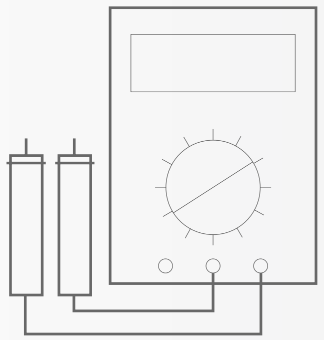
International Energy Agency, 2020 Global Outlook

320



drive components are required on average for a battery electric vehicle (BEV) whereas previous drive concepts require around 4,000 components.

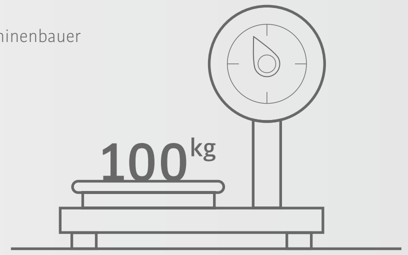
Technik Einkauf, Wie sich Werkzeugmaschinenbauer auf E-Mobilität einstellen



350 watt hours / kg

is the power density by which conventional battery cells should be able to increase through the use of high-capacity Lithium-Nickel-Manganese-Cobalt-Oxide (NMC) materials.

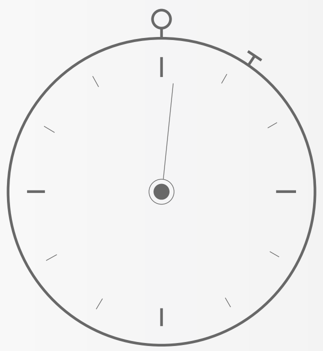
Fraunhofer ISI, Batterien für Elektroautos: Faktencheck und Handlungsbedarf (PDF)



100 kg

of aluminium will be in an average car in 2025. By then, the automotive industry will account for a quarter of total aluminium consumption (30 million tonnes).

Automobil Produktion, Der Weg zum Leichtbau: Qualitätskontrolle neuer Metalllegierungen



1.5 seconds

are taken for each spot during the robotic welding of aluminium components such as those required for the manufacture of the battery compartments for electric vehicles. KUKA welding robots score high here – for example, the KR QUANTEC with a repeatability of +/- 0.05 mm.

Dear Readers,

As the company moves into the age of e-mobility, Albert Sanchez, Vice President Industry Team Tier 1 at KUKA, focuses on comprehensive, experience-based process know-how and intelligent robotics for welding and joining lightweight materials.

We live in eventful times: globalization, digitalization and climate change are fundamentally altering the coordinates of our living and working environments. The pandemic has further accelerated this transformation.

The transition to electromobility is a prime example of this. It presents the entire automotive industry and its suppliers with the challenge of replacing previously profitable products with new products in order to achieve the necessary emission targets and keep pace with competitors in electric vehicle (EV) development. It is not just a matter of replacing one type of drive with another, but of rethinking the entire concept, right down to the production processes.

Lightweight construction is becoming ever more important, not least because heavy, high-performance batteries need to be integrated into the car body. Battery compartments and chassis are merging together. The increasing use of lightweight materials, such as aluminium and plastics, places enormous demands on production and joining technology.

Intelligent robotics is and remains the key to efficient new manufacturing technologies offering maximum reliability. KUKA has been a trusted partner of the automotive industry and its suppliers for decades in this area. Particularly during a transformational period, where new certainties and profitable processes still need to be found, experience and proven process steps – for example, in areas such as the welding of aluminium – cannot be valued highly enough.

The transition to electromobility is a challenge. But, more than anything, it is also an opportunity. Let's seize it together.

Sincerely,

Albert Sanchez

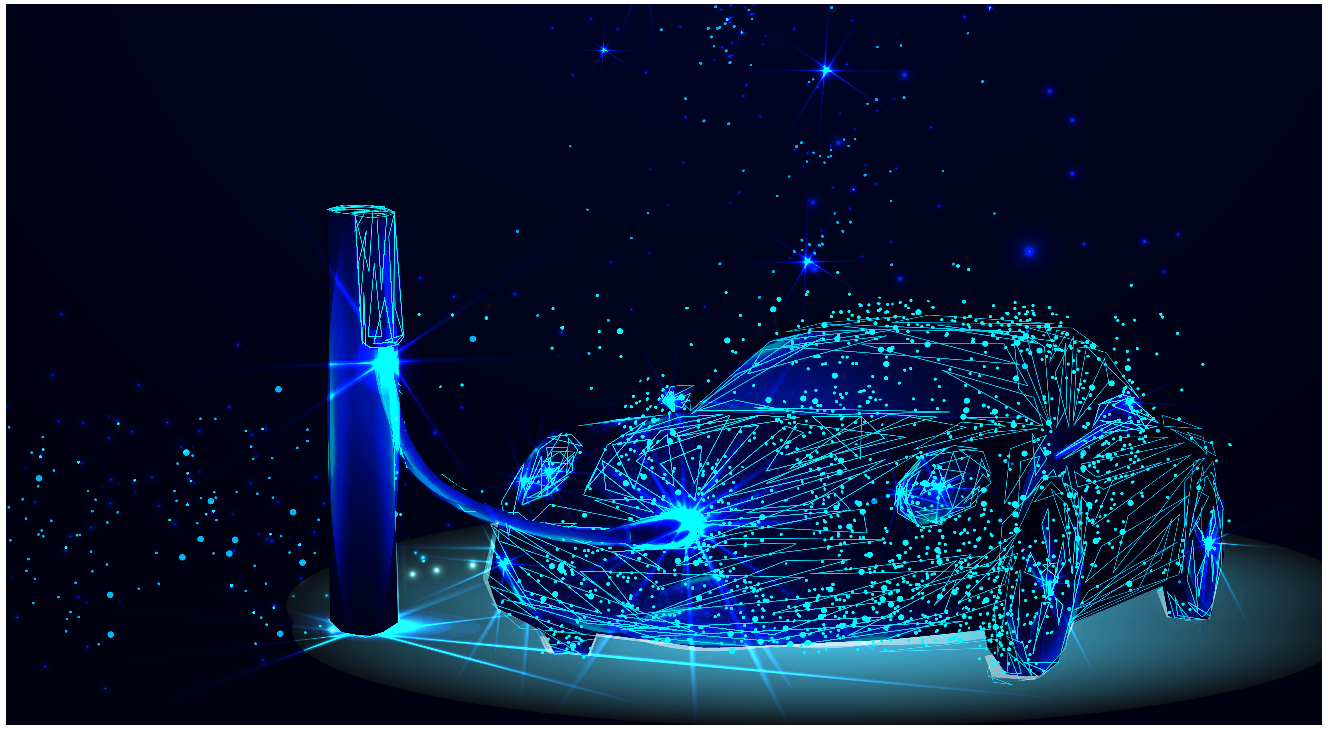
E-mobility
An industry in flux

At an epochal crossroads, opinions differ: For some, fundamental change is associated with concerns about decline. For others, it is the prospect of something earth-shatteringly new that inspires great hope. The transition to the age of e-mobility has elicited both opinions. The course to replace internal combustion engine (ICE) vehicles with electric vehicles has been set. The European Union is focusing entirely on decarbonization. It continues to set the bar higher for reducing CO2 emissions from 2020 onward. Climate change is a liability for every industry, but in the short term manufacturers are faced with retooling their existing infrastructure or facing fines for failing to do so.

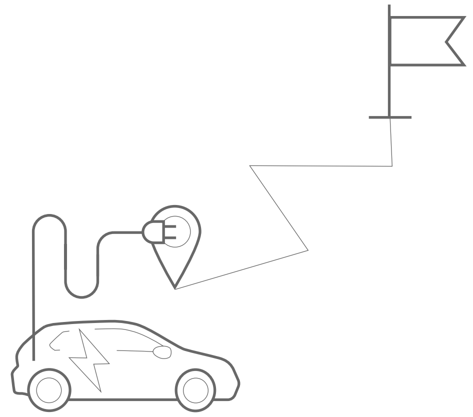
The International Energy Agency (IEA)[1] therefore expects that by 2030 58% of cars and light trucks will be electric or fuel cell vehicles, as reported in the IEA World Energy Outlook 2020. Combining zero-emissions vehicles with electricity from renewable sources will decrease global greenhouse gas (GHG) emissions, 14% of which come from transporation, according to the US Environmental Protection Agency's GHG Emissions Data. It's also imperative that companies act fast to mitigate the long-term economic risks of climate change. According to the consulting firm Deloitte: "If companies do not act proactively at all levels available to them, they will limit their ability to act in the long term and put a large number of jobs at additional risk."

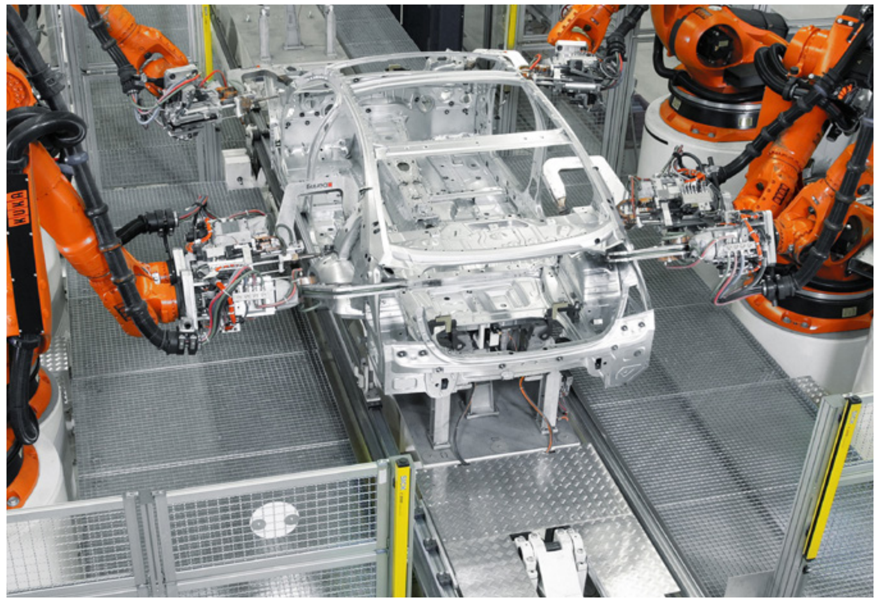
Professor Jürgen Fleischer from the wbk Institute of Production Science at the Karlsruhe Institute of Technology (KIT) had this to say about it in the journal "Technik + Einkauf": "New structures are being created, special-purpose machine manufacturers are suddenly becoming Tier 1 suppliers and conventional Tier 1 suppliers are faced with restructuring or acquiring know-how." As the electric vehicle market accelerates growth, new suppliers will also emerge.

In such periods of epochal change with their myriad uncertainties, proven technologies and process architectures have the potential to turn into decisive game-changers. For example, if the automation strategy "only" has to be adapted to new products – such as a chassis with integrated battery pack – and does not need to be completely redesigned. Such is the case with welding and adhesive bonding technologies, which have been implemented by robots in the automotive and components industry for decades. Here, KUKA has always set standards with its in-depth expertise in smart continuous-path applications. This can now also become a real competitive advantage in new automated production processes in the field of e-mobility.



The new battery formula
faster – lighter – further





One force behind the accelerating adoption the electric vehicles has been improvements in range and battery performance. In the past ten years, the energy density of the large-format lithium-ion battery cells used in electric cars has nearly doubled. According to estimates from the Fraunhofer Institute for Systems and Innovation Research ISI[2], the energy density could double again (particularly in volumetric terms). In order to increase vehicle range, perhaps beyond 700 km, carmakers will look to innovative ways to reduce on space and weight in module and pack production as well as in vehicle integration.

The challenges here are significant. On the one hand, to compensate for the battery mass, vehicle weight must be reduced by using lightweight materials. On the other, the design must be capable of absorbing the impact of a collision. To appropriately process the lightweight materials required for this (such as aluminium and hybrid materials), developers are particularly focusing on materials science – for example, in researching the fatigue behavior of welded joints on aluminium in heat-affected zones.

The joining methods required to build a battery compartment in the body substructure thus place high demands on the automation solutions used for this purpose – especially in the case of aluminium.

Intelligent and innovative production processes will determine whether Electric vehicles achieve the targeted economic advantages over ICE vehicles. "Much depends on whether the cost reduction potential of e-vehicles, especially of the batteries, is realized," according to the assessment of the researchers at the Fraunhofer Institute ISI. Manufacturing is made more cost-competitive by efficient and safe automation and assembly processes.

"Much depends on whether the cost reduction potential of e-vehicles, especially of the batteries, is realized."

1 International Energy Agency, 2020 Global Outlook
2 Fraunhofer ISI, Batterien für Elektroautos: Faktencheck und Handlungsbedarf (PDF)

Hitting the spot
Smart robotics for welding and joining

It's a simple calculation: reducing the weight of battery-electric vehicles contributes to an improved range. Thanks to their material properties, aluminium, magnesium alloys and composite materials play a major role in reducing the necessary weight. They are able to absorb energy in the event of a crash, while at the same time bringing the necessary heat resistance and structural stiffness demanded in automotive manufacturing. The processing of these materials – particularly in joining methods such as welding or adhesive bonding – increasingly poses challenges for automotive suppliers. KUKA has decades of experience and is an expert in a wide range of processes of this kind – which, in the best-case scenario, need "only" be adapted to the new materials. Here, feasibility, process reliability and the economic design of the systems for the appropriate technologies are always at the forefront.

Aluminium spot welding
In the patented RoboSpin technique, KUKA combines high process stability with a lengthened electrode life. During the welding process, the electrode spins about itself in a few milliseconds, thus preventing alloying of the component and electrode materials.

Friction stir welding
As a pioneer in the conventional friction welding of rotationally symmetrical components, KUKA adapts the process to robots, thus enabling continuous-path applications – for welding the cover onto the battery compartment, for example. This process allows the joining of non-ferrous metals with low melting temperatures as well as mixed-material combinations such as aluminium and steel.

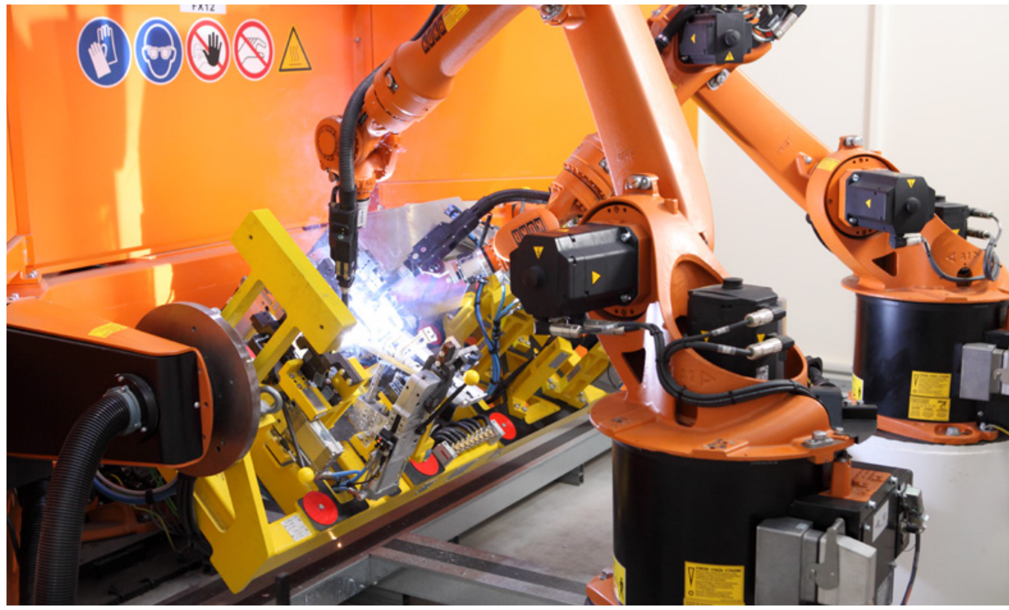
Arc welding
KUKA.ArcTech showcases its strengths in "cold" welding for joining aluminium. The prerequisites are precise continuous-path control and perfectly coordinated communication between the components. KUKA.ArcTech offers a broad spectrum of functions for optimally setting the weld parameters.

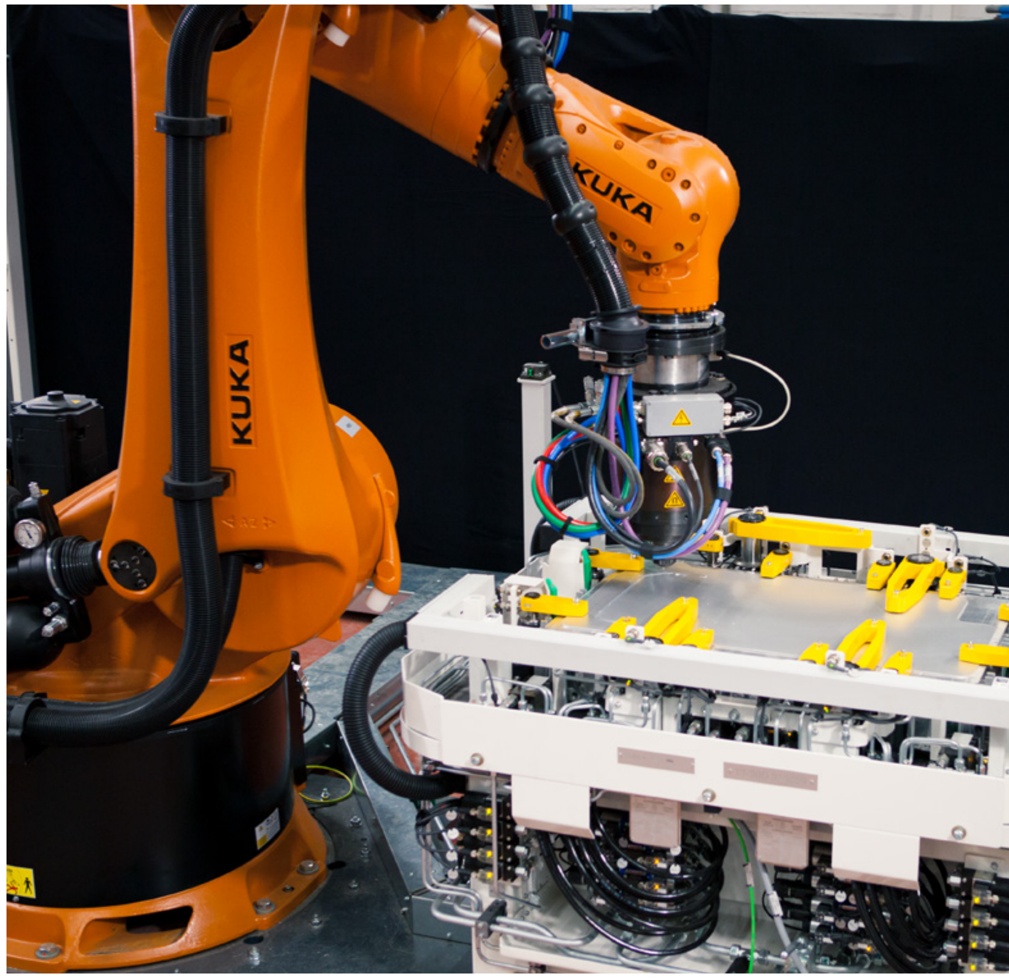
Laser welding
Thanks to its high process velocities, laser welding of aluminium offers significant advantages over arc welding. To avoid typical hot cracking, a filler wire or powder must be added in the case of the 6000 series aluminium alloys that are frequently used. Here, KUKA.LaserTech offers the complete range of possibilities.

Laser hybrid welding
This combination of arc and laser welding unites the advantages of both processes. The filler material is already fed as a melt to the laser process via the conventional arc welding process. The laser beam stabilizes the process and simultaneously enables a higher welding speed and increased welding depth. Both joining processes are combined via the continuous-path control of the KUKA robot. The two process applications ArcTech and LaserTech ideally complement each other here.

Process data acquisition
Since many components (such as the battery compartment) are part of the chassis and thus safety-relevant, KUKA offers appropriate software for limit value monitoring and documentation of all relevant process parameters for all the aforementioned continuous-path applications: KUKA.ProcessScreen. This software application can be run directly on the robot controller and requires no additional hardware. Visualization can take place on the smartPAD or any device in the network.

Conclusion: The epochal change in automotive manufacturing presents major challenges for suppliers. This is particularly the case when it comes to the demanding processing of increasingly required lightweight materials such as aluminium. When it comes to welding and joining new components, place your trust in partners with decades of experience in this area. We have the expertise and the right technologies. Contact us. We're at your service!





KUKA has taken automated welding to a new level. This gives automotive suppliers all the options for processing a wide variety of lightweight materials for the mobility of tomorrow.

“Collaboration with KUKA was good and got even better as time progressed. Even any disruptive factors that arose could always be satisfactorily resolved. We were thus jointly able to bring the project to a successful conclusion.”

Armin Kleemaier, project manager at MAGNA Presstec

IMPRINT

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