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# Components that move

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**LIEBHERR**



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# Unlimited potential: components by Liebherr

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In a world, where machines form the backbone of industry, Liebherr stands out as a symbol of innovation and reliability. “Our past achievements are undoubtedly the basis for our current success. They have got us to where we are today. And they have a significant impact on what we stand for and our ability to position ourselves in the market,” says Jan Liebherr, the president of the administrative board of Liebherr-International AG, in an interview. Our components product segment forms a part of this technical powerhouse – a domain, where cutting-edge technologies meet deep application knowledge. Whether it’s about huge tower cranes shaping city skylines, wind turbines harnessing the power of nature or specialised components for the maritime and tunnelling industries, we at Liebherr provide solutions as versatile as your challenges. “Our strength lies in the close relationship we maintain to you as our customers and your applications – an advantage we’ve continuously built for over 70 years,” explains Pietro Lemmi, managing director of Liebherr-Component Technologies AG, responsible for sales and customer service. “We understand how our components are used, and are therefore able to develop our products to make your daily work more efficient, while allowing you to benefit from technological progress.”

With a wide range of components, we empower you to select solutions tailored precisely to your needs. Each component can be used independently or as part of a comprehensive system that sets new benchmarks. Our components represent more than just products – they stand for partnership and innovation. “Our advantage lies in our proximity to the end product. Being an integral part of the Liebherr Group, we possess detailed application expertise that finds itself in the development of our components, creating a true unique selling point,” says Ulrich Geier, managing director, responsible for technology and development.

Our expertise spans numerous applications – from the harsh conditions of mining to the precision required in antenna technology. Across all environments, our components deliver peak performance. This commitment to providing robust and reliable components is the hallmark of our work.

Through continuous development, we ensure that each component perfectly aligns with your requirements. Simultaneously, we stay at the forefront of technological trends and invest in pre-development projects to shape the innovations of the future. This results in technologies that meet current market demands and support your long-term goals, such as decarbonisation, zero-emission applications and digital transformation. “As our customers, you face the challenge of repositioning yourselves in a dynamic and ever-changing world, whilst proving your competitiveness. We see ourselves as a stable partner who supports you with long-term, high-quality and globally available solutions,” explains Dr. Maximillian Schaut, managing director, responsible for finance, IT, HR and procurement.

Our commitment, however, does not end with the delivery of our products. We understand how crucial the lifespan and efficiency of your machines are. With a comprehensive aftermarket service package, we are always at the side of industries, such as wind energy and mining. High-quality remanufactured components, reliable repairs and a global network of experts provide you with consistent support.

“Beyond developing diverse products and solutions for a green future, we are actively working to gradually reduce the environmental footprint of our manufacturing processes. Across our global facilities, we aim to significantly increase green power generation and eliminate the need for natural gas,” explains Dr. Christian Zenner, managing director, responsible for production and quality at Liebherr-Component Technologies AG.

With our flexible components, we provide you with the freedom to choose customised products that perfectly meet your requirements. Step into the world of our components and experience, how we push the boundaries of technology to create products that are up to your expectations. Our goal is clear: to be a driving force behind your success, as we are building the future together.

A photograph of four men standing on a modern office staircase. They are all smiling and dressed in business attire. The man on the far left is wearing glasses and a black blazer. The man next to him is wearing a black blazer. The man next to him is wearing a blue blazer. The man on the far right is wearing a dark blue blazer. They are standing on a white staircase with a glass railing. The background shows a modern office interior with white walls and a glass door.

From left: Ulrich Geier, Dr. Christian Zenner,  
Dr. Maximilian Schaut, Pietro lemmi

***“We understand how our components are being used and develop our products in a way that makes your daily work more efficient, whilst enabling you to benefit from technological advancements.”***

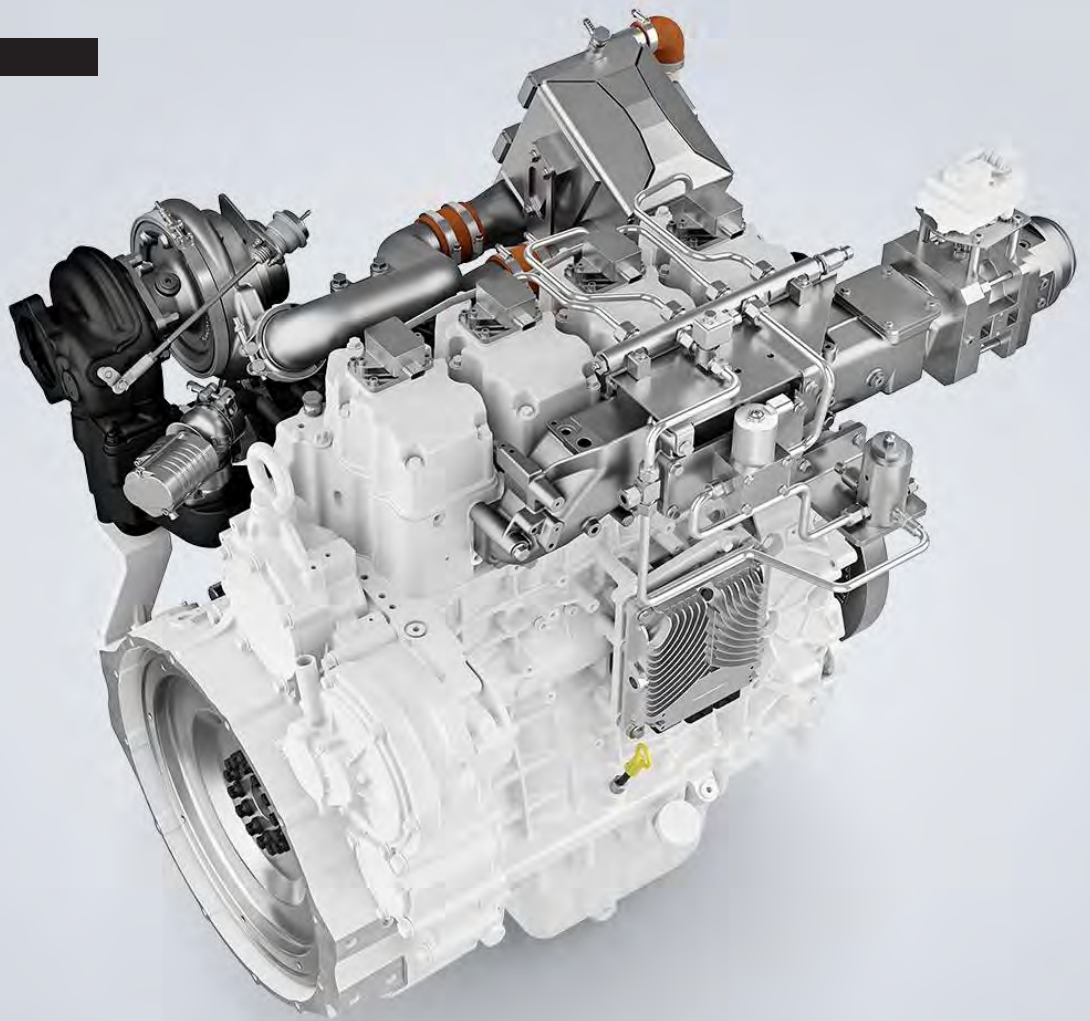
**Pietro lemmi**

Managing director at Liebherr-Component Technologies AG

## Chapter 1: Emission-free into the future

# Today & tomorrow

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Our 4-cylinder hydrogen engine is still under development, but is showing encouraging results in terms of CO<sub>2</sub> and nitrogen oxides (NO<sub>x</sub>) emissions.

# Different perspectives

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**As the demand for sustainable solutions in heavy-duty industries grows, Liebherr is at the forefront of innovation, blending existing technologies with future-oriented developments. In this article, we explore some of the cutting-edge technologies currently deployed by our components product segment, from advanced hydraulic systems to wind-assisted propulsion and emission-free energy solutions. Additionally, we will look ahead to the promising innovations in the pipeline, showcasing our commitment to reducing environmental impact, while enhancing efficiency and performance. Join us, as we navigate the exciting landscape of today's technologies and tomorrow's possibilities in sustainable machinery.**

Liebherr, a leader in the production of construction machinery among others, is fully aware of the environmental impact of its machines, many of which are still powered by fossil fuels. Therefore, we at Liebherr are committed to further reduction of emissions by pursuing an open-technology approach, whereby a variety of fuel and energy solutions are being explored. While the shift towards alternative energy sources is gaining momentum, we believe the combustion engine will remain a strong and reliable option for many heavy-duty applications. Why? Because these machines operate under some of the toughest environmental conditions imaginable – high dust exposure, extreme temperatures, fuel impurities and intense vibrations. Under such circumstances, traditional combustion engines continue to offer reliability and power that other technologies are partly still working to match. Different power requirements between full load and idling also play an important role in construction machinery and can be covered very well by the combustion engine.

Liebherr thinks globally, when it comes to reducing emissions, and examines different technologies and fuels. Hydrotreated vegetable oils (HVO) are particularly of interest being an already available, interim technology. All our combustion engines and fuel injection systems are validated and approved for use with HVO fuels, offering a simple and efficient alternative to diesel.

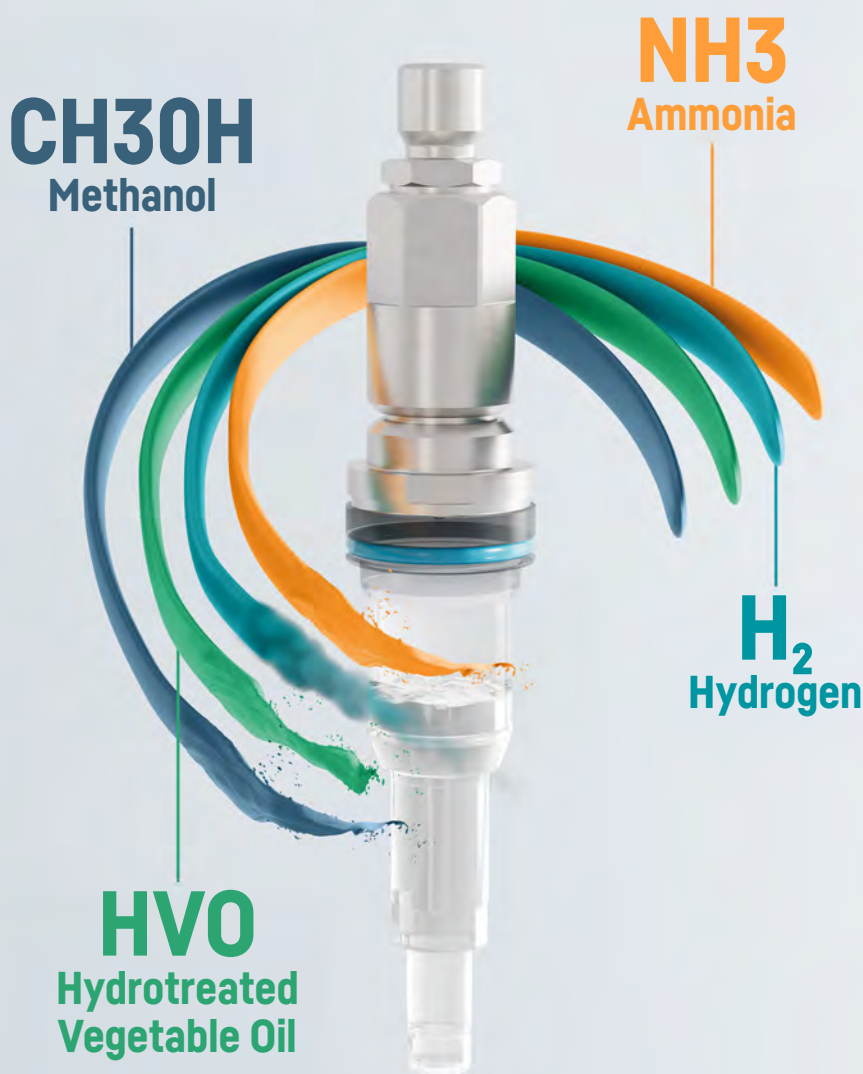
For machines with high-energy requirements, hydrogen-based powertrains are a promising option for nearly greenhouse gas-neutral performance.

We in Liebherr's components product segment have recently made a significant investment in the development of our hydrogen engine and test facilities. Prototype engines have undergone testing since 2020. Meanwhile, the prototypes have shown encouraging results in terms of performance and emissions, both on test benches and in the field. Different injection and combustion technologies, such as port fuel injection (PFI) and direct injection (DI), have also been assessed in the process. The first prototype construction machines equipped with these engines have been running since 2021.

Our common rail systems (CRS) are paving the way for more sustainable engine performance, allowing diesel and hydrogen-powered engines to operate CO<sub>2</sub>-neutrally. These are designed to run with alternative fuels like HVO, biodiesel blends (B20 up to partly B100), as well as synthetic fuels, and offer a flexible solution for the reduction of emissions in heavy-duty applications. One challenge that arises when dealing with environmentally friendly fuels of all kinds is the energy density. It is lower for almost all new

types of fuel than for the familiar diesel. In driving practice, this means that the same amount of fuel provides less energy, which impairs the performance of the end device. To achieve the same performance, you either need a larger engine and, therefore, more space in the machine, or our LI2.9 injector. It features a very compact design and, at the same time, an above-average flow rate. It enables higher outputs even with fuels of lower energy density, like HVO. The performance level known of a diesel engine is retained.

Beyond biofuels, we also provide injection solutions for hydrogen, methanol, ethanol and ammonia. These are suitable for single-fuel and dual-fuel drive solutions, as well as for retrofit engines, providing a wide range of options for climate-friendly powertrains. Field-tested in various machinery, our CRS is already proving its effectiveness in real-world conditions, leading the charge toward a greener, more sustainable future for industries worldwide.



# How we live electrification at Liebherr today

**With electric systems currently in high demand, our team is optimising existing solutions or adapting hydraulic concepts.**

In addition to innovations in engine technology, our Liduro Power Port (LPO), for example, represents a crucial step forward in the emission-free operation of electrified machinery on construction sites. The LPO is a battery-based energy storage system that enables machines to run and charge locally without emissions, contributing to reduced noise, fine dust and CO<sub>2</sub> in urban environments.

Construction sites often have limited or no access to grid power. The LPO addresses this challenge by offering a highly efficient and flexible energy supply that can power machinery across various load peaks. It charges via different current strengths and connectors, providing a constant power output of 40 kW to 1,200 kW, depending on the model. The LPO can also charge and discharge simultaneously, ensuring uninterrupted operations.

Energy and condition monitoring are handled through local control and a remote app, allowing construction site operators to track geo-location, battery status and energy usage, providing essential tools for fleet management. This versatility makes the LPO a cost-effective solution, particularly when used as a supplement to grid power or as a stand-alone “isolated grid” on sites with no power access.

The LPO reduces the need for oversized grid connections and eliminates the inefficiencies typically associated with diesel generators. With its ability to handle peak demands efficiently, the LPO delivers power without waste, ensuring an optimal price-performance ratio.

With our Liduro Power Port (LPO), we make a crucial step forward in the emission-free operation of electrified machinery on construction sites.





Our new permanent magnet motor offers manufacturers of mobile off-highway machines a revolutionary added value.



One further example on our way to electrification is a permanent magnet motor. This is an electrically powered, directly oil-cooled motor designed for use in battery and diesel-electric powertrains. With its compact design, high power density and efficiency, the motor is particularly suited for fully electric work machines, especially as an alternative to hydraulic designs. It offers the same installation space, however with greater efficiency and reduced installation requirements, allowing to avoid significant oil leaks, pressure-related accidents and maintenance costs.

And what are the advantages for you? In mobile work machines, the motor's power-to-space ratio is crucial. Until now, hydraulic motors have had the highest power density by volume. Our newly developed electric motor now achieves the same power density as a hydraulic motor but brings significant additional benefits.

The installation of an electric motor is simpler and faster, as there is no need for extensive oil lines required by hydraulic motors. This avoids contamination on construction sites, in natural areas and indoors as a result of leaking oil lines, as well as accidents caused by burst lines. The maintenance-intensive hydraulic motors are replaced by maintenance-free electric ones, significantly reducing maintenance efforts. Additionally, the design enhances durability: Fewer gear stages are needed, and the high torque-to-speed ratio reduces mechanical load on the motor.

With an efficiency of 94 – 96%, the permanent magnet motor is far more efficient than a hydraulic one (approximately 50%), consuming considerably less energy. Although the initial cost of an electric motor is generally higher than that of a hydraulic motor, our new electric motor proves more cost-effective over the entire lifespan of work machinery, when considering operational costs compared to hydraulic motors.

Our permanent magnet motor can be used in mobile work machines (excavators, telehandlers, etc.), as well as in all applications, in which compact design, emission reduction and contamination prevention are essential.

Moreover, our electric travel drives for crawler and tracked vehicles have proven their worth in tough construction environments for years, such as in drilling rigs and third-party equipment. "In addition, we're currently working on a solution for hoisting applications that allows a compact planetary gearbox in a winch despite higher input speeds. Thereby, we use electric motors that run at a higher speed, and can therefore be more compact at the same time," – explains Matthias Kiebler, innovation manager in the drives business unit.

Furthermore, we use digital data to extend the longevity of machines and reduce your operating costs. Sensor technology in the SAT600 slewing drive collects data from ongoing operations to predict maintenance intervals and ensure high machine availability (read more on how we indulge into digitalisation in Chapter 3).



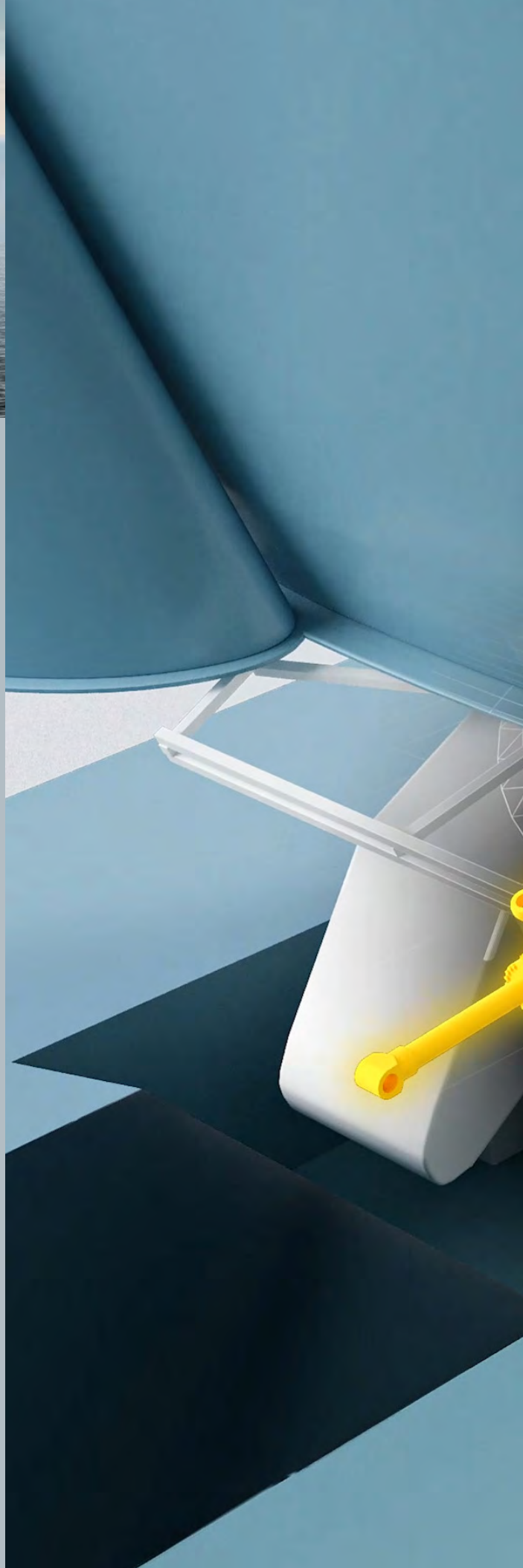


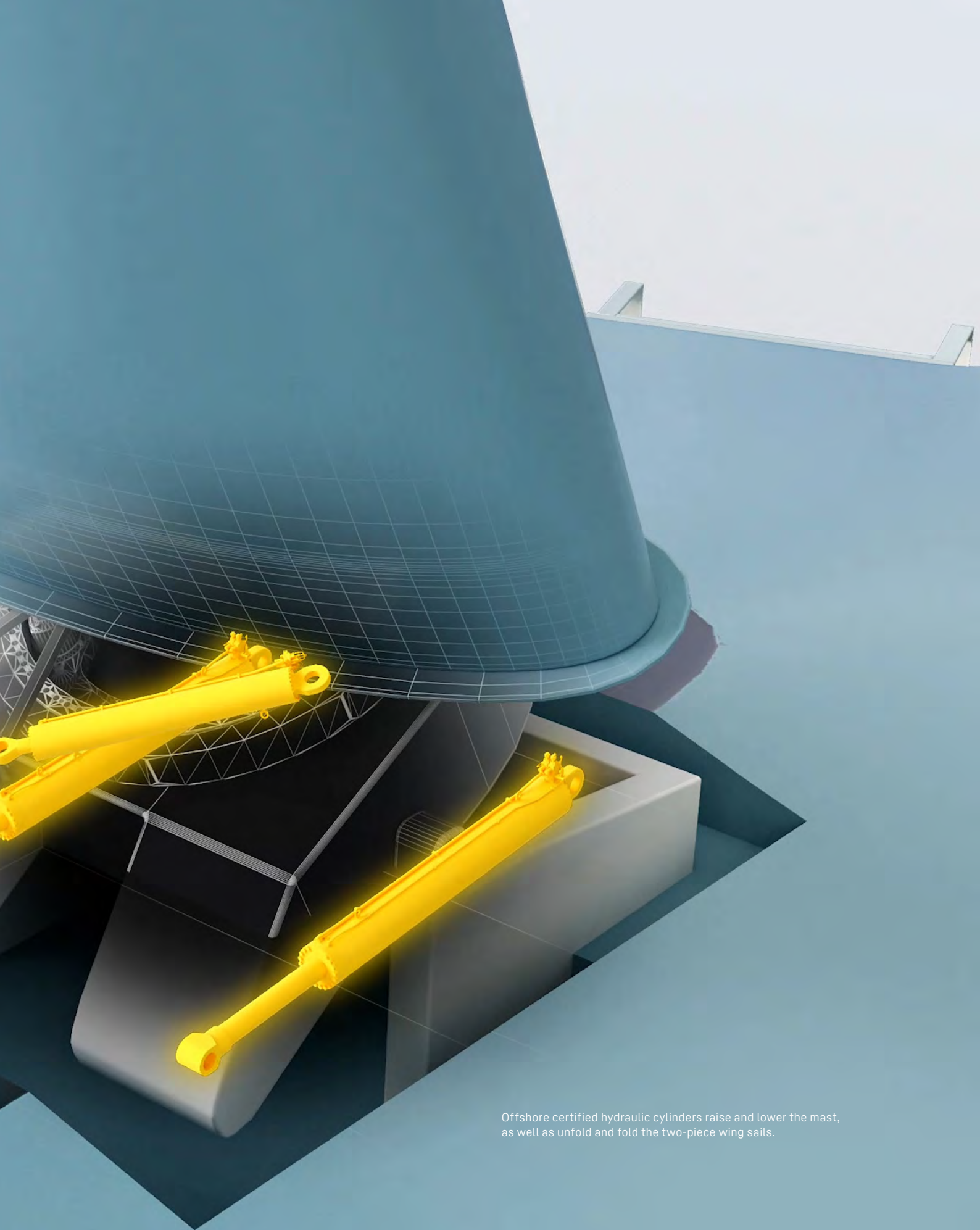
## Wind-assisted propulsion

The ambitious goal set by the International Maritime Organization (IMO) – to drastically reduce CO<sub>2</sub> emissions by 2050 in the maritime industry – drew the attention of shipping companies worldwide to environmentally friendly technologies and alternative powertrain systems. With this trend in view, our Liebherr-Components' team has developed a complete solution for wind-assisted propulsion in response. The system, consisting of slewing bearings, slewing drives, hydraulic cylinders and a hydraulic power unit, harnesses the power of the wind to propel ships, improving the energy efficiency of cargo vessels.

A key innovation thereby are the so-called "wing sails" – large retractable sails resembling airplane wings. Thanks to their aerodynamic design, these sails optimise wind usage and enhance propulsion efficiency. Our hydraulic cylinders play a critical role therein, erecting the sail mast and adjusting the sail size based on wind conditions. These robust offshore-certified cylinders, extending to around nine metres in length, stabilise the 40-metre-high sails. Their corrosion-resistant coating ensures durability in harsh marine environments. The reliable counterbalance valve makes our cylinders indispensable for safe and flexible operations, even under extreme weather conditions at sea.

Our commitment to sustainability is evident across all facets of our operations. From our advanced CRS solutions and hydrogen-powered engines to the Liduro Power Port's emission-free power supply, our Components' team lays the groundwork for a future, where heavy machinery operates with minimal environmental impact. By continuously investing in alternative fuels, electrification, wind-assisted propulsion and energy storage solutions, we at Liebherr ensure that our equipment does not only meet today's demands, but also anticipate the needs of tomorrow's greener, more sustainable world.





Offshore certified hydraulic cylinders raise and lower the mast, as well as unfold and fold the two-piece wing sails.

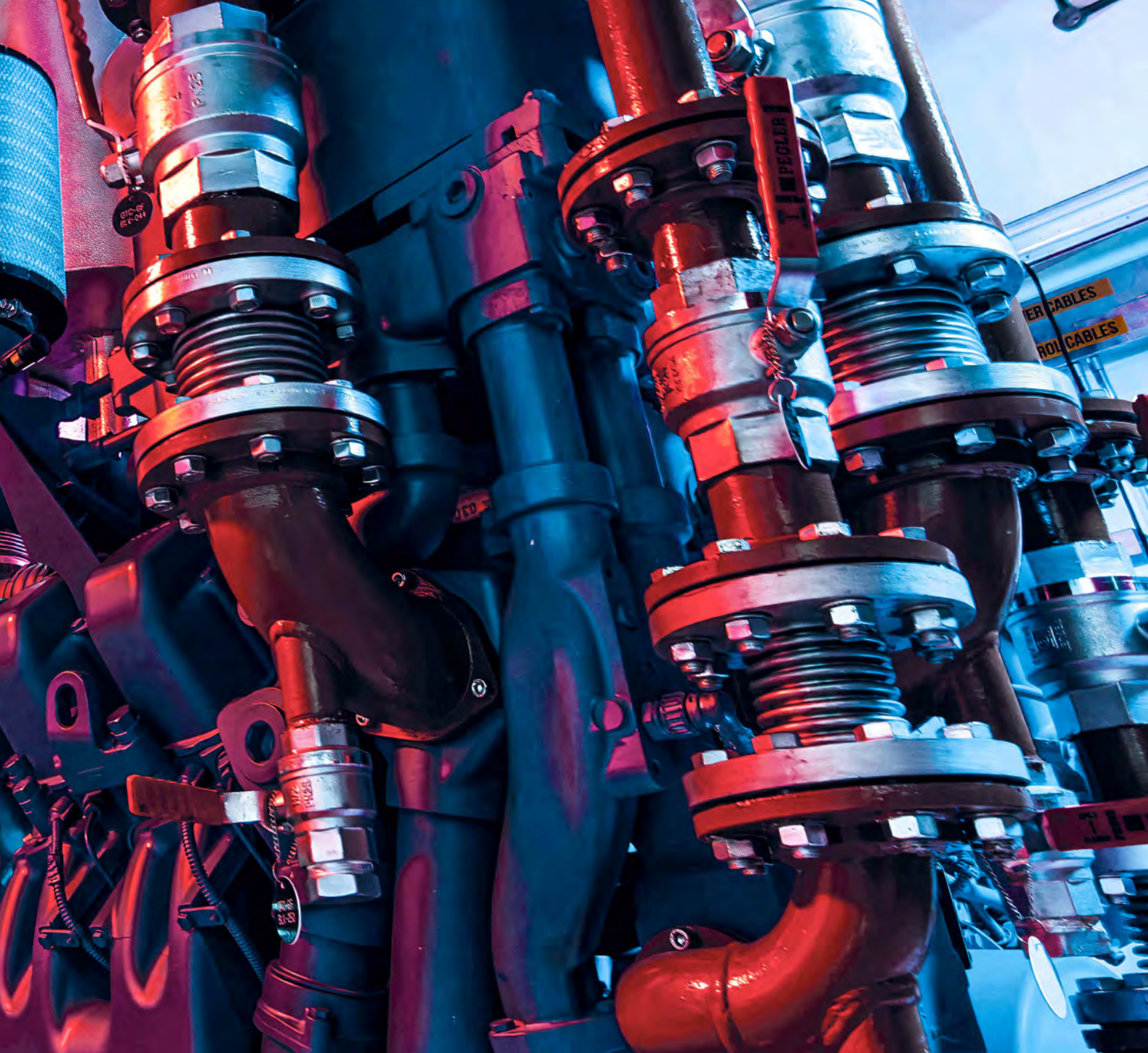


With our injection technology, we set new standards in eco-friendly energy supply, enabling sustainable and efficient power generation through the development of a low-emission ammonia combustion engine.

**Components as a driving force of innovation: eco-friendly injection technology for the genset market of the future**

Our product segment is a leader in the development of innovative and sustainable injection technologies tailored to the demands of a rapidly changing energy market. With extensive experience and advanced solutions, our company tackles the growing challenges of environmentally friendly power generation, offering pivotal contributions to the genset market. Particular focus lies on the development of hybrid solutions and the integration of renewable energies.

One of the most significant developments in genset technology is the introduction of modern common rail injection systems, designed and manufactured by our team in Germany. These systems allow precise control over fuel flow, leading to optimised combustion, reduced fuel consumption and a significant reduction in emissions. They also contribute to lower operating costs. Our innovative injection solutions are setting industry standards. We are also working increasingly on integrating environmentally friendly biofuels and synthetic fuels, which offer a far better CO<sub>2</sub> footprint compared to traditional diesel.



Another exciting trend in the genset industry is the development of hybrid microgrids, where diesel generators work hand in hand with renewable energy sources like solar and wind power. In these systems, gensets ensure a stable power supply, whenever renewable sources are insufficient. We are taking this a step further by developing an ammonia combustion engine, which could serve as an emission-free alternative to diesel. Ammonia, a hydrogen derivative, enables carbon-free energy supply – a major milestone for the industry.

The genset market is expected to grow in the coming years, driven by the demand for sustainable and intelligent energy solutions. The industry faces the challenge of developing technologies that meet requirements for both reliability and environmental friendliness. In this transformative process, we position ourselves as your trusted, competent partner in combustion technology, offering advanced solutions and tailored concepts for more sustainable power generation.

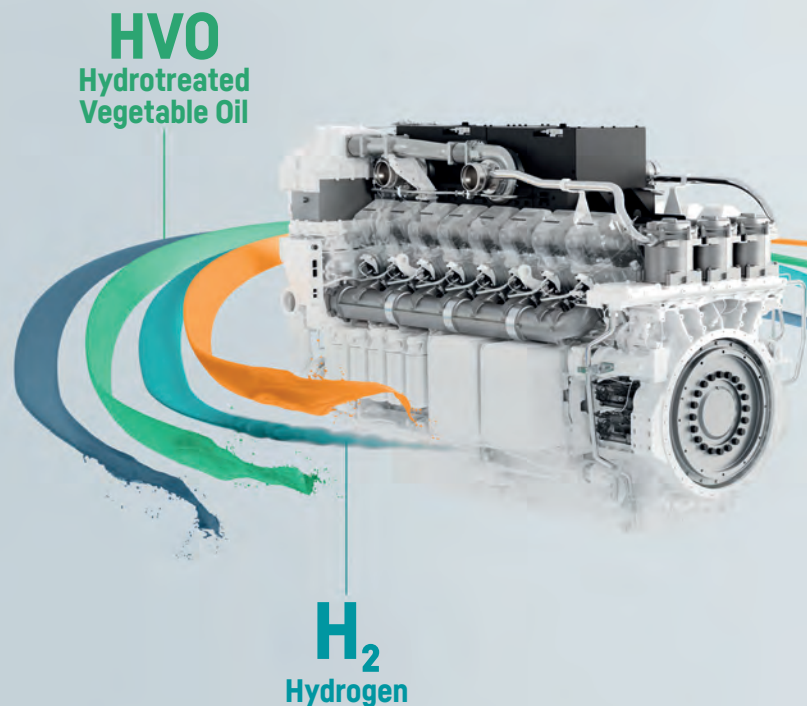
# A future outlook with alternative fuels

In a world, where the reduction of global greenhouse gases is one of the most pressing challenges, we stand at the forefront of innovation, working tirelessly to develop alternative and climate-friendly powertrain concepts. With a wide array of products that serve industries around the globe, the company knows that there is no one-size-fits-all solution, when it comes to achieving net-zero emissions. That's why we are committed to an open approach to powertrain technology, exploring a diverse range of fuels that can meet your varying demands and operational environments. As a trends-radar, our Components' team is constantly analysing emerging technologies and market shifts, ensuring it rises to new challenges with cutting-edge solutions. This approach has led us to explore advanced alternatives, such as ammonia, methanol and ethanol – fuels that hold immense potential for reducing emissions in industries that rely heavily on powerful machinery and engines.

## Ammonia: a powerful alternative for heavy industries

Ammonia has emerged as a particularly promising alternative fuel due to its high energy density, ease of transportation and excellent storage capabilities. As global industries look for cleaner alternatives to traditional fossil fuels, ammonia is gaining attention as a viable substitute for diesel in controlled, professional environments. These include industries like mining, shipping (especially tankers and container ships), power generation and even rail transport. In these demanding applications, ammonia has the potential to significantly reduce emissions without compromising on performance.

The appeal of ammonia does not only lie in its energy efficiency, but also in its versatility as a fuel for various high-power applications. Its ability to replace diesel in sectors that require large-scale, continuous power makes it a serious contender in the race towards greener energy solutions. Our commitment to exploring ammonia as a diesel alternative ensures that we will continue offering sustainable solutions to industries, where emission reductions are both challenging and critical.



### **Methanol: the future of maritime fuel**

Methanol is rapidly gaining traction in the maritime industry, where the need for cleaner fuels is becoming increasingly urgent. In fact, our product segment began exploring the potential of methanol as early as 2018, conducting feasibility studies and predevelopment research in its combustion properties. This early research has positioned us to respond quickly, should market demand for methanol-powered solutions rise.

As a fuel, methanol offers several advantages for the shipping industry. It burns more cleanly than conventional marine fuels and is easier to handle and store. Methanol is also a liquid at ambient temperatures, making it easier to integrate into existing infrastruc-

ture compared to gaseous fuels like hydrogen. With the shipping industry under increasing pressure to reduce its carbon footprint, our proactive approach to methanol development puts the company in a strong position to offer viable, sustainable powertrain solutions for marine applications.

### **Ethanol: a familiar fuel with new potential**

Ethanol is another alternative fuel that we are closely examining for its potential to reduce emissions across multiple sectors. Long used as a renewable fuel in transportation, ethanol is widely available and can be produced from various biomass sources, making it a promising candidate for applications, where biofuels are practical and sustainable.

Our open approach to powertrains means that the company is not just focusing on one fuel, but is actively exploring ethanol alongside ammonia and methanol, ensuring you access to a variety of sustainable options that suit your specific needs.



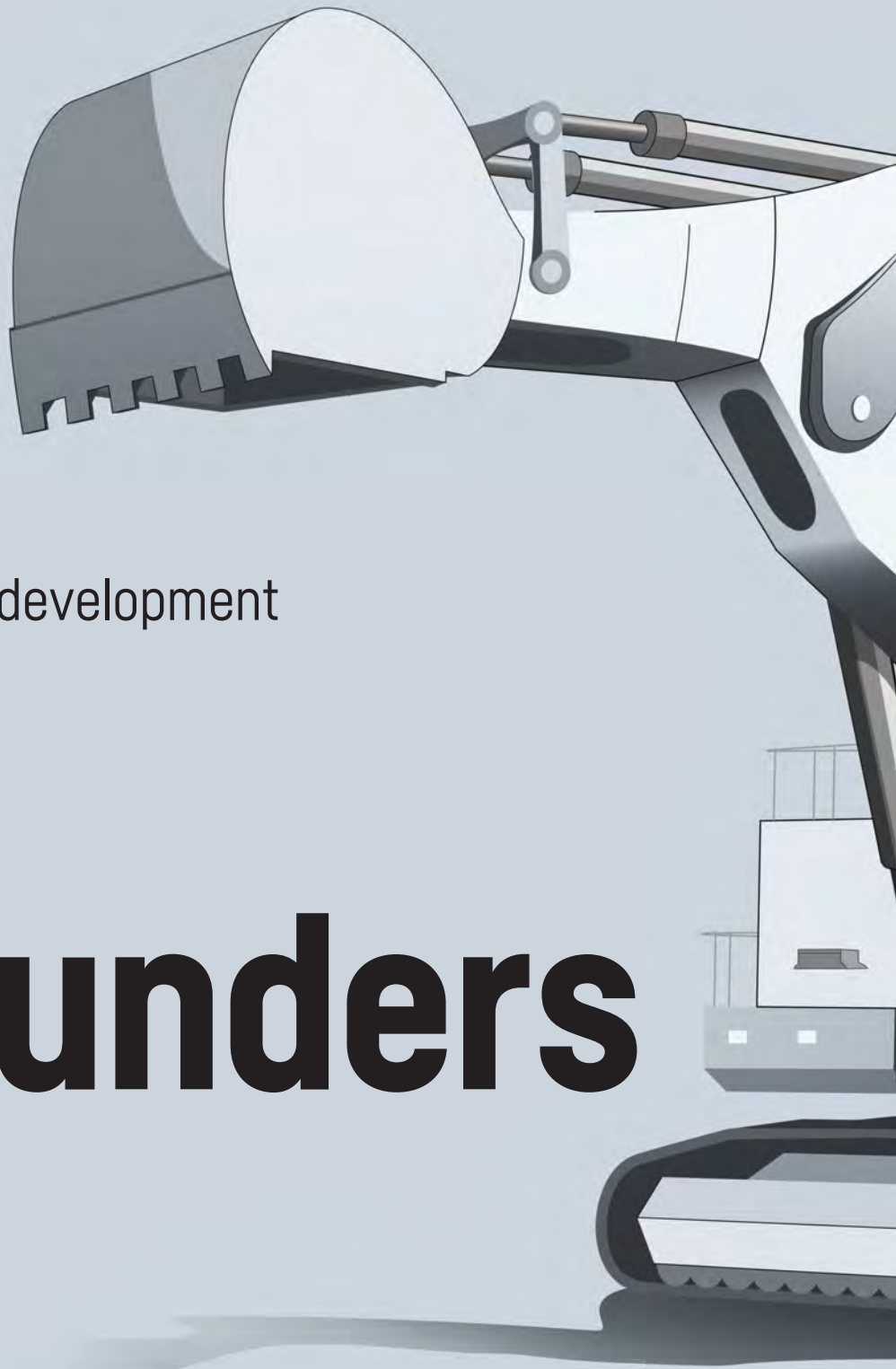
### **Paving the way for future innovation**

While exploring alternative fuels like ammonia, methanol and ethanol, we commit to driving sustainability across industries. Our team is also currently working on injection technologies for new combustion concepts, such as high-pressure injection of alternative fuels, while also optimising existing common rail systems for fossil fuels to meet future EU emission regulations, including EU Stage 6.

Our dedication to predevelopment projects and early research means that we are always prepared to adapt to new market demands and technological advancements. Different environmental regulations worldwide require, for example, different injection technologies to meet the specific need for emission reduction in a timely manner on the one hand, and to ensure independence from fossil fuels in the long term on the other.

As industries shift towards greener practices, our versatile platform solution suits diverse requirements and market segments, including off-road applications, construction machinery, industrial machines, power generators and marine transport for dual-fuel, single-fuel or retrofit engines.

In the end, our goal is clear: to reduce greenhouse gas emissions by offering flexible, innovative powertrain solutions that meet the diverse demands of the global market. By understanding trends, rising to the challenges of today and preparing for the future, we at Liebherr help to lead the way towards a more sustainable tomorrow.



Chapter 2: Modular development

# Our allrounders

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## Future slewing bearings: digital, electric and maintenance-free

Industries worldwide are under pressure to reduce their environmental footprint, while becoming more efficient, sustainable and safer. But how can these goals be achieved? Often, the answer lies in the hidden champions of heavy industry: slewing bearings and slew drives.

These components are at the heart of machines in a wide range of applications, including excavators, cranes, tunnel boring machines, antennas, offshore cranes, bridges and wind turbines. To meet the growing demands, we at Liebherr focus on continuous innovation. Our advanced slewing bearings and slew drives are designed to seamlessly adapt to modern standards, making operations more efficient, safer and environmentally friendly.

The upgrade: How our software-integrated wear measurement for slewing bearings works.

### Digital wear monitoring for slewing bearings

Bearing clearance monitoring (BCM) provides a digital solution for measuring wear in slewing bearings. Built-in sensors allow precise measurements of axial and radial wear without requiring technicians to perform manual checks in hard-to-reach areas. This does not only improve safety, but also speeds up the monitoring process. Permanently installed sensors enable quick wear measurement via a web app, which can reduce downtime by up to 75%.

An upgrade to the BCM can be seamlessly integrated without the need for additional measuring devices or gateways, reducing system complexity and allowing you to analyse measurement data within your own systems.

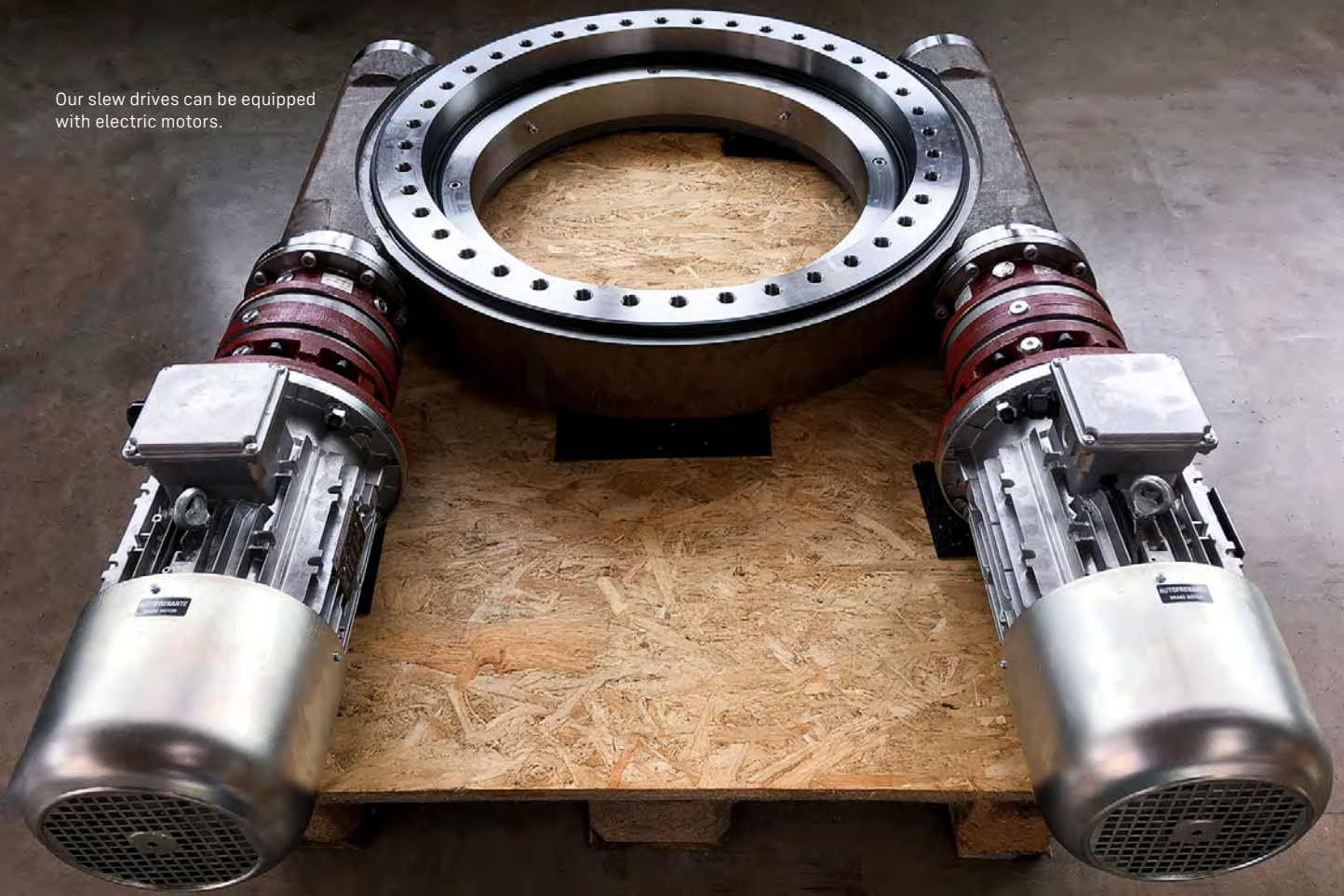
#### Our BCM:

1. Sensor and connection
2. Specifically developed code

#### Your system:

3. Control system
4. Data visualisation
5. Data interface, if required

Our slew drives can be equipped with electric motors.



**Electrifying slew drives:  
efficient and environmentally friendly**

Our slew drives can be powered electrically, offering clear advantages: They reduce noise emissions and do not require hydraulic oil, which prevents the risk of oil leaks. Electrically driven slew drives are ideal for applications, where no hydraulic systems are used. They offer a clean solution, especially in sensitive environments. The electric motors are also highly adaptable and can be combined with various gears. Thanks to intermediate flanges, motors can be easily integrated and installed in a space-saving manner. Electrically powered slew drives excel in precise positioning tasks, as their power control allows for accurate movements.

**Lifinity solid lubrication:  
maintenance-free slewing bearings**

Our innovative solid lubrication, Lifinity, eliminates the need for regular relubrication. In this process, a heated polymer-oil mixture is introduced into the heated bearing. As it cools, it forms a stable layer that provides long-term lubrication for the bearing.

A major advantage is the significant reduction in maintenance, as regular relubrication is no longer necessary, leading to considerable savings in operating costs and time. This increases productivity, as equipment requires less downtime for maintenance, thus extending the lifespan of machines and boosting overall operational efficiency. Lifinity also reduces the risk of corrosion, enhancing the longevity of the bearing.

Additionally, Lifinity is environmentally friendly: Conventional greases and oils can leak and pollute the environment, but with Lifinity, there's no such risk. This technology also meets strict NSF/H1 standards, making it suitable for food-related environments.

By implementing digital measurement, electrification and maintenance-free technologies, we offer advanced solutions for slewing bearings and slew drives that meet the rising demands across a variety of applications and industries. Our components are future-ready and play a vital role in making your operations more efficient, safer and environmentally friendly.

# Drive technology – and beyond

## Components that deliver on their promises

Whether hydraulic or electric, our components segment offers a broad range of proven solutions across all drive types. Our experts in the drive technology division work tirelessly to deliver optimal solutions for every application. Key focus areas are safety-critical aspects, such as lifting heavy loads or the precise positioning of crane booms, ladders and telescopic arms. Here, the advantages of our low-backlash, highly durable gearboxes shine through, making a true difference thanks to our extensive development and application expertise.

With our vast product portfolio, you can find the right component for any machine drive type – be it fully electric, diesel-hydraulic, hydrogen-powered or hybrid applications. “We are familiar with almost every application and can provide the right product for each one,” says Thorsten Pohl, head of sales for the drive technology division. “Our components also offer added value in terms of safety, quality and reliability. Compact design, along with digital products and services, is becoming increasingly important.” Our drive technology is backed by unique expertise: The components are used in all Liebherr applications – the treasure trove of our vast experience, from which you and your applications can benefit, when working with us.

Slewing, driving, lifting – always the right components by Liebherr for your construction machines

|                 |  slewing |  driving |  lifting |
|-----------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Tower crane     |          |                                                                                             |          |
| Mobile crane    |          |                                                                                             |          |
| Crawler crane   |          |          |          |
| Excavator       |          |          |                                                                                             |
| Crawler         |          |          |                                                                                             |
| Wheel loader    |                                                                                             |                                                                                             |                                                                                             |
| Deep foundation |          |          |          |
| Telehandler     |         |                                                                                             |                                                                                             |
| Crawler dozer   |                                                                                             |         |                                                                                             |

### Safe lifting, turning, positioning

Safety and reliability are central aspects of all our components – two factors that go hand in hand. When lifting multi-ton objects over long boom arms, the highest level of safety must be ensured. The same applies to rotating and positioning telescopic arms or ladders, where minimised backlash and smooth acceleration of the slewing drive prevent sway in loads or personnel. High-quality components also provide for a higher machine productivity, as they help maintain uptime. This is especially crucial, when components must withstand extreme stress, as with the exciter blocks and cutter wheel drives in Liebherr construction machines.



Our electric travel drives for crawler and tracked vehicles by Liebherr have proven their reliability for years in tough construction environments.

### **Expertise down to the last detail**

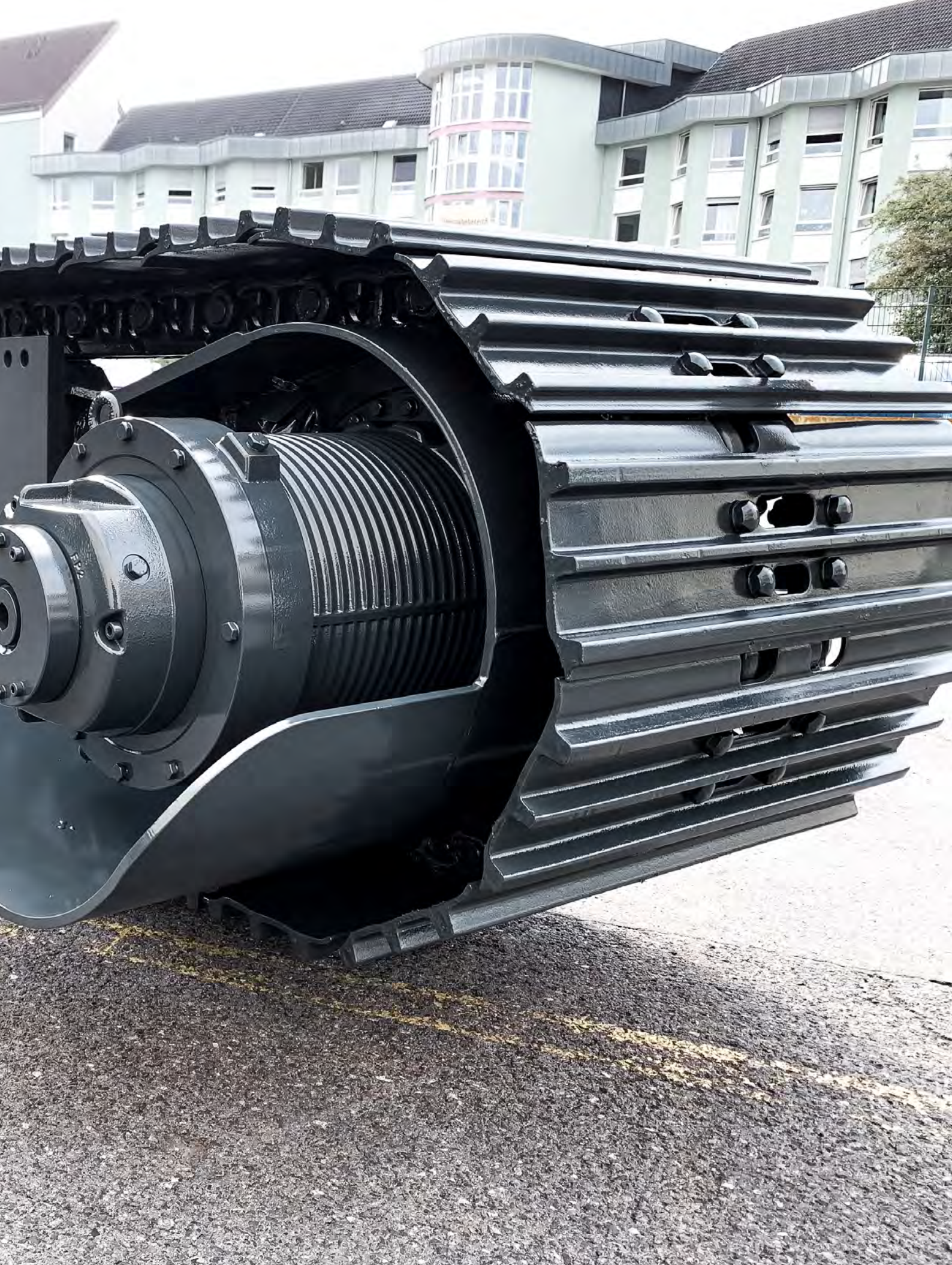
Our gearboxes and winches are designed and assembled in-house to provide you assurance and reliability. “We know that we can rely on our components and can lift up to 6,000 tons with our winches,” says Matthias Kiebler, innovation manager at the drive technology business unit. “Technical adjustments, such as dual motors for redundancy, secondary brakes and custom-designed gear systems are as essential for maximising the benefits in mobile applications, as are FEM analyses and load tests conducted in advance,” Kiebler explains further. “We also have a dedicated department for fundamental research and product testing. In-house development allows us to work closely and personally with you, providing high flexibility in project execution.”

### **Electrification and digitalisation: the next steps**

We are open to all types of drive concepts, with electric systems currently in high demand. The team is constantly challenged to optimise existing solutions or adapt hydraulic concepts to meet new demands. Our electric drive systems for crawler and tracked vehicles have proven their worth in the tough construction environment for years, including in Liebherr construction machines or in your machines outside the Liebherr Group.

“In addition, we’re currently working on a solution for hoisting applications that allows a compact planetary gearbox in a winch despite higher input speeds. Thereby, we use electric motors that run at a higher speed, and can therefore be more compact at the same time,” – explains Matthias Kiebler, innovation manager in the drives business unit. “We also leverage digital data to enhance machine longevity and reduce operating costs for users.” One example is the sensor technology in the SAT600 slewing drive, used in a mining excavator. We are already collecting data from active operations, aiming to plan maintenance intervals proactively and sustainably improve the availability of your machines.





# The modular hydraulic cylinder

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**Imagine a world, where machines perform at peak efficiency, while preserving resources and the environment. At the heart of this vision are hydraulic cylinders – the essential components driving sustainable, high-performance applications. This is where our expertise shines. With a dedicated team of specialists, a process-optimised production and assembly, we are creating hydraulic cylinders that are not just fit for today's needs but are primed to excel in the future. By choosing from our solutions, you can customise your application to meet the challenges ahead, transforming new regulations and higher standards into opportunities to enhance performance.**

As the call for sustainable practices reshapes industries worldwide, construction machinery is under particular scrutiny due to its intensive energy and resource consumption. Our hydraulic cylinders are built to stand the test of time, thanks to exceptional reparability and a steady supply of spare parts. On top, their durability coupled with our elaborate cylinder assembly bench, makes repairs quick and efficient, which is particularly beneficial for customers like you, who require high machine uptime. The extended service life of our cylinders means fewer resources are consumed over time, driving both sustainability and cost-efficiency.

Sensors are another game-changer, offering real-time monitoring of cylinders to detect wear early and prevent failures in this way. Our predictive maintenance approach does not only optimise repair schedules and minimise unplanned downtime, but also maximises machine safety and efficiency.

Another essential advancement is lightweight construction. Our focus on weight-reduced hydraulic cylinders has a dual impact: boosting machine performance by enabling longer booms and more agile movement, while cutting CO<sub>2</sub> emissions. Using materials like carbon fibre reinforced plastic (CFRP), which are characterised by high load-bearing strength and rigidity, we achieve high load capacity and maximum performance with less weight. A recent example of this innovation is our lightweight material handling prototype, featuring two CFRP hybrid cylinders on the boom. The reduced cylinder weight lowers energy consumption, enabling increased load capacity for material handling. Michael Lenk, technical sales expert at Liebherr-Components Kirchdorf GmbH explains, "The material handler with CFRP stick cylinders is a pioneering technology, which allows us to combine efficiency, sustainability and lightweight construction to maximise machine energy efficiency."

We are also advancing in corrosion and wear protection for our piston rods. By developing alternative coatings, we are committed to further extending cylinder up time. Additionally, we adhere to stricter environmental regulations, like the REACH regulation, which limits chromium (VI) usage in the near future. Our forward-thinking approach ensures our readiness to meet the needs of tomorrow.

Each of our hydraulic cylinders is a step forward in efficiency, durability and sustainability. What drives us? A commitment to continuous improvement. We are never satisfied standing still, because the future is not just something we wait for – it is something we build. And that's our mission – day after day, cylinder after cylinder.



We use customised Liebherr assembly benches for the efficient and fast repair of hydraulic cylinders.

# The DPVG hydraulic pump family

## Nominal sizes 85, 140 and 280 cm<sup>3</sup>

**Imagine facing a challenging task: You need a drive system that seamlessly integrates into your machine, robust enough to endure even the toughest conditions, and flexible enough to meet various applications. This is where the story of our DPVG hydraulic pump family begins – a universal building block that functions like a custom key, unlocking endless possibilities in drive technology.**

Now, picture a modular system, where every part fits together perfectly, each piece precisely where it's needed. That is the DPVG family: A versatile hydraulic pump that stands out for its reliability, modularity and durability. More than just a component, it adapts effortlessly to diverse machinery and drive types, making it the ideal solution for multiple industries.

Our axial piston pump for closed circuits does not only impress by its hydrostatic swashplate bearing, but also by the load-independent stability of its rotary group. It is ideally suited for closed travel and rotary circuits, such as those in wheel loaders, bulldozers, shredders or crawler excavators with dynamic load changes. It is also well-suited for work, drilling and winch drives, and is widely used across construction, agriculture, forestry, recycling, mining, machinery and plant construction or maritime industries.

The secret to its longevity lies in the hydrostatic swashplate bearing, which minimises mixed friction and causes significantly reduced material wear. Compared to conventional rolling element bearings, which have a lower lifespan, the DPVG pumps are highly resilient. With years of proven performance in both our applications and your machines, they impress with their high reliability and robust design. Additionally, a special “ELS” controller (electric proportional control with a safety valve) ensures the pump's swivelling back to its neutral position in any operating condition. This enhances safety in both field and on-road applications.

With the DPVG hydraulic pump family, you are equipped for any challenge. These pumps are built to withstand tough conditions, while offering the flexibility to adapt to the unique requirements of diverse machines. Rely on the strength and precision of the DPVG series – the ultimate solution for your demanding drive technology needs.

Our axial piston variable displacement pump DPVG 280 for closed circuits features a hydrostatic swashplate bearing.



Our DPVG hydraulic pump family offers diverse application possibilities and is suitable for various types of drives.



# Same as new, only better

**The art of remanufacturing: Where efficiency, sustainability and quality must go hand in hand, remanufacturing offers a solution that unites these exact requirements.**

As our customers, you place the highest demands on your machines and components, and the same expectations apply to spare parts. When these parts are available quickly – affordably priced and sustainably produced – few needs remain unmet. While this may sound almost too good to be true, it's achievable through a unique production process: remanufacturing.

In simple terms, the latter involves taking used components like engines, gearboxes or hydraulic pumps and completely disassembling them. Afterwards, each part is

cleaned, inspected, reprocessed, if necessary, and reassembled with the goal of reusing as many parts as possible. The reuse of parts, especially those with substantial mass, results in lower material costs and a significant reduction in the raw materials needed for new production. This has a highly positive impact on the environment and climate: The recycling rate of these high-mass parts achieves over 60% CO<sub>2</sub> savings compared to manufacturing new parts. Even factoring in scrap and unusable parts, the savings remain at over 50%.



With remanufacturing, we focus on sustainability: Over 50% CO<sub>2</sub> savings by reusing heavy components – a win-win solution for both the environment and the economy.

In arc furnaces, scrap is transformed into high-quality reinforcing steel.



Consequently, you benefit from remanufacturing in multiple ways. One good example is BSW, die Badische Stahlwerke GmbH, from Kehl. It is the only steel producer in Baden-Württemberg (Germany), who manufactures more than two million tons of steel annually with its approximately 850 employees, using modern electric arc furnaces. The company produces high-quality reinforced steel, like bar steel and wire rod for the construction industry. Seven Liebherr machines are diligent in operation at its facilities directly on the Rhine River, among them are four material handlers of the LH 80 and LH 110 series, two crawler excavators R 924 and R 934, as well as a wheel loader L 566 XPower.

For the maintenance department of BSW, remanufactured machine components are an indispensable factor for both economically and ecologically sustainable operations: "In Europe, and especially in Germany, we are on a transformational path towards producing 'green' or emissions-neutral steel," explains a representative at BSW. He notes that this transformation goes far beyond steelmaking.

In fact, many key elements enable sustainable steel production: In addition to the large-scale installation of photovoltaic systems on the company buildings and the planned

feeding of waste heat into the district heating system of the city of Strasbourg, the internal handling of goods is an important factor.

"We produce around the clock, therefore smooth workflows are essential. In maintenance, we rely on Liebherr's remanufactured components. On the one hand, they offer the same quality at a lower price as compared to new parts and are available on short notice. On the other, they fit seamlessly into our environmental and sustainability philosophy for the 'steel mill of the future'. We try to keep our ecological footprint as small as possible."

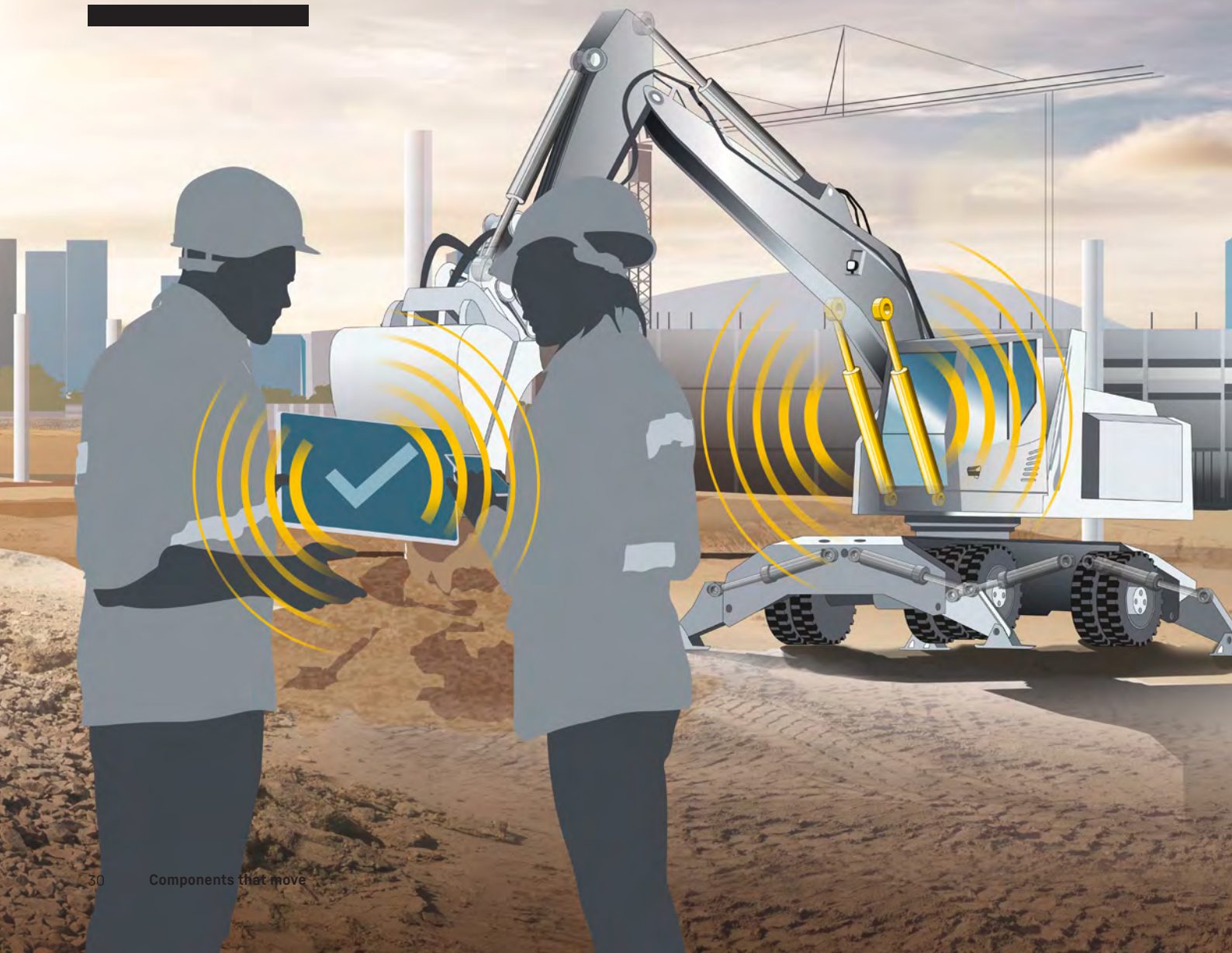
Speaking of fitting: The raw materials used by BSW come 98% from steel scrap, which may even contain some non-installable parts from our remanufacturing programme. And what about BSW's byproducts? These are fed back into the production process or reused as environmentally friendly materials in other applications. For example, the mineral content of furnace slag can be applied as highly durable material in road construction. This is high-level recycling.

All in all, by using our remanufacturing programme, steel re-production in Kehl makes a valuable contribution to a sustainable circular economy.

Chapter 3: This is how we live digitalisation

# The digital construction site of tomorrow

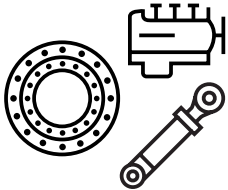
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# Our hardware and software for every ecosystem – your added value

From single components like digital cameras to complete IoT solutions for component health monitoring, we have a comprehensive portfolio in store for you. We are always very close to the topics that move the world of construction machinery – from a connectible component equipped with a sensor up to a full integration into existing applications. The main idea thereby is always to generate useful information from the raw data and make it available, where it is needed, in order to add value to your processes. Our modular solutions can be easily integrated into your ecosystems by using

standard and state-of-the-art technology. We develop these solutions in close cooperation with you and are on your side as a competent development partner with a rich portfolio of products and services. One thing is clear – active and effective use of your data brings immense advantages with it. Collecting the right data, evaluating and combining it with domain-specific expertise leads to the optimisation of work processes and provides a clear competitive advantage.



## **Connectable components**

Our components generate the required data due to the integrated sensors, anytime and anywhere.



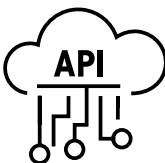
## **Data collection and transmission**

Our proven edge devices collect and transmit the data according to all your data security and quality requirements.



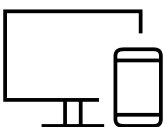
## **Data analytics and action recommendation**

Our vast expertise in the development of components allows us to interpret the collected data after cleaning and processing. In-house developed algorithms detect anomalies at an early stage and generate valuable information and recommendations for action.



## **Information provision**

The generated information is available via different interfaces – push, pull, stream – exactly when and where you need it. Thereby, compliance with standards and data security, as well as compatibility with your systems is our top priority.



## **User interface**

We deliver the data ready to consume and easy to integrate. The decision about the front end is entirely up to you – from a microservice that your application uses, an e-mail that is sent to the right address through to a complete application.

# Digital products and services

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**With the digitalisation of a construction site, efficiency and productivity rise, leading, in turn, to growing complexity. This results in the increasing demand for more efficient resource and process management.**

And this is exactly where our digital solutions come into play as enabler for users to do their best possible job. They do not only provide for greater efficiency and safety on a job site, but also cover a wide range of applications and industries besides construction – from agriculture or municipal machinery up to mining. And as work environments grow rougher, dustier or shakier, you'll always be able to rely on the quality of our components, the sensors and generated data.

## Plan: anticipating your daily business

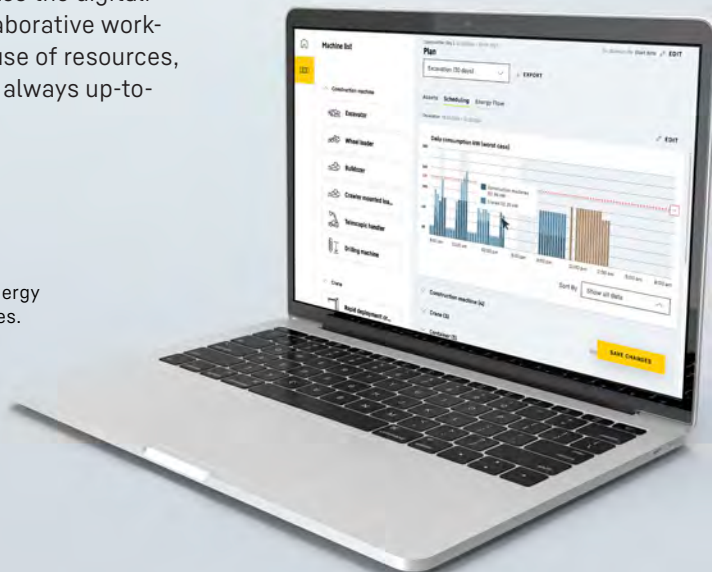
In an increasingly electrified world, effective planning is essential for the success of any project. As construction sites shift towards battery-powered machinery, it becomes crucial to anticipate energy consumption, to ensure efficient, reliable power and charging management. Enter our **Energy Planner**, a cutting-edge tool that enables energy planning on construction sites.

As a browser-based tool, it is designed to holistically plan and optimise all energy and performance requirements of a construction site across various trades and construction phases. It provides a comprehensive solution for managing and monitoring power consumption, as well as the setup of a construction site to ensure reliable, cost-efficient planning and smooth workflows. The tool offers you a cross-brand library of construction equipment from different manufacturers, including diesel-electric, diesel-hydraulic, as well as fully electric machines, and enables the digitalisation of the planning process within a collaborative working environment. This guarantees efficient use of resources, the avoidance of duplication of work and an always up-to-

date planning status. Moreover, the energy planner stands out by generating solution proposals based on both historical and current data, enriched by our extensive process and machine know-how. The tool even supports the integration of charging processes for battery-powered equipment, ensuring that power demands are met efficiently while reducing downtime.

In a future world where every watt counts, the Energy Planner enables project developers and construction managers, like yourself, to optimise their resources in operation, to minimise energy waste and reduce costs. By planning ahead and relying on data-driven insights, we help you to work smarter, not harder.

Our Energy Planner offers energy planning on construction sites.



# Construction site operation: precision in real-time

Our digital solutions are not just limited to the planning of resources and processes; they are vital when supporting machine operators, like yourself, in your day-to-day tasks. For those managing large and complex machines – whether wheel loaders, excavators or dump trucks – visibility is often restricted, sometimes causing delays in the work process. Challenging site conditions, such as changing light, vibration and temperature fluctuations make things even more difficult. In the worst case, poor visibility can lead to personal injury or property damage.

Our **digital cameras** and **camera-monitor systems** offer you increased work safety by providing you with sharp HD images in all lighting conditions. Whether it's a rear-view or side-view camera, or a 360-degree surround view system, our advanced camera technology helps you to quickly and accurately identify people and objects in their working environment. The sharper the camera image, the easier and more comfortable it is for you to manoeuvre the machine. And the application areas of our digital cameras go even further. The sharp images create opportunities to optimise the use of your resources, even outside of the machine. In combination with other sensors, this information can be processed and analysed in a cloud solution.

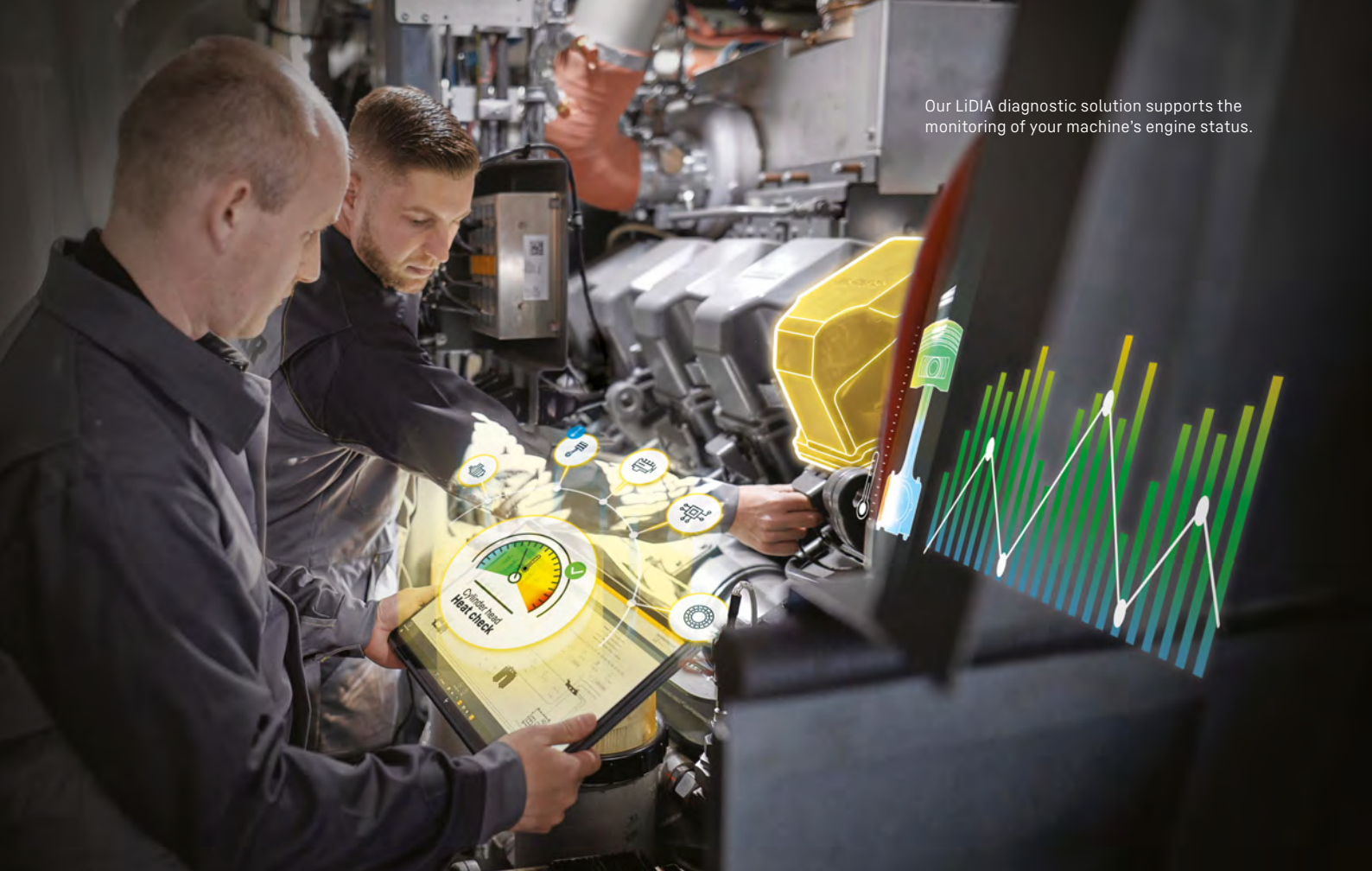


The fourth generation digital cameras combine in-depth expertise in the special requirements of the mechanical engineering industry with over a decade of development experience.

When it comes to the construction site of the future, our **E2E edge gateway solutions** are a game changer. The powerful AI-ready devices enable you to manage machine and process data locally, facilitating continuous improvement and taking machine efficiency to the next level. As a central machine-to-x interface, they also enable data-based IoT applications, such as predictive maintenance, remote operation and machine autonomy. Secure 24/7 operation, over-the-air firmware and security updates are also part of the solution. Thus, you can rely on us in your digital transformation process, no matter what industry you indulge in.



Our edge gateway solutions offer you plenty of future-proof scope in the areas of IoT and AI.



Our LiDIA diagnostic solution supports the monitoring of your machine's engine status.

## Maintain: proactive care for maximum uptime

In industries, in which machinery endures extreme stress, diagnosis, constant condition monitoring and predictive maintenance are key to reducing downtime and ensuring maximum uptime and equipment availability. Our solutions step in to provide foresight and early damage detection, allowing you to monitor wear parts and the components in real time, thereby minimising costly breakdowns.

Our **bearing clearance monitoring (BCM)** system, for example, revolutionises the way wear on slewing bearings is tracked. Instead of relying on manual measurements in hard-to-reach areas, the BCM integrates sensors directly into the slewing bearings, providing wear data. This does not only enhance safety by reducing the need for technicians to work in hazardous conditions, but also cuts downtime by up to 75%. Be it our stand-alone solution with the integrated sensors and the web-based app with offline functionality or the software integrated solution, in which wear-calculation is integrated into your control system, continuous monitoring leads to early problem detection, longer bearing life and lower maintenance costs.

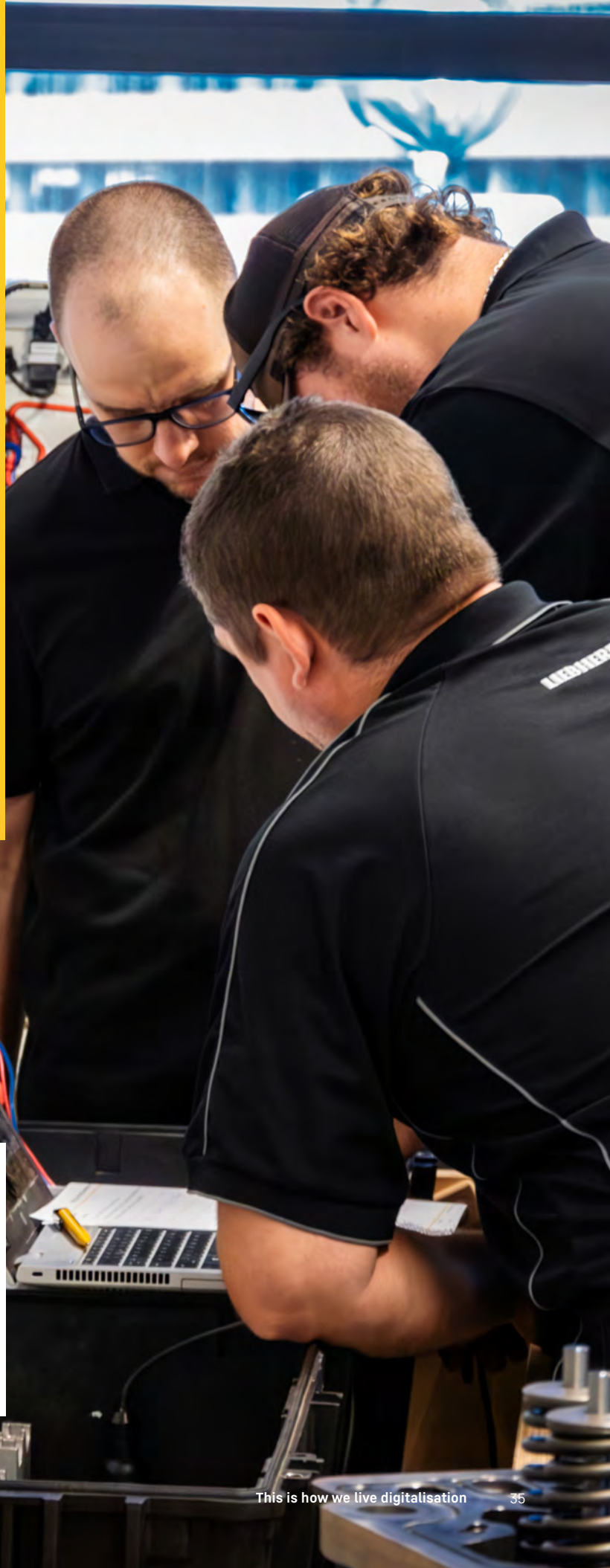
Talking about predictive maintenance solutions, our **LiDIA tool** supports remote diagnostics of the machine's engine. It offers a quick overview of the entire information on the engine system, including status, diagnostic trouble codes, limitations and failure reactions. Such guided diagnostics provides a "hands-on" support for problem resolution. LiDIA does not require any configuration and simplifies diagnostic procedures to the essentials, offering a quick, holistic view of the entire engine system. Whether it's monitoring engine performance or troubleshooting complex issues, LiDIA puts the power of expert diagnostics in your hands.

## Train: empowering your workforce

In a rapidly changing digital landscape, well-trained personnel are key to your operational success. Therefore, we offer web-based training programmes for combustion engines along with instructor-led trainings. These are designed to keep your team up to date on the latest technologies, including the fundamentals of combustion engines. Your benefits include accessibility and flexibility, as training modules are always available online, allowing participants to access them anytime, from anywhere. The courses are short or divided into sequences, making learning more manageable, while offering cost efficiency by saving both time and travel expenses. This learner-centred approach empowers employees to learn at their own pace, without interrupting daily operations.

Our Liebherr Training Academy also offers courses at multiple levels for the entire components portfolio, tailored to both newcomers and seasoned professionals. This ensures that your workforce is always prepared to operate and maintain equipment effectively, no matter how complex the technology becomes.

From planning and operation over to maintenance and training, our solutions enable your digital transformation, laying the groundwork for a safer, more precise and efficient operation on most demanding job sites. By providing a comprehensive digital toolbox, we make sure you're not just staying up to date with technological advancements, but are setting the pace.



Chapter 4: More than meets the eye

# Projects that excite

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# Driving visions forward

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## Our component solutions for Fortescue's ambitious zero-emission goals

**With the largest contract in its 75-year history, Liebherr is setting a strong course for the future. On September 24, 2024, at MINExpo in Las Vegas, Liebherr and the global technology, energy and metals group Fortescue signed a groundbreaking agreement. This contract does not only entail the joint development of innovative machines, but also the delivery of 475 Liebherr machines in total to Fortescue. It marks a pioneering partnership committed to a greener future. Fortescue, one of the world's leading iron ore producers, aims to drastically reduce its CO<sub>2</sub> emissions by 2030. This vision goes beyond renewable energy sources, like wind or solar power, and includes deploying Liebherr's cutting-edge mining technology.**

At the heart of this visionary project is Fortescue's shift to battery-electric machines. Liebherr will supply 360 autonomous, battery-electric T 264 mining trucks, 55 electric R 9400 E mining excavators and 60 battery-powered PR 776 dozers. These vehicles will replace a significant portion of Fortescue's current diesel-powered fleet, contributing substantially to the reduction of CO<sub>2</sub> emissions. The core of this transition is a zero-emission battery system developed by Fortescue Zero, the company's technology division. Initially, this innovative system will be deployed in the mining trucks, with plans to extend it to other Liebherr machines like the PR 776 dozer. Fortescue's long-term goal is to make this emission-free mining ecosystem available across the industry, reshaping the future of global mining sustainably.

These forward-looking machines and their components will be manufactured and supported by several Liebherr Group sites in Germany, Switzerland, France, Austria, the USA and Australia. Every detail of the machines and their key components, from electronics to mechanical parts, will be carefully developed, produced and later maintained. This €2.5 billion contract is not only a milestone for Liebherr – it also brings economic stability and predictability not only to the company, but also to its employees at these production sites.

Mining environments expose machines to extreme conditions, including heat, dust and high wear. At Liebherr, we emphasise developing robust, durable components capable of withstanding such demanding conditions.

For example, at our component site in Switzerland, we manufacture various hydraulic pumps and motors for the electric excavators and dozers. Our plant in Oberopfingen, southern Germany, supplies shock absorbers and a range of hydraulic cylinders, including hoist, steering, feed and tilt cylinders. Electronic components are manufactured at our facilities in Biberach an der Riß and Lindau (Germany). The mining trucks are equipped with switchgear, including power electronics developed in-house, software and electric motors. Our e-motors and power electronics are also installed in the dozers, while switchgears for the excavators are produced in Biberach.

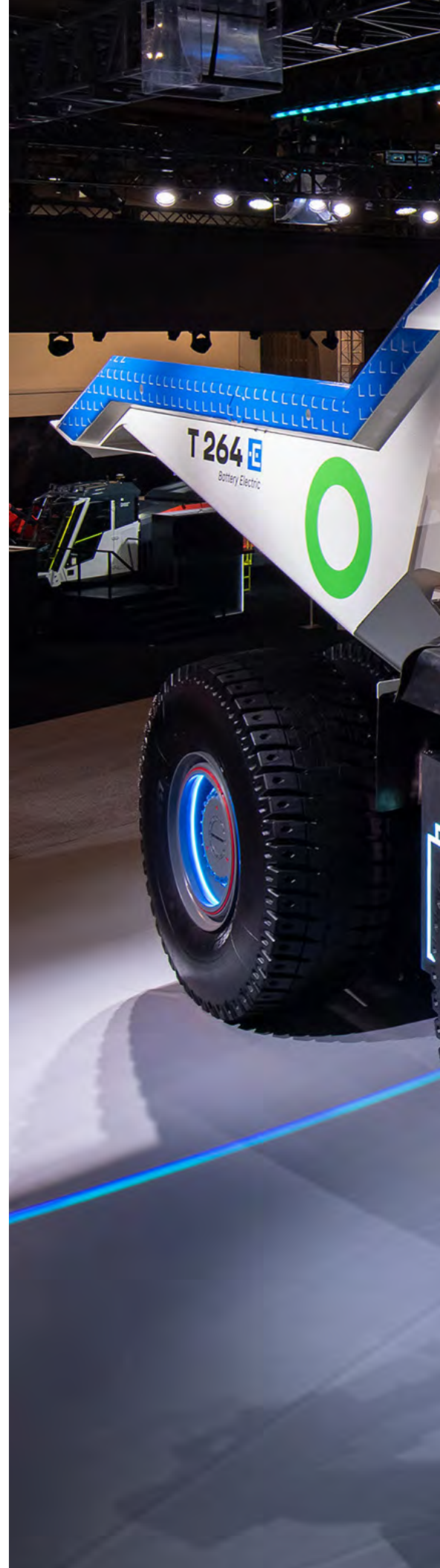
Furthermore, we produce 55 robust and reliable slewing bearings for the R 9400 E mining excavator at our Biberach site. These roller bearings can be optionally equipped with the bearing clearance monitoring (BCM) system, enabling simple, fast and safe wear measurements of the bearings. These technological advancements showcase our forward-thinking approach to meeting both current and future requirements.

A centrepiece of the project is our drive technology from Biberach, which ensures that these massive machines can move as intended. For the T 264 mining trucks, we manufacture wheel drives (RAD1100), front wheels (FRW240) and brakes, along with electric motors, frequency converters and complete control technology, guaranteeing smooth and efficient truck performance.

Roland Widmann, head of development at Liebherr drive technology, explains: “The uniqueness of our mining trucks is that they have always been designed with electric drives; we’ve never had a purely mechanical solution.” Despite the strong focus on zero-emission goals, machine productivity and availability remain central. “By switching to fully battery-electric drives, we even expect performance improvements – especially in uphill driving, which will result in higher gearbox utilization,” adds Widmann. “Through continuous development, particularly in terms of gear quality, sealing systems and brakes, we have been able to further optimise gearbox lifespan.”

Alongside wheel drives for the trucks, our drive technology department also produces key components for other machines supplied to Fortescue. The R 9400 E mining excavator receives FAT1050 travel drives for the crawler undercarriage and SAT450 slewing drives for rotating the upper carriage. The PR 776 dozer is equipped with state-of-the-art drive technology, receiving the FAT800 travel drive. These components are the result of our vast research and development expertise, ensuring maximum reliability and performance.

Together with Fortescue, we expect to create one of the world’s largest zero emission mining fleets by 2030. This is a crucial step toward decarbonising the entire industry and underscores Liebherr’s leadership in advancing off-highway and heavy-duty machinery. Supported by Fortescue, Liebherr is also pursuing the goal of offering fossil fuel free options for its entire mining product line by 2030 – a clear commitment to a more sustainable future.





***“The uniqueness of our mining trucks is that they have always been designed with electric drives; we’ve never had a purely mechanical solution.”***

**Roland Widmann**

Head of development at Liebherr drive technology

# At the core of Europe's largest lifting swing bridge

With its impressive five-metre roller-ball bearing, our Liebherr team has created a slewing bearing that will soon set Europe's largest lifting swing bridge, the Friesenbrücke, in motion. This bearing is designed to rotate the central bridge section, which measures 145 metres in length and weighs 1,800 tons. It is part of a project commissioned by Deutsche Bahn. The bridge will span the Ems River near Weener, Germany, and rotate 90 degrees to allow ships to pass through.

This 12.5-ton core component was engineered to meet the stringent demands of infrastructure projects of this scale. Designed for a service life of 100 years, this engineering marvel has been meticulously validated by our engineers through finite element (FE) analysis. The roller-ball bearing is built to withstand around 1,850 rotations annually, while maintaining efficiency and safety.

This is what our slewing bearings and pinion look like when installed. Image © eberhardt-die-ingenieure-GmbH



Friesenbrücke –  
visualisation of the  
new construction

The Friesenbrücke itself will play a vital role along the railway route between Groningen (the Netherlands) and Bremen (Germany) and will be accessible not only to trains, but also to pedestrians and cyclists. "At a total length of 335 metres, the Friesenbrücke is Europe's largest swing bridge today," explains Alexander Volgmann from Deutsche Bahn. "This prestigious structure is made possible by the sophisticated machinery behind it," Volgmann sets forth.

"The rotation is achieved through a lifting and rotation mechanism, where the bridge's central section is first unlocked and slightly lifted before being rotated, using a hydraulic drive and the slewing bearing," further explains Karl Völkl of Hermann GmbH Maschinenbautechnologie, the provider of the bridge's rotating pillar.

### **Durability and protection for decades**

To withstand harsh environmental conditions, the slewing bearing is treated with a C5 coating that provides corrosion protection and ensures durability, even in maritime settings. Another key feature is the integrated bearing clearance monitoring system, which continuously measures wear on the bearing's raceways. "Our sensors are directly integrated into the bearing, allowing for precise condition monitoring. This enables maintenance to be scheduled efficiently before any serious wear occurs," explains Michael Sander, technical sales engineer at Liebherr-Components in Biberach (Germany).

Thanks to this digital innovation, measurement data can be seamlessly integrated into the customer's systems. To enable user-friendly integration without additional gateways, we provide a special code," Sander sets forth. "This reduces the system complexity and enhances operational safety."

The Friesenbrücke as it's being completed.  
Image © DB InfraGO AG



# Reaching for the stars

**Mtex antenna technology GmbH and our Liebherr components product segment join forces to provide the next generation Very Large Array antennas (ngVLA). The ngVLA site will be the largest radio astronomy facility of the National Radio Astronomy Observatory (NRAO) in the Northern Hemisphere, with stations throughout New Mexico, Texas, and Arizona.**

Humanity has always been captivated by the stars, driven by an insatiable curiosity to understand the universe and our place within it. From ancient astronomers charting celestial paths with the naked eye to modern scientists employing sophisticated technologies, the quest to unravel the cosmos has accelerated our progress and expanded our horizons. Today, at the forefront of astrophysical research, driven by remarkable scientific breakthroughs, the development of the next generation antennas is taking shape. "The ultra-sensitive imaging capabilities of these groundbreaking instruments allow us to have an unprecedented look into space and help unlock the secrets of the universe," explains

Lutz Stenvers, managing director of mtex antenna technology GmbH. The new antennas, boasting a diameter of approx. 18 metres, will be positioned in a clearly defined pattern throughout North America. The area with a total of 244 antennas will ensure optimal data reception from the cosmos.

"Cutting-edge technology, precision engineering and a tireless commitment to scientific discovery, rockets the project to the forefront of astrophysical research," continues Lutz Stenvers. "And Liebherr's components take over an important role in this."



Live-view of the  
Very Large Array  
antennas (ngVLA)

© NSF/AUI/NSF/NRAO

Image © NSF/AUI/NSF NRAO/S.Dagnello

### **Precision: the seamless synergy of three elements**

Crucial for the operation of an ngVLA are our components installed therein – a slewing bearing, two gear ring segments, two azimuth drives and four elevation gearboxes. The slewing bearing is used for azimuth adjustment of the antenna to enable its precise positioning. This roller bearing has a diameter of approx. 3.3 metres. Its weight of 4,128 kg provides for more stability. Also, its axial runout of 0.1 mm and radial runout of 0.05 mm plays a decisive role, when it comes to precision. Our slewing bearing is designed to be free of backlash, making it ideal for adjusting the azimuth of the antenna.

As a complimentary feature to the slewing bearing, the gear ring segments are of great importance for the elevation adjustment of the antenna, meeting the high demands on the gear quality. The two gear ring segments, each positioned on the sides of the horizontal antenna rotation axis, ensure its exact elevation adjustment.

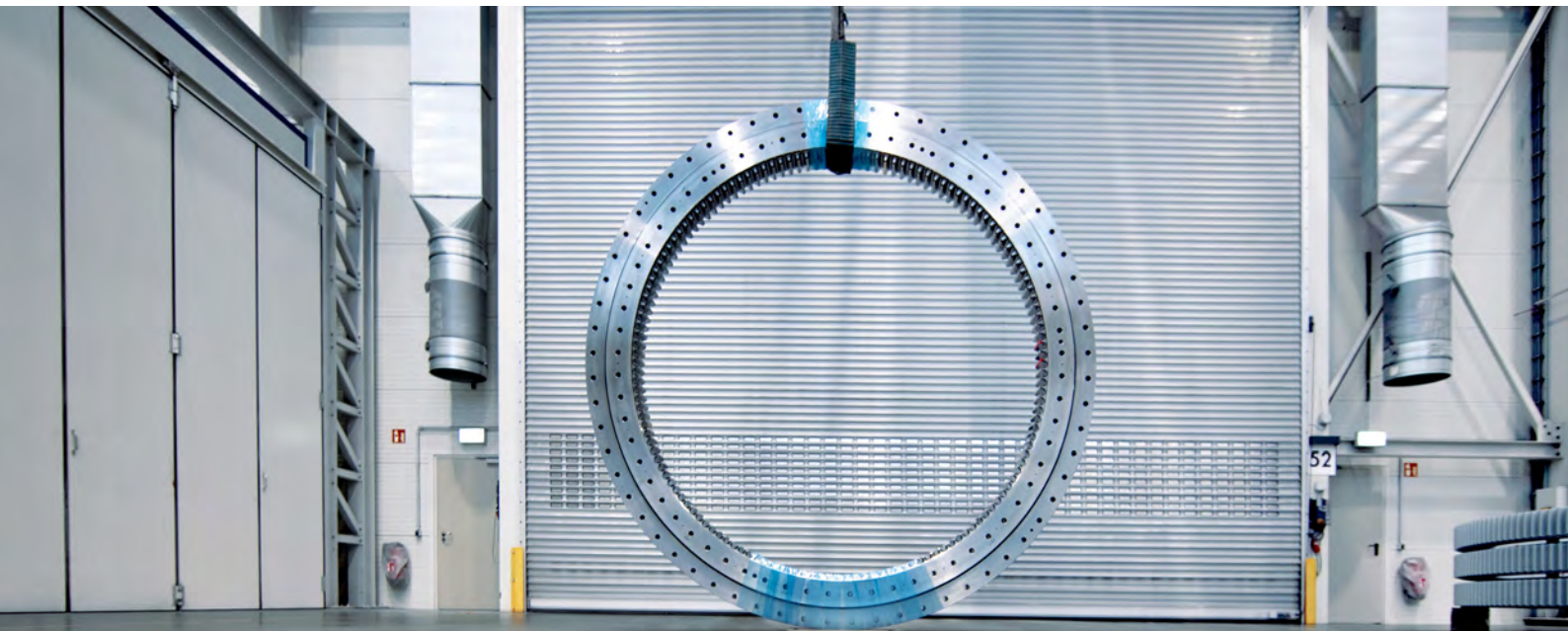
In addition, the interaction of the azimuth drives with the slewing bearing enables a high degree of precision, with which the satellite systems rotate around the tower axis. The key is a low torsional backlash, as well as increased stiffness of the planetary gearboxes. These optimisations make the adjustment mechanism of the entire system operate with maximum accuracy, targeting precise positioning in the long run.

The elevation adjustment, which is responsible for the inclination of satellite dishes, uses drives of the same size and technical improvements as the azimuth adjustment. However, due to the different installation positions of the azimuth and elevation gearbox, the transmission ratio, the motor flange and the drive shaft have been adapted. The interplay of the two adjustment systems is indispensable for exact antenna alignment.

### **Rigorous testing as a prerequisite for success**

Prior to market introduction, our Liebherr team subject the bearing prototypes to comprehensive testing. To ensure the precision of the azimuth bearing, there is the so-called 'wobble test'. Our team at the site in Biberach (Germany) approaches selected positions several times, in order to measure and guarantee the greatest possible accuracy during operation.

Extensive prototype tests were also necessary to ensure that the azimuth and elevation drives do not only meet, but exceed highest industry standards. In particular, the rigidity of the drives was tested and verified, in addition to other points. The expertise built up over decades is crucial for the symbiosis of the slewing bearing, gear ring segments and slewing drives as a unit. Committed to the development of precision engineering and innovation, both teams at Liebherr and mtex antenna technology shape the future of satellite systems and push forward satellite positioning technology.



Our slewing bearing along with the drives ensure precise azimuth positioning of the antenna.

# Achieving peace of mind

## How we support you with comprehensive services

**At Liebherr, we believe that delivering top-quality components is just the beginning of a partnership. Our goal thereby is to provide comprehensive solutions that ensure your machinery operates at peak performance throughout its entire lifecycle, offering what we call “peace for the whole life.”**

This commitment is fulfilled through our range of services designed to meet the highest industry standards, allowing you to focus on your core business with confidence.

At the heart of everything we offer is our commitment to quality. Our components are engineered to meet the most stringent requirements across various industries. Whether you are in construction, mining or energy business, we provide the reliable, durable parts – from an injector up to a complete combustion engine – you need to keep your operations running smoothly.

### **Specialised training and documentation**

We know that knowledge is key to long-term success. That is why we offer extensive product and service training, available both in-house and on-site, as well as via e-learning and web-training. Whether you need standard programmes or tailored courses, our training services help your team master the components and systems you are working with. Our “train the trainer” concepts ensure that your in-house experts can pass on their knowledge effectively, empowering your entire organisation.

### **Tailored warranty solutions**

Liebherr's customer-focused approach extends to our warranty offerings. We understand that every business has unique needs, so we provide tailored warranties to suit your specific requirements. With advanced tools for managing warranties and a global presence, you can be assured that we are ready to support you wherever you are.

### **Technical service you can count on**

From commissioning to field interventions, our technical service offerings are designed to provide full lifecycle support. Our highly trained technicians are available for inspections, analysis and repairs – both in-house and on-site. With our multilingual technical support, we make sure that you get the help you need, no matter where your operations take you. Did you know that we even have “flying doctors” who can be dispatched to address urgent issues?

### **Spare parts support at your fingertips**

At Liebherr, we pride ourselves on having a high-end central warehousing system, ensuring that over 97% of spare parts are readily available. We offer comprehensive spare parts support, from consulting and stock analysis to easy order tracking and availability tools through our EDI connection and e-commerce systems. Whether you are just starting or need ongoing parts supply, we've got you covered.

### **Special service offerings and solutions**

For those of you looking for tailored service solutions, we offer a range of specialised services, from lifecycle cost calculations to the development of service networks. We also provide support with diagnostic tools and license management, ensuring that you have everything you need to maintain and optimise your machinery's performance.

### **Remanufacturing and repair: extending the life of your components**

Our Reman programme is about giving new life to used components. Through remanufacturing, we restore worn parts to like-new condition, contributing to sustainability and cost-efficiency. With Reman as an alternative to new parts, we are able to achieve lower life-cycle costs from 25 % up to 50 %. Reduction of environmental impact and CO<sub>2</sub> emissions is another benefit: More than 75 % of material and 50 % of CO<sub>2</sub> can be saved as compared to the production of new parts. And as mentioned before, short-term delivery and long-term supply of spare parts even for older machines are guaranteed thanks to our central warehousing.



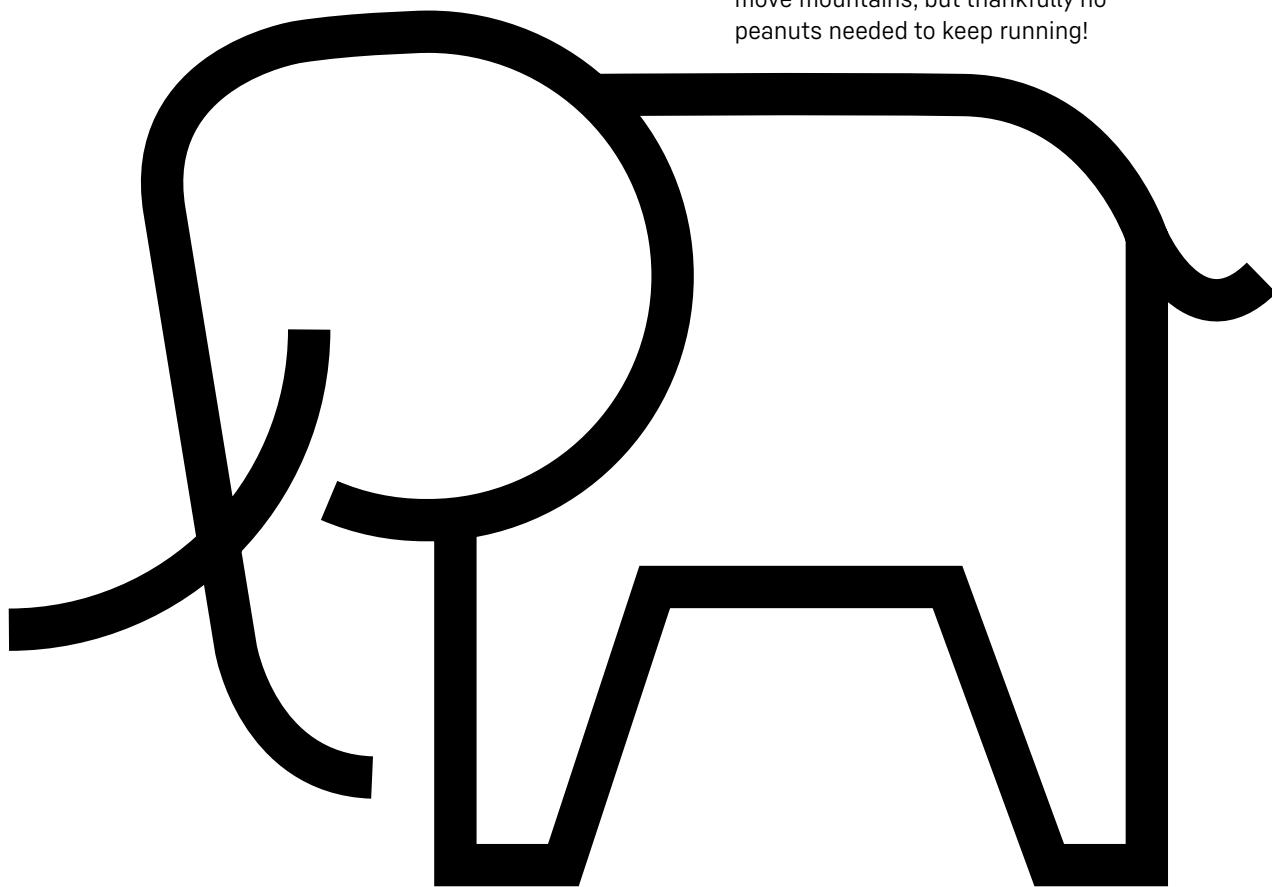
Our comprehensive services ensure your machinery operates at peak performance throughout its entire lifecycle

To sum it up, with a global presence, tailored offerings and a customer-first philosophy, we are more than just a service provider. We are your partner in success. From high-quality components to comprehensive after-market services, we provide the support you need, whenever and wherever you require it.

# Fun Facts

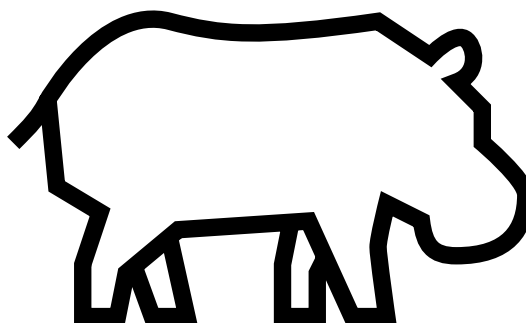
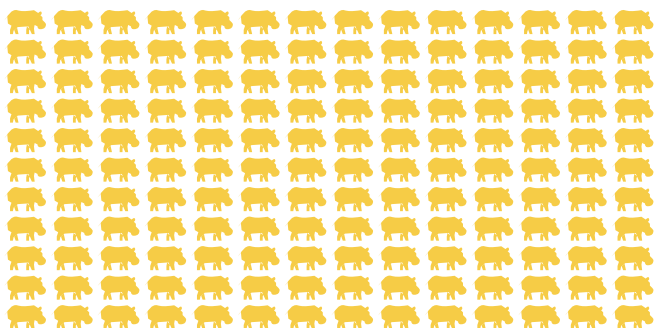
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Our **D9812 engine** weighs as much as a full-grown elephant – strong enough to move mountains, but thankfully no peanuts needed to keep running!



Our heaviest **slewing bearing** weighs as much as 155 hippos combined, tipping the scales at an astonishing weight of

## 214,500 kg



# 10

**soccer fields** – that's the size of the production space in Oberopfingen (Germany), where we expertly craft our hydraulic cylinders.

---

Our **rope winches** can hoist

# 3,000 t



to an altitude of 220 metres. Basically, that's like lifting 15 blue whales to the top of the Eiffel Tower!

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# 30,000

**gearboxes** leave our drives production sites every year, making their way to customers around the globe.

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Over its impressive lifetime, an LI3 injector has the capability to fill an entire **swimming pool** with an incredible capacity of

# 500,000 l



Our DPVG 280 hydraulic pump could fill

# 35

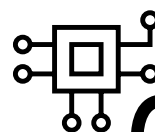


**in one minute.** Enough to keep a few Oktoberfest tents really happy!

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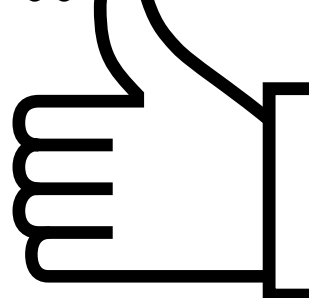
Our **smallest** electronic component, mounted on a printed circuit board, is so small, you could fit about

# 400



of them on a **single thumbnail.**

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By remanufacturing just one engine, we save enough CO<sub>2</sub> to cover a **roadtrip of**

# 4,200 km

That's like driving from Munich all the way to Cairo!

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We are a team of more than

# 50,000

**employees**, highly dedicated to a shared passion that is shaping the world of tomorrow.





Find out more about our components at  
**components.liebherr.com**



[https://www.linkedin.com/  
showcase/liebherr-components/](https://www.linkedin.com/showcase/liebherr-components/)



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