

# A2LT Whitepaper

## Roadmap to Sustainable, Affordable and Smart Lightweighting

Competence Map

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**No (Green) Deal without lightweighting?**

Lightweight Technology is THE key enabling technology that provides resource-friendly solutions, while at the same time adding commercial value, across all industries. Driven by mobility-linked challenges, lightweighting is the path to fundamental resource savings – up to 50 % in materials usage and up to 40 % in power consumption.

The Austrian Advanced Lightweight Technology Platform A2LT aims at strengthening the competitive position of its member businesses and aspires to build a strong Austrian position in lightweighting technology. With the collective strength of all partners A2LT is a thinktank and a collaboration platform empowering successful competition in the global market.

In an increasingly connected world, collaboration across borders is essential. The strong partnership within the European Lightweight Association ELA allows access to customers, technologies and best practices for all members' businesses and research institutions within leading European regions.

At the same time, A2LT is an information and technology hub to make the public aware of the benefits of lightweight construction for the economy and for climate protection. These technologies along the lightweight construction value chain are not only expected to generate a multi-billion Euro market for businesses, but to also be able to contribute to a brighter future for coming generations.

Our vision therefore is for Austrian companies and research institutions to be global technology leaders in lightweight construction with global visibility as such. This will sustainably strengthen the innovative and economic reach of the lightweight construction sector in our region and within Europe.

Our mission towards sustainable, affordable and smart lightweighting:

- We seek to strengthen the economic reach of Austrian companies through joint activities.
- We seek to strengthen the innovative force of the lightweight sector in Austria by developing collaboration at a company and research level.
- We seek to make A2LT visible as a lighthouse and a thinktank for lightweighting-related topics.
- We seek to be the single point of contact for policy at a regional and European level.
- We seek to improve the respective network work through a continuous exchange of ideas and experiences.

A2LT strives to strongly support the European Union's Green Deal and is intent on making political decision-makers aware of this contribution.

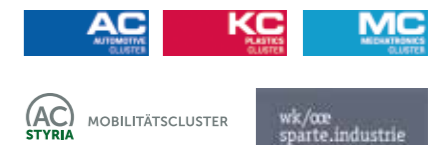
**No (Green) Deal without lightweighting!**

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Aluminium parts from the cold chamber die casting machine. Image: AIT/LKR/Zinner

## Sustainable, affordable and smart

**Lightweight construction is not an end in itself. It plays a major part in meeting sustainability targets – not just in the field of mobility, but in many other sectors. The A2LT policy paper entitled ‘Roadmap for sustainable, affordable and smart lightweight construction as an area of Austrian strength’ defines precisely how Austria can build on its excellence in lightweight construction.**

By cutting down on weight, material and energy, lightweight construction supports the economical and environmental optimisation of products, processes and systems. Sustainability, affordability and intelligence are the main factors in overall optimisation: from this viewpoint, lightweight construction is both the key technology and the one issue that cuts across. In terms of the product life-cycles, lightweight construction significantly reduces carbon emissions, thereby supporting the attainment of national and international climate, environmental, resource conservation and sustainability targets.

### Excellence in lightweight construction

Austria is a centre of excellence for research and industry in the field of lightweight construction. To ensure viability and competitiveness, however, this position needs to be consolidated and expanded over time. Rising

demand in the mobility, aerospace, energy and construction industries spells enormous potential for value creation and job creation. On this point, the leading representatives of Austria’s lightweight construction community in industrial and research circles – who pool their activities within the A2LT (Austrian Advanced Lightweight Technology) platform – are agreed.

### Roadmap to technological pre-eminence

In their roadmap to sustainable, affordable and smart lightweight construction as a field of Austrian strength, they define six major topics whereby measures can support a leading role for Austria as a centre for lightweight technology. Over the long term, this approach will serve to establish a strong market position while safeguarding high value industrial jobs. The A2LT platform will discuss, share and expand on the six platform

topics with relevant stakeholders at national and international level.

### Boosting innovation through research

A high degree of innovation and a forward-looking attitude (especially on the part of the public sector and responsible ministries) are called for if industry is to remain competitive and sustainable. The technological transformation and the ever-developing transfer of knowledge and information are proceeding unabated, which is why links to cutting-edge international research and technology must be established and accelerated by all available means.

### For a resilient Europe

To ensure the resilience of Europe as a production hub, we must strive to achieve technological pre-eminence in the field of innovative lightweight construction. This will only

be achieved by being open to technology from a full lifecycle perspective. In two of the four dimensions defined by the EU Commission – namely the green and the geopolitical dimensions – lightweight construction can deliver a critical contribution. The aspiration of European technological leadership must be strengthened – ideally where a leading role already exists. “We stand for a commitment to long-term R&D efforts with a view to maximising the effectiveness of lightweight construction to cope with the challenges of the future,” says platform spokesperson Stefan Seidel.

### Accelerating the technology transfer

“Think of it like manoeuvrable speedboats versus cumbersome tankers: alongside big flagship initiatives as funding instruments at national and international level, we have to develop efficient and non-bureaucratic instruments that speed up industrial applications of technology,” believes Plastics

“Think of it like manoeuvrable speedboats versus cumbersome tankers: we have to develop non-bureaucratic instruments that speed up industrial applications of technology.”

“Specific flagship projects in support of sustainable, affordable and smart lightweight construction are required.”

Cluster Manager Wolfgang Bohmayr. To this end, it is necessary to simplify funding conditions and accelerate processes, and also to classify topics at higher technology readiness levels as eligible for funding. In this way, results of research can translate into successful products and shorter times-to-market, thereby enhancing value creation.

### Incentives across technologies and industries

As part of a national strategy of research, technology and innovation, lightweight construction will be explicitly defined as a priority. Under the terms of a lightweight construction-themed programme, issues

worthy of funding can be defined with greater precision while research and industrial partners can receive more effective support in finding solutions. Isolating this topic from mobility, production and energy research programmes can also enhance the importance of lightweight construction to Austria as a technology hub.

### Suitable funding instruments

Alongside improved product performance, the demands on lightweight solutions are multiplying rapidly – and may be summed up as sustainability, cost effectiveness and intelligence. In multi-material lightweight construction in particular – a field of strength in Austria – demands on relevant production technologies and flexible production concepts are poised to increase in the medium to long term. This paradigm shift must be reflected in the strategy of research, technology and innovation and the funding instruments derived on that basis.





Stefan Seidel (r.) explaining a drivetrain component by Pankl Racing Systems. Image: Pankl Racing Systems AG

**Fostering a culture of cooperation**

Given the right objectives, lightweight construction can deliver a major contribution to the attainment of both national and international climate goals. This implies massive innovative and market potential, which Austrian companies are driving right across the value chain. "Mobility is definitely the driver of lightweight construction technology, but in the light of the big global challenges we face, the number of relevant sectors is increasing exponentially," explains Florian Danmayr, who heads the Automotive cluster.

through environmentally sound technological progress. Networking, visibility and exchanges across national boundaries are required to harness these developments while contributing existing excellence. This can be achieved through networking and public relations (understood as technology marketing in response to the latest results of research and projects). The process of incorporating lightweight construction into industrial applications is thereby accelerated. Exchanges of best practice by means of technology and knowledge transfers

approaches can help to adopt the circular principle, with research and innovation providing support. In many of these sectors and areas, full potential has not yet been reached – and leading representatives of Austria's lightweight construction industry and research institutions can play a big part in the solution. In facing up to the challenges, they can position themselves in the global forefront in future.

"Lightweight construction is not an end in itself. It plays a major part in meeting sustainability targets."

ter. Specific flagship projects in support of sustainable, affordable and smart lightweight construction are therefore required. A highly developed culture of cooperation is essential as the basis for multi-material and cross-sector projects – and neutral platforms can support the facilitation, initiation and development of such cooperation.

**Building on internationalisation**

Last but not least, the European Green Deal aims to secure Europe's global position

between the spheres of administration/politics and start-ups/SMEs/science – allied with fresh perspectives – will consolidate the effect.

**Designed for recycling**

Implementation of the EU's climate and environmental goals calls for a fresh industrial policy based on the circular economy, whereby lightweight technologies play a critical role. In those industries with high circular potential in particular, holistic

- ... affordable lightweighting
- ... sustainable lightweighting
- ... smart lightweighting

<b>Science &amp; Research</b> 	<b>Lightweighting Materials &amp; Simulation</b> 	<b>Processing &amp; Manufacturing Technology</b> 	<b>Applications &amp; Products</b> 
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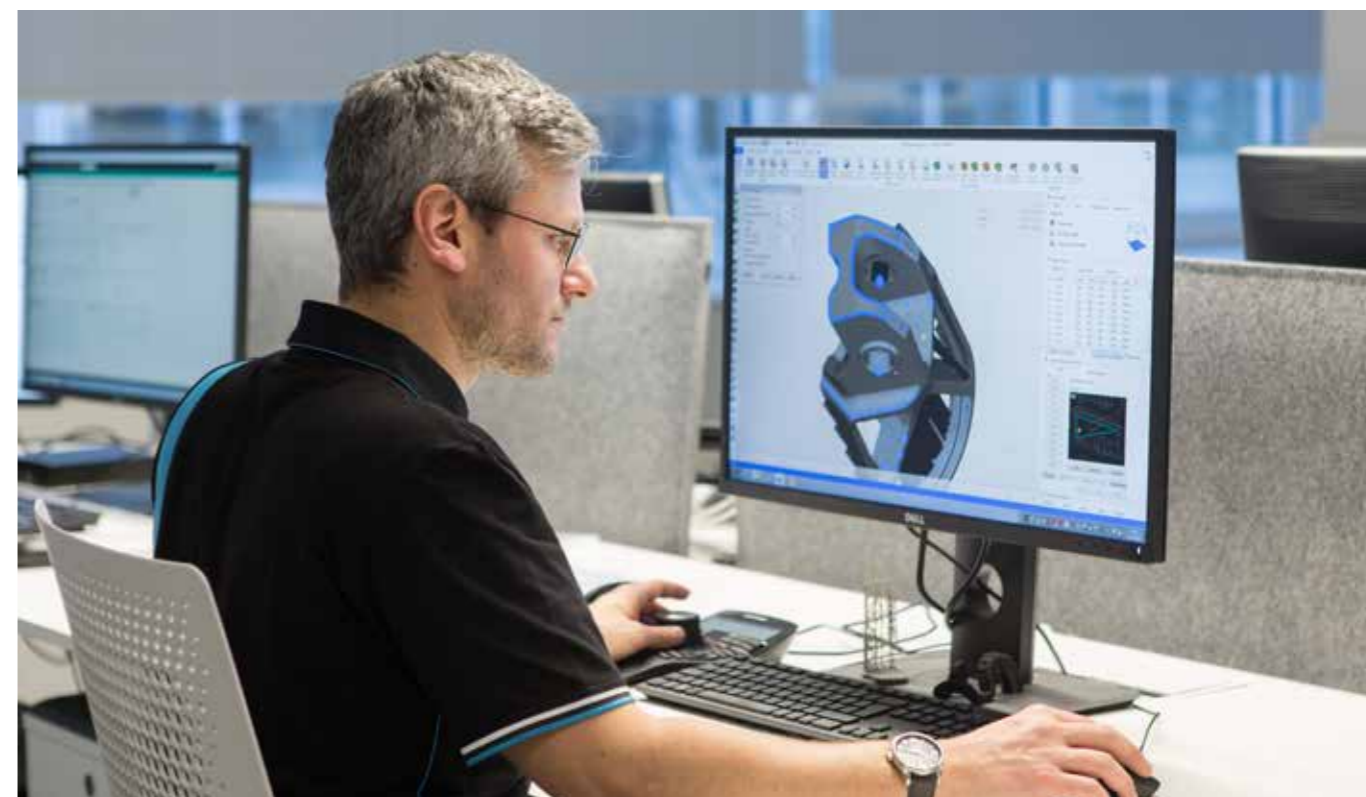
**A2LT positions**

	<p>Promoting technological pre-eminence in lightweight construction: Securing a competitive advantage, facilitating the achievement of climate goals</p> <p>Effect/aim: Establishing Austria and Europe as resilient production hubs</p>
	<p>Accelerating technology transfers from research to industrial applications</p> <p>Effect/aim: Implementation in concrete innovations</p>
	<p>Optimising funding programmes and general conditions for industry and research</p> <p>Effect/aim: Funding instruments for lightweight construction across technologies and industries</p>
	<p>Defining specific R&amp;D priorities for sustainable, affordable and smart lightweight construction</p> <p>Effect/aim: Ensuring technological pre-eminence</p>
	<p>Strengthening international networking in lightweight construction and intensifying public relations</p> <p>Effect/aim: Alliance of strongest lightweight construction regions</p>
	<p>Establishing design for repair/reuse/recycling as equally important as functionality and production efficiency</p> <p>Effect/aim: Exploiting economic and environmental potential of recyclable lightweight construction technology</p>



The main players in the A2LT (Austrian Advanced Lightweight Technology) platform are the automotive, plastics and mechatronic clusters, the industry division of the Economic Chamber for Upper Austria and the ACStyria mobility cluster.

[www.a2lt.at](http://www.a2lt.at)



The parts are manufactured completely in-house – from the initial design, through to production. Image: Pankl Racing Systems AG





Among other things, FACC produces fairings and components for aircraft engines. Image: FACC/Bartsch

## "Lightweight is an interdisciplinary key technology for sustainability"

A2LT, the Austrian Lightweight Construction Platform, is a success story. As the platform's spokesperson, Robert Machtlinger, the CEO of FACC, initiated and shaped the reorientation of the content with a focus on sustainable, affordable and intelligent lightweight construction. As the new platform spokesperson, Stefan Seidel, the CTO of Pankl Racing Systems, was already intensively involved in this and will now operatively implement the roadmap. In this interview, the two "Sirs" of lightweight technology talk about their motivation, their philosophy, and the benefits of A2LT.

**What prompted you to get involved in the A2LT platform as the advisory board spokesperson?**

**Machtlinger:** Lightweight construction is an interdisciplinary technology with many facets and fields of application. The use of different lightweight materials and optimal manufacturing processes is the only way to achieve the best possible results. The A2LT is an association of all the leading companies in Austria in the lightweight technology environment. We see it as our task to constantly improve networking in this environment – after all, success relies on cooperation.

**Why did you take on the role of advisory board spokesperson for the A2LT platform?**

**Seidel:** The A2LT has become an important consortium of leading technology companies that focus on innovation and lightweight construction. Taking on the role of advisory board spokesperson in such a consortium is a very exciting challenge. This also means defining the future orien-

tation of A2LT, especially with regard to sustainability and digitalisation, as well as being the central hub for national lightweight construction agendas.

**How does this benefit your company and the A2LT companies?**

**Machtlinger:** Innovation thrives on exchange and cooperation. We need to learn from and with one another and exchange ideas on new developments to be successful in Austria, but also as an industry in general. Looking beyond the proverbial horizon is also an important way for us to broaden our outlook. Often, an interdisciplinary view opens up completely new perspectives.

**Seidel:** The focus on establishing the A2LT as a central, interdisciplinary interface for lightweight construction topics adds enormous value for all of the companies involved in the A2LT. On the one hand, it enables us to secure more funding and to push ahead with joint research projects, which further consolidates our role as a technology leader; on the other, it also boosts the visibility of the products and member companies.

**The A2LT position paper is entitled "Roadmap for Sustainable, Affordable, Intelligent Lightweight Construction as an Austrian Field of Strength". What is your position on this?**

**Machtlinger:** Lightweight construction is one of the key technologies that will help us to support our ambitious climate and sustainability goals as an industrialised country. The position paper precisely specifies the key topics here with the aim of making Austrian lightweight construction technology even more innovative than it already is. We support this agenda, and I can only emphasise how decisively lightweight construction will support the transformation process, especially in the mobility sector. Because lighter also means more efficient. This gives us immense leverage, especially in terms of sustainability. As a high-tech country, it is a great opportunity for us to be successful internationally with new developments.

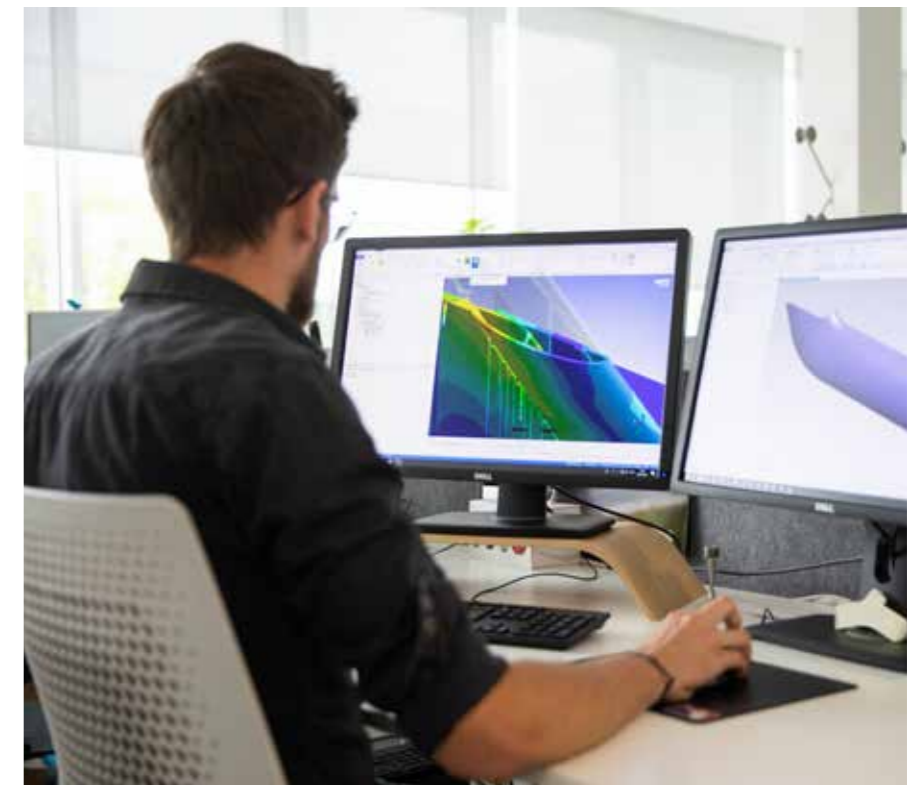
**Seidel:** Austria is the home to many leading technology enterprises from a wide range of industries, many of which are involved in

lightweight construction. The A2LT offers a robust platform for networking, exchanging ideas and jointly promoting lightweight construction. Since the topic of lightweight construction is also increasingly finding its way into large-scale series production applications, the topic of cost effectiveness is also increasingly coming to the fore. If you want to be successful, it is not only important to be ahead in terms of the technology, but also to have attractive pricing. Besides this, it is also important to adopt sustainability and digitalisation trends into production processes and products. In this context, the topics of sustainability and digitalisation in particular shift into the limelight, and they need to be addressed if you want to become or remain a leading international player in the lightweight construction sector. We must not see the topic of "lightweight construction" as a single discipline, but rather as a concatenation of skills from the widest imaginable field in order to form a basis for establishing efficiency. And the platform offers great preconditions for this.

**Where do you see the strengths of the Austrian lightweight construction players?**

**Machtlinger:** Our strengths lie in great diversity in terms of the overall system. We have companies that are technology leaders in the materials, semi-finished product, process and finished product environment. On top of this, there is excellent collaboration between companies, research facilities and universities. The A2LT is a wonderful example of this. In combination with state-of-the-art manufacturing methods and highly qualified personnel, we are an international lighthouse for innovative lightweight construction technologies.

**Seidel:** There are many strengths. First and foremost, one must emphasise the well-founded technical education offered by Austrian universities. This high scientific standard significantly shapes lightweight know-how and research fields in the enterprise. Beyond this, the global orientation of many partner companies is a competitive advantage – many A2LT members are global leaders in their market segments. Many



Pankl Racing Systems also develops lightweight components for the aircraft industry. Image: Pankl Racing Systems AG

companies have also already made great progress in the area of sustainability and have created a solid basis.

**And where do you see the biggest challenges?**

**Machtlinger:** Austria is a technology exporting country – many of our customers value our products because we offer solutions that are only available in Austria. We need to expand and promote this important asset in a focused and forward-looking way. Our strategy must be to focus on high-tech and innovation, and that requires openness to technology and research. It is therefore both a task and a challenge for us to lay out the roadmap at an early stage and in many areas. From research into new materials and processes through to training the workforce. This is the only way for us to sustainably secure our position on the international market.

**Seidel:** In order to be able to take the technological lead in the future, the required investments must be made in the right places. This is only possible in cooperation with politics. The right use of funding instruments is important in order to avoid jeopardising this pioneering role. Also, digitalisation offers companies many opportunities and great development potential, but it also means shifting from core business to new technologies. One major challenge will

be for companies to find their focus in this field in order to pursue new strategies in a targeted way.

**The EU's Green Deal focuses on the transformation of the economy towards more sustainability. What role does lightweight construction play here?**

**Machtlinger:** In the mobility industry in particular, there is no alternative to lightweight construction when it comes to sustainability. The CO<sub>2</sub> savings potential is enormous – because low weight means lower energy requirements in operation. New manufacturing processes such as 3D printing, where materials can be built up, for example, in bionic structures, significantly reduce the amount of material required.

**Seidel:** Lightweight is indisputably a key technology for making many branches of industry more sustainable, since it saves resources in production on the one hand, while also enabling sustainability in the use of the products on the other. Lightweight construction plays a particularly important role in the transport sector. This is why lightweight solutions will significantly influence the mobility concepts of the future.

**Which trends, technologies and research areas could accelerate this development?**

**Machtlinger:** The trend is towards a holistic ecological appraisal of technologies – in



other words, assessing the sustainability of the way in which the materials are produced, of the product itself, its ecological footprint during operation and its recyclability at the end of the product's service life. Besides this, the technologies must be cost-effective and affordable. I am confident that we can meet societal and political expectations if the technology is open. The A2LT roadmap combines all of these factors – we need sustainable, affordable and intelligent overall systems to provide the best possible solution for technology deployment in both existing and new applications.

**Seidel:** Irrespective of the drive strategy or means of transport: integrated lightweight components mean that less mass has to be moved. Conversely, less energy is used for locomotion. This means that lightweight construction has a significant influence on all mobility solutions. What is decisive here is focusing not only on the individual parts, but on the benefits of lightweight construc-



Image: Pankl Racing Systems AG

#### About

Stefan Seidel (46) is Chief Technical Officer and has been a board member of Pankl Racing Systems AG since 2015. As CTO he is responsible for sales as well as research and development in the racing and high performance areas. Stefan Seidel was born in Graz in 1976, where he also completed his school education. After studying Mechanical Engineering and Business Economics at the Technical University of Graz, he started his career at Pankl Drivetrain Systems. This was followed by a move to the aluminium industry before he returned to Pankl in 2007.

tion solutions in the overall system. In the future, CO<sub>2</sub> savings must be taken into account when parts are evaluated. This is the only way for us to more strongly establish new technologies, which have not previously offered attractive pricing, on the market. The industrialisation of cutting edge manufacturing processes such as 3D printing will be an important aspect in rolling out innovative lightweight construction solutions on a broad scale on the market.

#### Why is cooperation so important in lightweight construction?

**Machtlinger:** Lightweight is an interdisciplinary field of innovation. The different strategies and methods for optimisation range from the development of new materials to new manufacturing processes or optimised component structures. Which approaches are ultimately successful for your own product depends on a variety of factors. In line with this, it is important to know which technological developments are currently in the pipeline in order to then draw on specialists in each case and exchange ideas with one another.

**Seidel:** It is the combination of materials, design and production technologies that forms the basis of lightweight construction. It is essential for the right materials to be available for a design and producible in a sustainable, resource-saving and affordable way to be able to roll out innovative solutions on a broad scale. The rapid further development of both materials and production options makes it increasingly difficult for individual companies to cover the entire range on their own. As a result, it is becoming increasingly important to enter into cooperations in order to ensure technological leadership in all partial aspects. And this is precisely the basic idea behind A2LT: it networks companies from a wide range of industries in order to provide the basis for sustainable, affordable and intelligent lightweight construction.

#### Where do you see other lightweight construction focus sectors beyond mobility?

**Machtlinger:** The construction industry in particular is benefiting from the lightweight trend as the demand for materials is particularly high here. However, lightweight construction is generally an interdisciplinary topic that plays a role almost everywhere.

**Seidel:** Lightweight construction is finding its way into many aspects of our daily lives. Mobility is certainly one essential area, but

lightweight also offers a huge amount of potential in plant engineering, as it does in the construction industry and all the way up to the aerospace industry. Aerospace in particular will also be increasingly important in the future, as this industry is expecting a significant growth curve and every gram of weight saved has an enormous impact.

#### What are you currently working on at FACC with regard to lightweight construction?

**Machtlinger:** We live lightweight construction in every one of our products and every one of our developments – and we have done so since FACC was founded. Lightweight construction is firmly anchored in our DNA. Currently, we are particularly proud of the fact that we have the privilege of developing the lightweight technologies for the next generation of aircraft in coop-



Image: FACC/Bartsch

#### About

Robert Machtlinger (54) has been the Chairman of the FACC AG Management Board since February 2017. He previously held various positions within the company until he was appointed to the management board in 2011. In his role as CEO, Machtlinger is responsible for FACC's strategic orientation, customer & government relations as well as marketing & communications, human resources, programme management, development, innovation and research in the growth market of aerospace. As a developer, manufacturer and full-service provider of advanced lightweight composite systems, Machtlinger is actively shaping the mobility of the future.



Construction of lightweight components. Image: FACC

eration with our customers. The bandwidth here extends from the development of 100 % recyclable aircraft structure components to the development of biological raw materials. Our goal is to significantly reduce manufacturing costs in lightweight construction, to be CO<sub>2</sub>-free in the environment of industrial FACC manufacturing by 2040 and, by doing so, to support the implementation of our customers' and the industry's goals in the best possible way. The SPACE contract recently awarded to us by the ArianeGroup shows that our research expenditures are paying off. Looking forward, this is an important topic for us, and one that we have defined as a new business field in our Corporate Strategy 2030. This is where we, in the best possible way, can bring to the table the FACC composite technologies that we have developed for the aviation industry over the past decades.

#### What are you currently working on at Pankl Racing with regard to lightweight construction?

**Seidel:** At Pankl, we also constantly strive to optimise our products with innovative materials and new designs to give our racing customers a competitive edge. The technologies are subsequently industrialised in order to also establish them in large scale production in the automotive field. To do this, we rely on our state-of-the-art in-house manufacturing processes, such as metallic 3D printing in our Pankl Additive Manufacturing Competence Centre based in Kapfenberg.

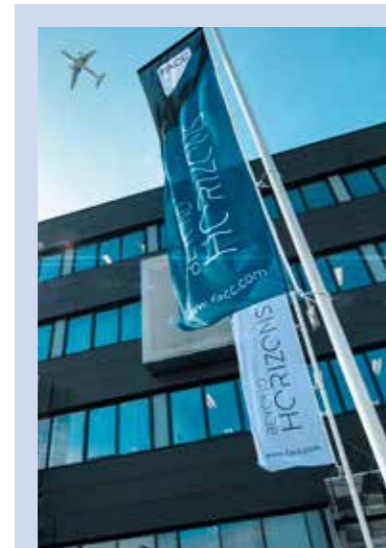


Image: FACC/Gortana

#### About FACC AG

FACC is a global aerospace leader in the design, development and manufacture of aviation technologies and advanced lightweight systems for aircraft. As a technology partner of all major manufacturers, FACC collaborates with its customers on solutions for the mobility of the future. Worldwide, an aircraft with FACC technology on board takes off every second. Around 2,700 employees from 41 nations are employed at 13 international locations worldwide. The company is listed on the Vienna Stock Exchange and is part of the AVIC Fortune 500 group.

[www.facc.com](http://www.facc.com)



Image: Pankl Racing Systems AG

#### About Pankl Racing Systems

Pankl Racing Systems AG develops, manufactures, maintains and distributes high-tech mechanical systems for dynamic components in the global niche markets of the racing, luxury automotive and aviation industries. The company was founded in 1985 and is headquartered in Kapfenberg, Styria. It operates the Racing, High Performance and Aerospace divisions. Pankl works with the following technologies: machining, heat treatment, forging technology and additive manufacturing.

[www.pankl.com/racing](http://www.pankl.com/racing)



## Concentrated lightweight construction expertise

Austria is home to a large number of companies in the lightweight construction sector. From SMEs to large global corporations, they are world market and technology leaders in many areas: materials development, process engineering, production of semi-finished products, 3D printing and much more. For example, they supply tanks for rockets designed to explore space or lightweight components for aircraft and the automotive industry. This concentrated know-how would be unthinkable without the research facilities and universities in Austria.

### Innovation through cooperation

The Austrian Advanced Lightweight Technology (A2LT) platform brings together a number of partners – both companies and research facilities – as members of the platform who pool their expertise and innovative strength in order to promote lightweight construction and, above all, make lightweight more sustainable, affordable and intelligent. A2LT members benefit from an exchange of knowledge and ideas and collaborate independently of materials. In this way, they jointly generate a level of innovation and competitiveness beyond the potential of any single enterprise.

### Competence map

On the following pages, our members introduce themselves with their products, services and key competences. This partner guide can therefore be read like a competence map of lightweight construction. If you would also like to become a member of our platform and help shape lightweight construction for the future, you are very welcome to join us! If you are interested, please feel free to contact our project managers.

[www.A2LT.at](http://www.A2LT.at)

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## Micro-sandwiches for containers

CIMERA® micro-sandwiches from 4a manufacturing GmbH allow Envirotainer AB to launch a new benchmark in temperature-controlled air freight container solutions. Due to an advanced vacuum insulated panel technology in combination with CIMERA® micro-sandwich panels inside, the containers provide new state-of-the-art temperature stability and lightweight properties at the same time.

A special CIMERA® version has been engineered to support modern cool chain transport solutions. Especially for lightweight applications with the aim of achieving the greatest weight saving potential and with highest requirements regarding flexural stiffness, the CIMERA® sandwich material opens up a wide range of options thanks to various material compositions. By selecting the appropriate materials, many mechanical characteristics can be influenced and optimised: weight, flexural stiffness, formability and temperature resistance are just some of the tunable parameters. Suitable core materials are needed to realise material compositions with such a wide range of adjustable properties. MILLIFOAM® core material by 4a manufacturing offers these features (e.g. tight thickness tolerance) required for such innovative micro-sandwich solutions.



The Releye® RLP container provides new state-of-the-art temperature stability and lightweight construction at the same time. Image: Envirotainer AB Releye® RLP container

### The container

Envirotainer AB started the development of the new Releye® RLP a few years ago. The container itself is a temperature-controlled air cargo container which needs to meet the strictest requirements for pharmaceutical transport. The environment inside the container is controlled by the latest technology using a defined airstream inside the container. On the outside, the container is protected by an innovative vacuum insulated panel technology which protects the cargo against most extreme environmental conditions. This new container technology ensures an autonomy period of more than 170 hours of controlled environment inside the container; this can only be achieved by using CIMERA® micro-sandwich panels to precisely insulate and control the airflow. This makes the container fleet the most CO<sub>2</sub> efficient fleet on the market.

### Internal panel structure

In the course of an agile development process, the 4a manufacturing team devel-

oped potential micro-sandwich flat panels that were able to fulfill all requirements. Two main objectives in the project were: to achieve the maximum lightweight potential and a high flexural stiffness. In addition, the panels have also to be very resistant against mechanical impact in the course of loading and unloading procedures. With a low coefficient of thermal expansion, the panels also withstand temperature gradients which gives additional stability. The result is a fibre-reinforced CIMERA® panel solution with a special MILLIFOAM® foam core material with properties that fulfill all aesthetic and technical requirements. Now, the CIMERA® panels were certified by FAA and EASA and are used throughout the complete Releye® container series.

### In physics we trust

4a technology group was founded in 2002 in Traboch, Austria. 150 employees worldwide focus on new technologies in the fields of mobility, communication, road and vehicle

safety. Our key competency for new customer products is our deep understanding of materials, plastics, composite materials, lightweight construction and mechatronics. The 4a companies share the motto "in physics we trust".



### 4a technology group

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## Tomorrow's lightweight alloys

The LKR Leichtmetallkompetenzzentrum Ranshofen (Light Metals Technologies Ranshofen) of the AIT Austrian Institute of Technology is a leader in research and innovation for the lightweight design of the future. LKR researchers have more than 25 years of experience.

The LKR covers the entire value chain: the development of high-quality light metal alloys, their sustainable and energy-efficient processing and the development of functionally integrated lightweight parts.

### Materials development

LKR researchers have long-standing experience in the design and processing of light metal alloys. Of special importance are material properties such as strength, corrosion and fire resistance, joinability, crash behaviour and processability. Services include alloy development and customisation, simulation, casting, homogenisation, extrusion, the forging and deep-drawing of test alloys, development of customised heat treatments and characterisation.

### Casting technology

The LKR researches into a variety of casting technologies for innovative light metal alloys. Systems for horizontal and vertical continuous casting, mould casting, die casting and low-pressure die casting are available. Our services include simulation-based component and process development, tool development, prototyping and the provision of plant capacities. We offer holistic solution approaches from the idea to the component suitable for series production.

### Forming technology

Research at the LKR leads to more efficient, stable, productive and cost-effective forming processes of innovative light metals and the optimal use of state-of-the-art materials. The services include developing new forming processes, optimising the process chains and ultimately extrusion, forging and rolling. The team also works on the accompanying heat treatment processes as well as on digitalising and evaluating the data from the individual process steps.



The laboratory for additive manufacturing at the LKR Leichtmetallkompetenzzentrum Ranshofen GmbH. Image: AIT/LKR

### Wire-based additive manufacturing

LKR experts explore new methods of wire-based additive manufacturing, a promising method for 3D printing of large parts made of light metals. The workpieces are produced under computer control, no forming tools are required. The services include developing special wires, optimising the hardware and processes, concept development and producing specimens and prototypes.

### Numerical simulation

Simulations can help to predict, optimise and improve the understanding of material properties, processes and component behaviour in practice. LKR's expertise ranges from new theoretical concepts through to application-oriented simulation. The services cover the complete chain from atomistic alloy simulation, material modelling, and process simulations of the various primary forming and forming methods used at the LKR through to component simulation.

### Material testing and characterisation

The LKR deals with material, process and product analysis as well as damage eval-

uation. To do this, the researchers rely on state-of-the-art methods such as spectrometry, dilatometry, notched impact testing, deformation analysis, mechanical materials testing, fatigue testing, metallography, differential thermoanalysis and electron microscopy using electron backscatter diffraction (EBSD) and energy-dispersive X-ray spectroscopy (EDX).



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## Lightweight technology made easy

Saving weight in a smart way? Create innovative designs? Integrate intelligent safety features? ENGEL is specialised in finding new ways to find the best solution. That is why we work with our customers to develop individual industrial production solutions for specific material combinations in composite lightweight construction.

The experts at ENGEL combine comprehensive expertise in the field of thermoplastic-based composite lightweight construction with many years of experience in injection moulding including process automation. This is essentially the prerequisite for developing particularly economical series production processes for the automotive and aviation industries, just to name some examples. ENGEL is a partner, that offers customers an extensive product portfolio and process engineering and automation expertise. ENGEL's solutions in lightweight technology:

### organomelt

Replacing steel or aluminium sheets with lightweight components: ENGEL organomelt is a composite technology for moulding semi-finished thermoplastic fibre products and overmoulding them with high-quality plastics to produce components with high stability and excellent mechanical properties. The highly integrated, automated thermofforming and injection moulding process for thermoplastic sheets enables the cost- and resource-efficient production of fit-for-purpose lightweight parts.

### UD tapes

ENGEL offers the optimum solution for the processing of UD tapes. The tape stacking unit and the consolidation unit were designed to work in cycle with an injection moulding machine. Before the tapes are joined by spotwelding to a tapestack, they are deposited extremely accurately using optical image processing and adapted position control. In the next process step, the tapestack is consolidated into a blank in a combined heating and cooling press. In this way, ENGEL produces a tape stack that is precisely adapted to the component geometry, which can be followed by the subsequent processes - heating in the IR oven and forming in the mould and functionalising with injection moulding - without the need for trimming.



ENGEL relies on creating the latest technologies and ensuring sustainable global growth. Image: ENGEL

### Sheet Moulding Compounds (SMC)

This technology involves processing a stack of typically carbon or glass fibre reinforced, free-flowing prepregs in a compression moulding process. One of ENGEL's offerings is the v-duo, with high clamping speeds and active parallelism control - ideal for fully automated and precise component manufacturing. In addition, as a provider of turn-key solutions - from the individual press to highly-integrated processing lines - ENGEL offers custom-built systems for efficient series production of SMC parts.

### HP-RTM

Large, stable and lightweight parts efficiently produced: ENGEL's HP-RTM fibre composite technology enables superior design and premium properties for flat parts in the automotive industry. In this process resin is injected into fibre preforms, which are then cured under heat.

### In-situ

In-situ technology opens up new opportunities in the production of fibre-reinforced plastic components with a thermoplastic polyamide matrix. There are many options: The application spectrum ranges from

particularly thin composite parts to highly-stressed structural elements. The in-situ process combines polymerisation and moulding based on dry, pre-shaped reinforcing fabrics.

### Success story

ENGEL Austria GmbH is an Austrian family business with strong traditions. Ludwig Engel founded the company in Schwertberg back in 1945. The innovative injection moulding expert now has nine locations in Europe, North America and Asia. The global market leader is represented in 85 countries today. A workforce of 6,400 worldwide generates an export share of 95 percent.

# ENGEL

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## The future of aviation

FACC is a leading international technology enterprise in the aerospace industry with a focus on research and development into innovative lightweight components and technologies. As an aerospace pioneer, the company sets standards for a unique, sustainable and safe flying experience with its forward-looking products and services.

The Austrian high-tech enterprise FACC has become an international leader in the aerospace sector. With its components and services, it is an essential key supplier to all well-known aircraft and engine manufacturers worldwide. For more than 30 years, FACC has stood the test of global development trends and global competition. Growth through innovation has therefore become a tradition in FACC's history with a consistent investment into the research and development of innovative products for the aircraft industry through to new innovative technologies in the field of urban air mobility.

### Climate change:

#### Full thrust for CO<sub>2</sub>-neutral flying

The reduction of emissions, the use of green technologies, the use of biological materials and comprehensive environmental responsibility are increasingly becoming determining factors in the aircraft industry. FACC has the right technologies to do justice to this trend. Thanks to its versatile lightweight solutions, the company has contributed to making air traffic more environmentally compatible for years. The daily mission: making products even lighter and more aerodynamic.

### High-tech for space travel

FACC's key competencies include lightweight innovations for commercial aircraft, business jets, helicopters, aircraft engines and drones. Now, FACC is also deploying its lightweight construction technologies in space travel. FACC AG has been awarded a significant contract for the development and production of the Astris Kick-Stage Main Structure for the Ariane 6 launcher family, which will open up completely new opportunities for the company in commercial space travel.

### Committed to the sky

FACC aims to be one of the 50 largest global aerospace groups by 2030; the company



The EHang autonomous aerial vehicle produced by FACC. Image: FACC/Bartsch

is currently in the top 100. Sustainability will be an important lever, in particular for the aircraft industry. An environment of climate targets offers a specific opportunity to re-think air travel with innovative technologies from FACC that make flying more environmentally friendly, quieter and more attractive for passengers.

### Innovative force as part of the DNA

Innovation is a central factor for FACC's success. With its more than 300 patents, the company is represented in the world's leading passenger aircraft models. This is an incentive for even more efficiency, safety, sustainability and comfort in air travel. FACC AG will continue to play a leading role in shaping the future of mobility and set new standards in areas of innovation such as new materials, drone technologies or the latest interior solutions.

### About FACC AG

FACC is a global aerospace leader in the design, development and manufacture of aviation technologies and advanced lightweight systems for aircraft. Around 2,700

employees from 41 nations are employed at 13 international locations worldwide. The company is listed on the Vienna Stock Exchange and is part of the AVIC Fortune 500 group, which provides access to the largest growth markets in the industry.



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## Research in lightweight design

The University of Applied Sciences Upper Austria, School of Engineering in Wels was founded in 1993 and is one of the pioneers in the UAS sector. With its focus areas and extremely successful research projects, it is one of the most renowned universities of applied sciences in Austria.

With around 150 scientific staff and a very high proportion of third-party R&D funding, Wels UAS has one of the best research track records of universities of applied sciences in Europe. Various research groups at the UAS Upper Austria focus their research activities on lightweight design and fibre composite materials. The launch of the "Lightweight Design and Composite Materials" Bachelor's and Master's degree programme in the winter term 2016/17, saw the UAS strengthen its focus on this promising field in education and research, making it possible to meet business needs in this sector.

### Comprehensive infrastructure in lightweight design

As a scientific and technical university of applied sciences with established degree programmes in the fields of materials engineering, mechanical engineering, lightweight design and composite materials, as well as several active research groups in these fields, the UAS has a very wide portfolio of software, metrology, testing and production technology. The infrastructure in the research area of lightweight design goes far beyond the state of the art.

### Versatile know-how

The aim is to research into the entire field, from manufacturing, and simulating the manufacturing process, through structural mechanics, material modelling, and non-destructive testing to optimisation. By way of an example: at the Upper Austria University



The Upper Austria University of Applied Sciences of Engineering in Wels Image: FH 00/Rupert Steiner



Weight-saving, high-strength composites are the ideal material for drones. Students at the University of Applied Sciences Upper Austria applied their know-how and expertise in lightweight design to develop a camera drone in a very integral design and enable a weight saving of more than 40 %. Image: FH 00

of Applied Sciences research into FE-based draping simulations, the related material characterisations and their validation as part of the COIN development programme "Process Simulation for the Automation of Composite Manufacturing" (ProSim) has been on-going since November 2018. The acquired laying simulation know-how has already been applied in the "Fibre Composite Heat Treatment" (FIT) project, where a setup comprising a mechanical-thermal draping simulation for UD tapes coupled with an automated fibre placement (AFP) system was developed.

### Forward-looking research topics

In addition to research focuses in the field of structure and process simulation, research into the production and processing of thermoplastic composites in automated manufacturing processes has already been on-going in the scope of the ProFVK project since 2016, in close cooperation with the Transfer Centre for Plastics Technology

(TCKT) in Wels. Students are involved in all of these research projects right from the beginning to keep education closely practice-related.



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## Smart welding solutions

Passion for technology, revolutionary solutions and Austrian quality – this is what the Fronius brand has stood for since 1945. Fronius develops its tailor-made, innovative systems for welding technology for and with its customers. Both digitalisation and sustainability play a central role in high-end welding processes.

Fronius focuses on generating the perfect arc for consistently high welding quality. This is how the company became the innovation leader in arc welding and the global market leader in robot welding. Key sectors are the automotive industry and its suppliers as well as yellow goods and commercial transportation. Fronius's Welding Automation division also implements customer-specific, automated holistic welding solutions. Power sources for manual applications, welding accessories and a wide range of services round off the portfolio.

### The focus is always on the customer

The welding technology specialist sets great store by customer proximity in order to find the right solution for every welding challenge. With more than 1,000 sales partners world-wide, Fronius Perfect Welding is particularly close to its customers. In intense exchange, the team works together to develop new technologies and individual solutions. But Fronius is also about putting the spotlight on people and their needs. This is why high quality always goes hand in hand with reliability, health protection and ease of use in all Fronius products and services.

### Quality and sustainability

For Fronius, quality awareness is not just an empty promise, but a corporate value that is lived by and practised. The company puts its products through 13 different endurance tests during the development phase. This is the only way to guarantee a long working life. To ensure responsible use of resources, Fronius places emphasis on durability, reparability and recycling right from the development stage.

### High-tech and efficiency

Fronius shapes future trends in welding technology – with Cold Metal Transfer, for example. This process enables thermal joining of galvanised steel with aluminium sheets. Even wafer-thin aluminium sheets from a thickness of 0.3 millimetres can be



Fronius is the innovation leader in arc welding and the global market leader in robot welding. The focus is on the automotive industry and its suppliers as well as other industries. Image: Fronius International GmbH

joined in this way. And the Upper Austrians also seek to be the innovation leader in sustainability. Fronius welding instruments are characterised, in particular, by great energy efficiency: the welding expert was the first manufacturer ever to integrate transistor-based inverter technology. This translates to around one third lower electricity consumption and about 80 percent savings in terms of raw materials.

### Industry 4.0

Digitalisation influences joining technology in many ways. That's why Fronius develops software solutions to improve the performance of welding systems in terms of ease of operation, weld quality and speed. The documentation software logs all welding conditions. Software-based analyses enable an economical use of materials – filler wire and inert gas, for example. Cloud applications by Fronius help to evaluate data, and identify and immediately resolve weak spots. Remote access enables state analyses and service in real time to provide a basis for smart maintenance planning.

### Innovation leader on the global market

Headquartered in Pettenbach and with further facilities in Upper Austria, Fronius International GmbH with its 5,660 employees has global activities in the fields of welding technology, photovoltaics and battery charging technology. 36 international companies, as well as sales partners and representatives in more than 60 countries generate an export quota of 92 percent. 1,321 patents make Fronius the global innovation leader.



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## Lightweighting meets mechatronics

Johannes Kepler University Linz with its broad range of disciplines is a pioneer when it comes to innovative technologies. This is especially true for the Department of Mechatronics, which today already comprises 14 institutes with a wide variety of technical orientations. This interdisciplinary environment opens up a multitude of new avenues, e.g. the use of mechatronics for lightweight structures.

In an interdisciplinary research focus, the Institute of Structural Lightweight Design (IKL) is working on lightweight design solutions for industrial applications which use embedded sensor technology to monitor the component's condition during operation. These Structural Health Monitoring (SHM) systems are intended to ultimately guarantee the reliability and safety of optimised lightweight constructions and, by doing so, pave the way to further weight savings. Pertinent research topics from the perspective of lightweight structural engineering include analytical and computer-aided prediction methods for static strength, fatigue and damage tolerance of lightweight components or specifying load tests for validation of models.

### Interdisciplinary research

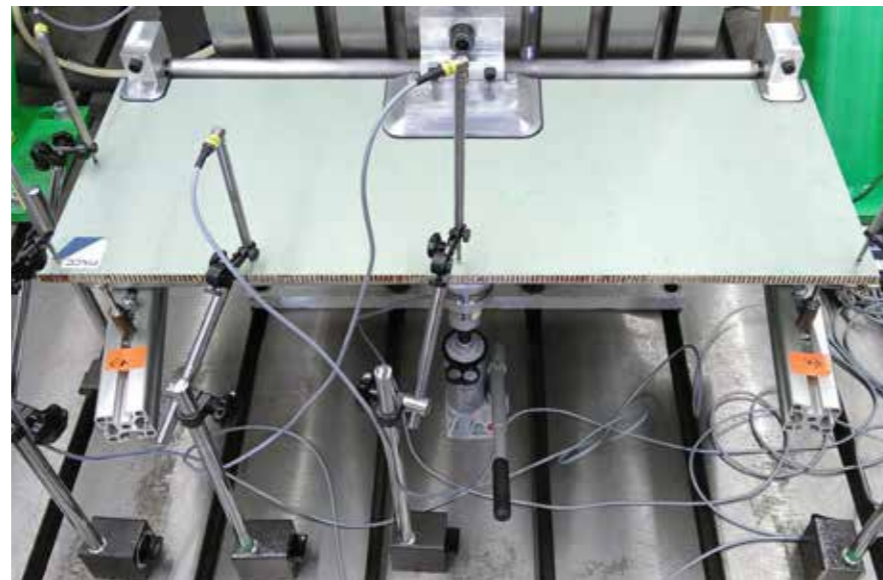
From the perspective of mechatronics, topics of great importance are ranging from sensor and measurement technology to machine learning and statistical data evaluation. In this context, cross-disciplinary research questions arise, such as: What information needs to be continuously collected with an SHM system and how can this information be used to evaluate and predict structural damage and structural integrity?

### Sustainability as the goal

Economic considerations have always been a strong motivator for lightweight design. Today, the focus lies also on the sustainability of a mechanical structure. Following this demand, the IKL is, for example, involved in a funded H2020 project entitled "SUSTAINability increase of lightweight, multifunctional and intelligent airframe and engine parts" (short



The Institute of Structural Lightweight Design is located in Science Park 1. Image: JKU Linz/Hertha Hurnaus



Idealised demonstrator of a civil aircraft wing spoiler scaled to 1:2. Image: JKU Linz/Markus Winklberger

title "SUSTAINair") together with ten European companies and research facilities. The aim of this project is to design new types of bonded joints, to equip these joints with state-of-the-art sensor technology for damage diagnostics, and to take into account the sustainability of all components involved throughout the entire life cycle – from design until disposal.

### Affordable safety without compromises

SHM aims to enhance the reliability and safety of optimised lightweight components. Safety-relevant issues therefore play an important role in the development of the systems. Experimental validation is essential. This often proves to be a showstopper for the introduction of new technologies, as demonstrating reliability typically requires expensive test campaigns on physical parts. Here, the IKL follows a building-block approach for cost-efficient verification of SHM systems. This approach is similar to the one known from certification of mechanical structures in aerospace industry. The building-block approach aims to largely replace expensive experiments on physical parts with inexpensive, easily reproducible experiments on structural demonstrators. For this

purpose, the IKL has developed, for example, a test platform consisting of an idealized 1:2 scale model of a spoiler of a large civil aircraft and a simple, but numerically optimized load introduction that simulates real aerodynamic load states (see figure). This platform enables now the cost-efficient investigation of strain-based SHM methods under realistic conditions.



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## Innovative lightweight fastening

KVT-Fastening, as part of the Bossard Group, has been a leading specialist for industrial fastening and assembly technology since 1972 and offers sophisticated, high-quality individual components and customer-specific solutions for applications in a variety of sectors. Innovative MultiMaterial-Welding (short MM-Welding) is particularly important for lightweight construction.

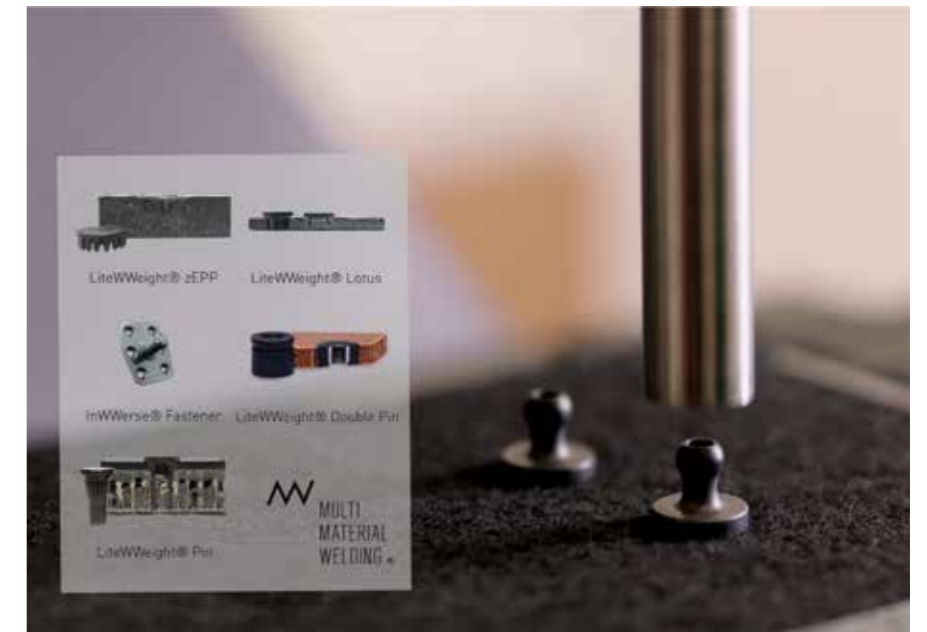
The most fundamental challenge faced by e-vehicle producers is that with porous materials, which play a central role in lightweighting, the lack of solid material makes it difficult or impossible to use conventional fastening methods. This is where MM-Welding comes in. MM-Welding technology employs an ultrasonic process to partially liquify a thermoplastic fastening element (LiteWWeight® Pin) to create a positive-locking connection in a fraction of a second. In another type of MM-Welding fastening method (InWVerse®), an ultrasonic process is used to partially melt two polymer components connected by a metallic fastener.

### More design without increased costs

Apart from overall weight reduction, MM-Welding fastening methods provide numerous design options, without any performance restrictions (pull-out strength) or increased cost. For high-end automotive interior designs, the fastener's aesthetics are as important as its technical features. The LiteWWeight® Pin ensures invisible fastener heads from above, for a clean and attractive appearance. And it especially excels in applications with standard honeycomb materials and honeycomb materials with pre-moulded holes.

### Solution for fibre and textile components

MM-Welding also offers LiteWWeight® Lotus fasteners for woven or non-woven fibre or textile components. It is an excellent substitute for conventional technologies such as rivets, staples, or adhesives, thanks to the strong integrated connection in the substrate. To overcome the dimensional constraints, LiteWWeight® zEPP, used for joints in EPP or similar foams, is a strong solution also available with a small footprint and therefore particularly suitable in limited space. Its special anti-twist elements offer high torque resistance, and the pull-out strength is high across a wide range of foam densities, without the need for predrilling.



MultiMaterial-Welding: KVT-Fastening GmbH portfolio Image: KVT-Fastening GmbH

### Optimised production processes

One way to streamline production processes is by reducing the number of steps. Switching from adhesive bonding to an ultrasonically joined metallic InWVerse® fastener, with fewer preparatory steps of the workpiece surface and less follow-up time (adhesive curing time), can significantly reduce the number of process steps. Long cycle times could impact on economies of scale. When used with fibrous materials, LiteWWeight® Lotus fasteners can help to speed up processing times, since access is only required on one side during production.

### Continuous development

Reducing the number of items in inventory is another viable approach to streamlining operations. While the conventional clip solution consists of two separate components, the LiteWWeight® Lotus Abalone fastening element is welded into the floor mat's fibrous substrate as a single element. Fewer parts in inventory can add up to significant cost savings in large production runs. Furthermore, the pre-treatment process, such as

drilling/punching holes, is not necessary. MM-Welding has been broadening its portfolio of standard fastening solutions for the mobility industry and is pushing forward with developments for boosting customer productivity. Vehicles containing MM-Welding fastenings are already on the road.



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## Modern expert machining

With its extensive material and process expertise and its tool solutions designed for quality and performance, Leitz offers a perfect package of products and services for machining modern materials. Leitz products are used in more than 150 countries globally, and on all continents.

Tools and application parameters which are matched to the material are essential to achieving optimum quality, cost-effectiveness and production reliability during machining. Aluminium, plastics, lightweight and composite materials are versatile in terms of applications but also pose a variety of requirements.

### Aluminium

Machining aluminium and non-ferrous metals repeatedly confronts processors with situations which require special solutions. Thin-wall profile are prone to vibrations, whereas solid materials exhibit a totally different behaviour during machining. Leitz has enhanced its range of tools through its many years of experience in professional machining of non-ferrous metals and is therefore able to offer solutions for the many challenges in machining profiles, blocks, plates or sheets.

### Plastics

When machining thermoplastics, both special tooth geometries and chip spaces, and the choice of process parameters are decisive. Leitz offers a wide range of tried-and-tested tool solutions in the field of panel cutting, shape and contour milling or also for blind and through holes for acrylic sheet (PMMA), polycarbonate (PC), polyvinyl chloride (PVC) or polystyrene (PS). Typical examples of duroplastic materials include, for example, compact laminated sheets, high-pressure laminates (HPLs) made of melamine or phenolic resin impregnated papers or printed circuit boards (PCBs) made of paper-based laminates. Here, too, Leitz tools guarantee the best possible results for panel cutting or for jointing and rebating.

### Lightweight and composite materials

Lightweight and high-strength materials are indispensable for high-end applications in the aviation, automotive and leisure industries as well as in boatbuilding. Fibre com-



More quality, efficiency and productivity in machining aluminium, plastics, and lightweight and composite materials with tool solutions by Leitz. Image: Leitz

posites play to their strengths, particularly in multi-material lightweight construction. And it is important to avoid compromising this potential due to complex machining. This is why tool solutions which optimise the processes are in demand. The Leitz tool program contains powerful milling and drilling tools for machining fibre reinforced plastics. This is underlined by a recent fibre cutting benchmark by the Technical University (TU) of Vienna, in which tools by 16 different manufacturers were used to machine carbon fibre, glass fibre and aramid fibre sheets. In 124 individual tests, tools by Leitz offered the best performance for all three materials.

### Company

Founded in 1876 in Oberkochen in southern Germany, the Leitz Group is the world's leading manufacturer of tools for professional machining of wood, wood-based materials, plastics, composite materials and non-ferrous metals. The product spectrum covers the complete range of precision tools for automated machines. 3,000

Leitz employees implement the ideals of the complete solution provider and manufacturing service provider every day. With seven production sites in Europe, Asia and America, sales and service companies in 36 countries, 120 service stations with rapid production facilities and sales partners in all relevant markets, Leitz is represented on all continents.



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## Lightweight cylinders for everyone

The MARK Group looks back on an innovation track record that goes back nearly 100 years. The company revolutionised skiing with the invention of the ski boot buckle. By entering the automotive market, MARK Hydraulik GmbH created the basis for sustainable entrepreneurial activity and the foundation for the on-going development of groundbreaking technologies and products.

The idea came first: innovative ultra-lightweight hydraulic cylinders for all industries. Market research and continual investment in research and development led to a new product. Ultra-lightweight hydraulic cylinders by MARK are between 30 and 70 percent lighter than comparable legacy cylinders. Scientific computations, test bed testing and practical use in tough everyday conditions demonstrate their outstanding performance. "If you've ever climbed a mountain with a rucksack on your back, you will understand what it's all about: the lighter the load, the less strength you need," says owner Rudolf Mark.

### Carbon creates weight advantage

There is no area of the cylinder that is not critically scrutinised for its weight-saving potential. Carbon and its processing is one of MARK's key competencies. When selecting substitute materials for conventional steel, MARK relies on the specialist knowledge of its metallurgists. MARK can draw on decades of experience here.

### Cost-effectiveness

The improved functionality and energy savings in the application can help to save costs in the long term. Cost-effectiveness is a general measure of efficiency or the rational use of scarce resources. The ability to use ultra-lightweight and corrosion-free hydraulic cylinders with enormous weight savings not only translates to economic benefits but also the lead in terms of engineering development.

### Freedom from corrosion and reduced emissions

Carbon cylinders are corrosion-free. This is an enormous competitive advantage in terms of wear and costs. And this is an interesting aspect, especially in chemical and maritime applications. Reducing the weight automatically means emissions savings. In all applications, the lighter basic design results in longer ranges, lower



MARK produces ultra-lightweight, corrosion-free hydraulic cylinders. Image: MARK Hydraulik GmbH

operating costs and a huge increase in energy efficiency.

### Interdisciplinary product

Carbon hydraulic cylinders by MARK are suitable for a very wide range of applications. They are used in vehicle transporters, aircraft and cranes. Offshore plants, robots and ships also rely on hydraulic cylinders from Upper Austria. And not only domestically, but worldwide. And, as a brand new development, also on the Chinese market. This is because cylinders of any size, length and diameter can be manufactured – as a function of the requirements for the application in question.

### Reduced to the essentials

The hydraulic cylinder liner needs to be able to withstand the internal pressure without any major deformation. To ensure this, MARK relies on a thin liner made of steel. The mechanical load is absorbed by a CRP jacket made of prestressed carbon fibre rovings, which is mechanically wound around the liner. In order to fully automate

the manufacture of the CRP cylinder liner, all connections have been moved to the end pieces. Advanced high-strength aluminium alloys bear the loads and reduce the weight. The significantly lighter composite cylinder is mechanically rugged and can be produced in large quantities.



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# Lightweight polymer construction

The Montanuniversität Leoben (University of Leoben) works on polymer lightweight construction for various different fields of application with a sound understanding of the materials, micro- and macromechanical modelling expertise and on the basis of broadly based processing technology.

The Polymer Engineering and Science department at Leoben recently celebrated its 50<sup>th</sup> anniversary. The University of Leoben has a long tradition of research into plastics as a lightweight material in line with the guiding principle "From the raw material to the finished product". One particular focus is fibre-reinforced polymers, especially continuously and oriented reinforced high-performance composites. The Polymers and Composites Design, Composite Materials Processing and Materials Science and Testing of Polymers groups collaborate in line with the A2LT focus topics, on making lightweight construction affordable, sustainable and intelligent. Optimised, innovative materials, test methods and parts are developed here.

## From the micro to the part level

Research work on modelling and simulation for component design is performed on a wide range of length scales for a variety of application areas. Structural mechanical analyses based on finite elements, optimisation methods and analytical approaches provide the information on the required material structure. Implementing this relies on a wide range of different processing technologies, which are upgraded for improved efficiency through the development of smart monitoring and control solutions.

## Focus on sustainability

Alternative raw materials as a replacement for fossil basic materials are hugely significant. Matrix materials where virtually 100 percent of the carbon content comes from regenerative sources, in combination



Alternative raw materials as a replacement for fossil basic materials are hugely significant. Image: Kunststofftechnik Leoben



Lightweight construction affordable, sustainable and intelligent: Small sized wind energy rotor blade made of bio-based materials Image: Kunststofftechnik Leoben

with textile reinforcements made from natural fibres, enable lightweight construction properties that are fully competitive with conventional fibre-reinforced plastics. Accompanying profitability studies and life cycle assessments help to ensure that the developments not only deliver maximum feasibility, but also affordability and sustainability as a result.

## Understanding of fundamentals and application orientation

With the aim of developing a sound understanding of the fundamentals and deriving methodological competence from this, a major part of the research takes place in

cooperation with industrial partners. Focusing on the questions arising from the applications guarantees high implementation potential for the research results.



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# A success story, since 1985

With high tech, high speed and high quality, Pankl Racing Systems has been one of the world's leading developers and producers of engine, chassis and drivetrain components since 1985. Pankl not only supplies the racing industry, but also the sports car and aviation industries with innovative products.

Pankl Racing Systems AG specialises in the development and production of engine, chassis and drivetrain systems for racing, high-performance vehicles and the aviation industry. The company impresses with lightweight components made of high-quality materials and designed for extreme mechanical loads. The parts are manufactured completely in-house – from the initial design, through finite element analysis, to production and test beds, Pankl covers the entire product development process. Thanks to its years of experience and the expertise of the entire team, Pankl is regarded as a technology leader, and supports its customers with innovative solutions to become even better.

## One-stop-shop for racing, high performance and aerospace

Quickly adapting new technologies, production methods or materials and incorporating them into existing processes is probably one of Pankl's greatest strengths. With this competitive advantage, the company regularly establishes new benchmarks in the field of lightweight construction. High-precision measuring and production facilities, as well as the various engine and drivetrain test beds, ensure that lightweight components can be manufactured and validated to meet the customer's toughest performance requirements.

## Additive manufacturing:

### Future technology in series production

Pankl Racing Systems uses state-of-the-art production technologies in many areas. When it comes to innovative lightweight solutions, 3D metal printing in particular offers a huge amount of potential. Pankl



Validating lightweight components on the engine and drivetrain test beds. Image: Pankl Racing Systems AG



Pankl Racing Systems is headquartered in Kapfenberg. Image: Pankl Racing Systems AG

has succeeded in bringing together what is to date the largest cooperation between leading technology enterprises under a single roof in the form of the Pankl Additive manufacturing competence center in Kapfenberg, with a view to establishing additive manufacturing technologies in new applications.

## From track to road

In cooperation with voestalpine Böhler Edelstahl, EOS and Quintus Technologies, Pankl Racing Systems is pursuing the goal of expanding the boundaries of lightweight construction and specifically deploying this technology in the high-performance automotive and aerospace sectors. For years, Pankl has used motorsport as its playground for developing and testing new ideas. Combined with expertise from the field of industrialisation, lightweight construction innovations in motorsport can be quickly adapted for the sports car sector. This means that Pankl can serve a wide range of industries with its entire product range – from prototype building to series production.

## Targeting the next sustainability goals with lightweight

All state-of-the-art mobility strategies now require a high lightweight component con-

tent in order to meet sustainability goals. With its development know-how and modern manufacturing technologies, Pankl helps its customers to achieve these targets and has therefore become the leading technology partner for engine, chassis and drivetrain components in the racing and automotive sectors. Pankl Racing Systems is headquartered in Kapfenberg in Styria, Austria. The company's ten facilities worldwide are managed from there. Pankl's technological expertise encompasses machining technology, heat treatment, forming technology and additive manufacturing.



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## Research on lightweight technology

The Polymer Competence Center Leoben GmbH (PCCL) is a collaborative research institute focusing on polymer science and technology. Hereby, the main focal points are polymer based, functional and structural materials as well as production and processing technologies. These are intended as the basis for future innovations in a wide range of applications.

The PCCL-K1 has established itself as an "Austrian Centre of Excellence". The declared goal for the coming years is to further evolve to an internationally recognised player with high visibility in selected areas of plastics technology and polymer sciences. PCCL is supported by the scientific expertise of three Austrian universities (MU Leoben, TU Graz, TU Vienna), of several international research partners (e.g. TU Munich, Politecnico di Torino, Czech Academy of Sciences, University of Budapest) as well as of the technological and market know-how of its 50 partner enterprises and the skills of the 122 employees.

### Environmentally compatible lightweight construction

The competence centre combines the high demand in the plastics industry for the development and establishment of pre-competitive research activities for the implementation of existing market potentials with the scientific ambitions of an internationally recognised research programme. New and strategic research focuses concerning lightweight construction, such as frontal polymerisation in composite structures as well as soluble and reusable resin and adhesive systems, have been added to PCCL's R&D programme. Environmentally compatible polymers, bio-based fibre composites and the recycling of polymers are significant future research topics, not only in the PCCL's lightweight construction projects. In this context, PCCL's contribution is essential to the circular economy and ecological compatibility of plastics.

### Research for more sustainability

Modelling and simulation approaches are applied in all areas, for example, in the efficient processing of elastomers and dielectric reactive resin, in predicting the mechanical properties of polymers and composites, and in fracture mechanics approaches. Furthermore, projects on the use of polymeric components in photovoltaic modules also contribute to the achievement of sustainability goals.



The Polymer Competence Center Leoben researches into polymer structural and functional materials, and the matching technologies for their production and processing. Image: www.zoegl.at

### Forward-looking research topics

In 2020, the PCCL and its partners additionally started working on both of the COMET modules approved by the FFG. Within the framework of these COMET two modules, institutes of the MU Leoben are involved as research partners. The COMET "CHEMITECTURE" module (Digital materials for a personalised world – Artificial engineering of polymers along the whole value chain) targets 3D printing of individually functionalised parts. Especially in this project, PCCL bridges the gap between the chemistry of functional materials at the molecular level and the architecture of additively manufactured polymers at the macroscopic level.

### Interdisciplinary approach

Polymers for hydrogen technology are the topic of the COMET "Polymers 4 Hydrogen - Decarbonizing of energy infrastructure using novel polymers" module. The PCCL is developing polymeric materials and sealing solutions for the use under high hydrogen pressure (up to 1,000 bar) and in extreme application conditions, thereby turning visionary

applications in hydrogen technology into reality. Following an interdisciplinary approach with topics ranging from polymer chemistry and polymer processing to the characterisation and simulation of material behaviour, the PCCL is taking a pioneering role here. Since its foundation in 2002, PCCL's employees have published 453 scientific articles in peer reviewed journals. Moreover, 15 patents have been awarded to PCCL. The current workforce of 122 employees generates an annual turnover of nearly eleven million Euros.



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## Innovation in composites

Peak Technology GmbH's products launch rockets into space, move satellites into the right orbit, propel formula 1 cars, electrify air travel, store hydrogen, and win the 24 Hours of Le Mans. It is the challenge that drives the Upper Austrian lightweight construction specialist.

In 2007, Managing Director Dieter Grebner founded Peak Technology GmbH with the aim of offering innovative lightweight solutions for racing and industrial applications. Right from the outset, he set store on the use of fibre composite materials and on close cooperation between development and production. Today, Peak Technology employs some 130 staff, developing a wide variety of products for customers in the motorsports, aviation and aerospace industries worldwide. The company implements specific customer projects in the shortest possible time, starting with the design and construction through to prototype development and quality validation. It is also possible to produce short runs directly on site. Peak Technology relies on the latest composite technologies in processing and develops its expertise in the fibre composites field through on-going training and cooperation with research facilities.

### High-pressure tanks for space travel

Ever since the company was founded, Peak Technology has produced high-pressure tanks for gases for motorsports and various industrial applications. The team started producing high-pressure tanks for space travel in 2009. These tanks are subject to the strictest safety criteria and are used, for example, in satellite drive systems. Tanks by Peak Technology are used in the Galileo navigation system, acting as fuel tanks for carrier rockets such as the European Vega-E. The Upper Austrian company develops and produces tanks with a weight-op-



Automated winding process for manufacturing carbon fibre reinforced lightweight parts. Image: Peak Technology GmbH



Wound and laminated parts are cured under pressure in the autoclave. Image: Peak Technology GmbH

timised design. The right choice of material and the production method help to massively reduce the unit costs, which benefits customers on the constellation market.

### Sustainability as a philosophy

Peak Technology also focuses on the sustainable development of the aerospace industry. For example, engineers are also working on strategies to support the recycling of the fibre composite components. Avoiding space junk is also a major topic. The possibility of thermal degradation (demisability) of the tanks at the end of the satellite's service life is at the forefront of new development projects.

### Committed to progress

"Our greatest motivation is the will to always do even better," as Dieter Grebner emphasises. "That's why we constantly optimise our methods and processes and invest huge amounts of time and resources in the further training of our already highly-trained staff. Because they are the only people who can guarantee maximum

quality without compromises – from 3D design and simulation, through to production and our consistent quality management." In close cooperation with customers, Peak Technology creates individual and flexible solutions which complete the transition from initial prototypes to series production in record time. In intensive work processes, the Peak Technology team looks for the best solution and works with vision and the highest precision.



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## Innovative surface coating

The RUBIG Group is consolidating its Laser Technology and Surface Coating divisions with its latest subsidiary, RUBIG Technology. This increases the field of application for lightweight parts at the same time. The surface coating technology is individually adapted to the customer's requirements. And RUBIG has even found a formula to fight viruses and bacteria.

Materials typically used in lightweight construction, such as aluminium, titanium or plastic, have special properties that make them particularly attractive compared to steel: density, specific strength and suitability for mass processing are just a few examples. On the downside, these materials have a few disadvantages in terms of their surface wear resistance. And this, in turn, restricts their potential uses in the component application. At RUBIG Technology, the latest addition to the RUBIG Group, the portfolio focus is on growing these fields of application.

### Improved protection against wear

Using laser deposition welding or laser alloying, hard material particles such as silicon and tungsten carbide can be integrated into the surface. These highly durable materials significantly improve the resistance to adhesive and abrasive wear and make surfaces even more stable than that of steel. The hard material phase components are adapted to the customer's needs as a function of the respective type of stress and the production process. This ensures that the use of lightweight materials is optimised in terms of machining, resources and stress.

### Individual coating recipe

PVD – Physical Vapour Deposition – is a surface coating technology based on physical impact. PVD coating systems are well-known for their excellent wear resistance and are therefore often used for machining tools. But they are equally useful for the surfaces of plastics. RUBIG Technology tailors both the design of the coating system and



RUBIG NitroPep rules out surface recontamination. Handles, for example, are no longer key interfaces in the chain of infection. Image: RUBIG Group



The RUBIG 5-axis laser processing centre offers virtually unlimited options true to the motto of "4 lenses and 4 technologies". Image: RUBIG Group

the coating recipe specifically to suit the plastic components or meet concrete customer requirements. Standard wear protection coatings but also functional, decorative coatings with a variety of coating compositions can be implemented.

### Fighting viruses and bacteria with Pep

Corona taught us a great deal about the presence, role and spread of viruses and bacteria and clearly showed us the limits of our infrastructure. Since the beginning of the pandemic, the RUBIG Group has concentrated on improving this infrastructure with new technologies. RUBIG Nitropep is a non-toxic coating developed for metals and plastics that contains disinfecting and antimicrobial agents such as chlorhexidine. Viruses and bacteria are killed within minutes after contact with a surface treated with Nitropep. Additional actions such as light irradiation are not required.

### Effective and non-hazardous

Targeted use at neuralgic points such as entrance doors to kindergartens, schools

or care homes can effectively reduce the transmission of pathogens. The coat is firmly bonded to the surface of the coated object and can only be removed mechanically, i.e., by destroying the surface. It is non-hazardous in terms of sensitisation and cytotoxicity. An accredited Austrian laboratory has demonstrated the effectiveness and non-hazardous nature. Chlorhexidine is also approved by ECHA as an active substance and in the pertinent product groups in line with biocide legislation.

## RUBIG DRIVING SUCCESS

### RUBIG Technology

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## Sustainable composites

At the Transfer Centre for Plastics Technology in Wels, experts are working on fibre-reinforced plastics for lightweight construction. Sustainability and recycling are the future focal points. Research is being conducted on innovative recycling solutions for customers who can also have their materials and components tested.

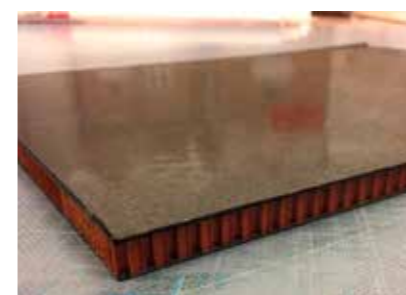
The TCKT – Transfer Centre for Plastics Technology is the specialist for fibre-reinforced plastics applications in the lightweight construction of the future. Aerospace, automotive or bicycle industry - the industries and applications are versatile. Especially in mobility, when it has to be light and stable and fibre-reinforced plastics (FRP) are used. This composite material has huge lightweight construction potential and will see increasing use in other industries, such as mechanical engineering and the building sector, in the future.

### Material development

The TCKT has many years of experience in plastics development, and particularly for lightweight applications in combination with short or continuous filaments. In the past few years, work has focused primarily on the subject of thermoplastic composites and recycled carbon fibres (rCF) – starting with the evaluation of different fibre-matrix combinations, process and property optimisation of tapes and thermoplastic sheets from in-house production, through to the production of various test specimen geometries for material characterisation tasks. TCKT is also trying to make the future of FRPs more sustainable with biopolymers, which are already being used successfully in the packaging industry and agriculture, in combination with natural fibres.

### Smart production

The magic word for smart and resource-conserving composites production is Automated Fibre Placement (AFP). The



Sustainable rCF sandwich sheet Image: TCKT



Automated tape laying Image: TCKT

TCKT takes deep insights into the entire spectrum from producing the tapes and fabricating them downstream up to the finished preform by means of an automated laying process on the AFP plant. A modern thermoforming station is then used for forming into finished parts or demonstrators. The experts can process both thermoset and thermoplastic unidirectional tapes for customers.

### Recycling of composites

Plastics recycling is one of the biggest challenges of our age. Unfortunately, there are very few economically and ecologically meaningful recycling techniques for fibre reinforced plastics so far. This is why the TCKT is researching innovative solutions for recycling these waste flows to create high-quality recycled materials, which in turn can be used to manufacture new, equally high-quality products. Among other things, tests are being carried on introducing pyrolysed rCF into new applications in the form of nonwovens. Glass-fibre reinforced plastic (GRP) waste can also find its way back into new parts after shredding

and reprocessing with a compatible matrix.

### Material testing and characterisation

When characterising materials, TCKT employees test both plastics and parts for customers in line with a wide range of standards and processes for mechanical, thermal, rheological or physical characterisation. The plastics experts draw on years of experience, especially in material testing of composites, coupled with expertise in the interpretation of the results, for the benefit of customers and purchasers alike.



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## Individual lightweight solutions

As a specialist in the lightweight construction industry, TRIPAN Leichtbauteile GmbH & Co KG has been a reliable partner for unique lightweight solutions for more than 20 years. The Upper Austrian pioneer produces individual panels for today's daily needs and for industry – tailor-made for a wide variety of requirements and applications. Innovation made in Austria.

Flexible surface design combined with an interior structure capable of bearing extreme loads – this is what characterises lightweight parts by TRIPAN. "Ultralight and extremely rugged in use" is the guiding principle in product development. The reliable, premium quality of the lightweight parts is valued equally in machine and vehicle construction, aircraft, cable car, and rail vehicle construction, as well as in shipbuilding and architecture. TRIPAN is a company with international activities, but generating domestic value and quality craftsmanship form the foundations on which the company stands. Regional production at the Hörsching location is an integral part of the company's philosophy.

### Unique panel solutions

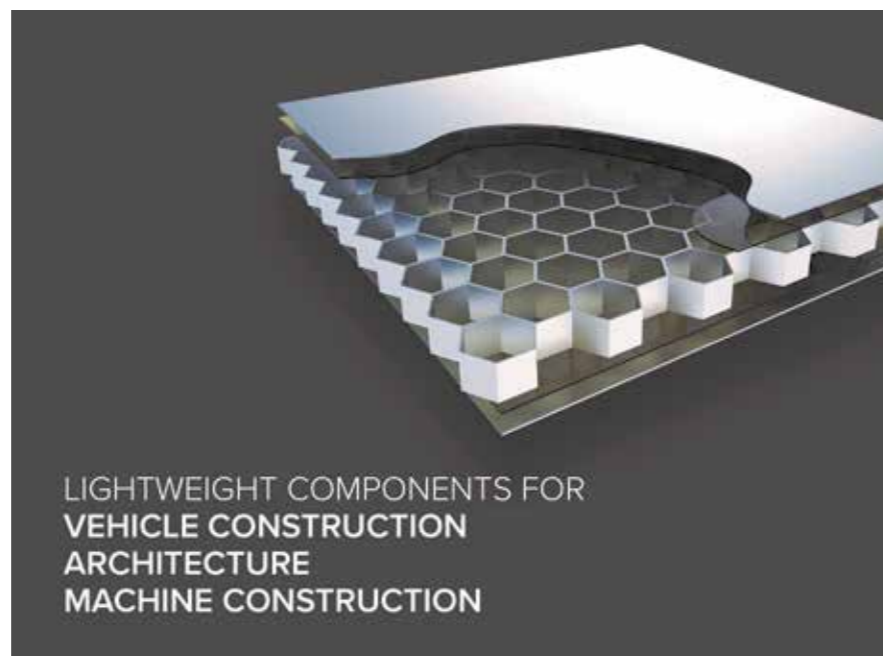
A lightweight panel fulfils many functions: providing protection, bearing loads, and creating space. The details of the implementation and the design of the finishes and edges are individually adapted to the customer's needs. True to the motto of: create your panel. The bionics of TRIPAN lightweight parts – gleaned from our natural surroundings and systematically enhanced – are a very important aspect. This is why the aluminium honeycomb core has been integrated into the composite parts. The core ensures a high load-bearing capacity with a low dead weight and eliminates the need for elaborate substructures.

### Applications

Innovative lightweight parts by TRIPAN are used in a wide variety of industries. In vehicle construction, the specialist man-



Company building TRIPAN in Hörsching  
Image: TRIPAN GmbH & Co KG



Lightweight panels by TRIPAN Leichtbauteile GmbH & Co KG in Hörsching. Image: TRIPAN Leichtbauteile GmbH & Co KG

ufactures, e.g., parts for special vehicles. Sandwich sheets are manufactured for superstructures, bulkheads, storage compartments, underbodies, crash absorbers or for reinforcing vehicle bodies. For mechanical engineering, TRIPAN produces parts that combine low dead weight with high flexural stiffness and/or heat resistance. TRIPAN also offers countless options for architecture. TRIPAN's innovative ceiling and wall panelling can be equipped with acoustic, heating or cooling functions, for example.

### TRIPAN CUBE Tiny House – The new standard of living

Dining room, living room, bedroom, office, kitchen and bathroom - the TRIPAN CUBE can be almost anything. Thanks to perfect lightweight construction technology, the Tiny House developed by TRIPAN is mobile and flexible. The carefully considered room layout allows for a wide variety of usage concepts and offers "living space" for up to three people. There are three living cube models that can be individually adapted to the customer's wishes. From the floor

through wall design to the interior design, no limits are placed on the imagination.

### Research for the future

Collaboration with research partners and platforms such as A2LT allow the company to share knowledge widely. Research is already underway into the further development of lightweight manipulators in robotics and multifunctional climate sails in architecture. And the on-going development of Tiny House solutions also offers new potential and inspiration.



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## Forming superior solutions

The Metal Forming Division is the competence centre of voestalpine for processing nearly any metallic material. With an industry-unique combination of material and processing expertise and worldwide presence, the division is a partner for sustainable lightweight solutions in the fields of mobility, renewable energy as well as construction and storage technology.

In the mobility sector, Metal Forming Division supplies tailor-welded blanks to reduce component weight by at least 15% through the optimum combination of the material and sheet thickness. Cold- and hot-formed structural parts made of advanced high-strength, ultra high-strength or press hardening steels are used for our customers to make lightweight components and improve passive vehicle safety with assemblies made of these high-tech materials. Especially in the field of hot forming, the division has a USP in the area of corrosion protection and sustainability with galvanised steels up to 2000 MPa.

### Mobility

Expertise in lightweight design continues in the body shell area with the production of doors, bonnets and tailgates, side panels and roofs made of high-strength, thin steel and aluminium. The engineering experts of Metal Forming Division develop the required tools and jigs and, together with our production experts, the most sustainable component manufacturing processes such as deep drawing, hot forming or roll forming.

### Sustainability

Sustainability also plays an important role at Metal Forming Division, which is reflected in our products and manufacturing processes. We developed and produce parts of modular battery boxes made of UHSS multi-chamber profiles and pressed parts for the e-mobility sector. The battery boxes are benchmarks in terms of weight and crash performance. We are also very proud of our highly efficient rotor and stator stacks for electric motors.



Additive Manufacturing by Metal Forming Division of voestalpine. Image: voestalpine



Tailor Welded Blanks by Metal Forming Division of voestalpine Image: voestalpine

For the sustainable electricity required in operations, the Metal Forming Division of voestalpine develops and supplies elevated PV systems and substructures and reduces its own CO<sub>2</sub> output at most locations (largest PV system in the Netherlands). A combination of sustainability and lightweight design is also found in hybrid structures for construction and storage with the reduced use of steel combined with renewable raw materials such as wood.

### Additive manufacturing

Finally, for our costumers in every segment, we develop and manufacture 3D-printed prototypes based on metals (steel, aluminium) and plastics. In addition to the classic powder bed fusion process, this is accomplished by means of wire-arc additive manufacturing (WAAM).

### About the Metal

#### Forming Division of voestalpine

The Metal Forming Division was established in 2012 when the voestalpine Profilform and Automotive divisions merged. The headquarters is located in Krems on the Danube in Lower Austria. More than 11,500 people are employed at more than 50 locations worldwide. The division comprises the business units Tubes & Sections, Automotive Components, Precision Strip and Warehouse & Rack Solutions. The

Metal Forming Division works with the following technologies: machining, cold-, hot- and rollforming, welding (for assemblies), (cathaphoretic and powder) based coating, heat treatment and additive manufacturing.

### The voestalpine Group

voestalpine is a leading global steel and technology group. The company group consists of some 500 group companies with locations in more than 50 countries on all five continents. It has been listed on the Vienna Stock Exchange since 1995. voestalpine is the world market leader in railway infrastructure systems, tooling steels and special sections. As a company, voestalpine is committed to global climate goals and is pursuing a clear plan for the decarbonisation of steel production with greentec steel.



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# Our events in 2022


## A2LT

30 March	<b>31<sup>st</sup> Plenary meeting of the A2LT lightweight platform within the framework of the ACstyria Lightweight Day</b> Red Bull Ring, Spielberg
6 – 7 April	<b>A2LT Delegates trip to LIGHTER International Conference</b> Gothenburg, Sweden
2 June	<b>32<sup>nd</sup> Plenary meeting of the A2LT lightweight platform</b>
27 Sept.	<b>33<sup>rd</sup> Plenary meeting of the A2LT lightweight platform</b>
24 Nov.	<b>24<sup>th</sup> Plenary meeting of the A2LT lightweight platform</b>

## A2LT PARTNER

27 – 29 June	<b>4a Technology Days 2022</b> Hybrid event: Sporthotel Royer, Schladming / Online
20 – 22 July	<b>23<sup>rd</sup> Symposium Composite materials and materials compound – Composite 2022</b> Hybrid event: Lecture theatre Montanuniversität Leoben, Leoben / Online
20 – 22 July	<b>5<sup>th</sup> International Conference Hybrid 2022 – Material and Structures</b> Hybrid event: Lecture theatre Montanuniversität Leoben, Leoben / Online
6 - 7 October	<b>12<sup>th</sup> Ranshofen Light Metal Days</b> University Mozarteum Salzburg, Salzburg


Photo from Pixabay



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