



Innovations for Sustainable Mobility



MAHLE is a leading international development partner and supplier to the automotive industry with customers in both passenger car and commercial vehicle sectors. Founded in 1920, the technology group is working on the climate-neutral mobility of tomorrow, with a focus on the strategic areas of electrification and thermal management as well as further technologies to reduce carbon emissions, such as fuel cells or highly efficient, clean combustion engines that are powered by renewable fuels, such as biofuels, hydrogen, or e-fuels.

MAHLE generated sales of €11.3 billion in 2025. Employing around 64,000 people at 127 production locations and 11 technology centers, the company is represented in 28 countries.
(As at: December 31, 2025)

#weshapefuturemobility

Dear readers,

MAHLE believes that technological diversity is and remains the most promising way to reduce greenhouse gases in the transportation sector.



Arnd Franz
Chairman of the MAHLE Group
Management Board and CEO

While we are fully committed to electrification, current market developments in many regions of the world show that we need to think beyond purely battery-powered vehicles for fast-acting climate protection. Hybrid solutions and innovative range extenders play a crucial role for customers to ease their transition to e-mobility.

The challenges are particularly great in the transport industry. Time and energy are scarce, valuable resources. Only those who work economically survive. With its electrification products, MAHLE is helping to make heavy-duty trucks more efficient and flexible and to reduce operating costs. Our latest range extender system for battery-electric trucks combines the sustainability of the electric drive with the flexibility and cruising range of the combustion engine. MAHLE stands for “electrified, efficient and economical”.

Renewable fuels are indispensable for reducing CO₂ emissions in road transport; we should start using them without delay. MAHLE technologies that are ready for series production make it possible to use hydrogen and biofuels now. With its focus on electrification, thermal management and sustainable combustion engines, MAHLE is excellently

positioned to meet the needs of all relevant commercial vehicle, passenger car and engine manufacturers worldwide. With our Tech Centers and plants, as a reliable and innovative partner with over 100 years of industrialization experience, we are present where our customers need us. We are also expanding into industrial and special applications by transferring our highly efficient, high-performance automotive technologies to new areas beyond automotive.

Efficiency is the measure of our actions in a challenging global competitive and market environment: In our products, in order to reduce the use of natural resources and energy and thus also the costs for our customers, and in our Life-cycle and Mobility business unit, to ensure availability and reliable service for independent workshops. In doing so, the application of artificial intelligence is increasingly making us faster, more performant, and more competitive.

MAHLE is on track. On the following pages, you will find out more about how we are shaping the future of mobility.

Contents

About MAHLE

Three Paths to Green Mobility	10
MAHLE Portfolio: For More Efficiency and Speed	12
MAHLE von Site	14
MAHLE—A Journey Through Time	94

Electrification

E-volution With a System Solution	16
Quiet Drives	18
Electric? It Pays Off!	20
The Best for the Electrons	22
Scalable Charging Solutions for Everyone	24

Thermal management

No E Without T	26
Guided by the Intelligence of Nature	28
Climate Specialists	32
Comfort all Year Round	36

Internal combustion engines

Ready for the Future	42
Moving Faster	44
Toward Sustainable Mobility	
Clean Addition	46

Sustainability

On Track	48
Moving Sustainably	50

A holistic approach to mobility

Freedom Ahead:	52
MAHLE SmartBike Systems	
Drive for Every Situation	54
Power from the middle	56
Expansion of New Business Fields	58
Scooters and Commercial Vehicles	60
Reliable Mobility on the Railway Track	62
Peak Performance for Drives and the Environment	64
Large Engine Components	66
Robust All-Rounders	68
Future-Oriented Logistics	70

Research and development

Developing the Future	72
The Street in the Laboratory	76
From Permafrost to Sahara Winds	78
AI Should Serve us.	80
Not the Other Way Round.	
Data: the New Currency for Tomorrow's Mobility	81
The Driving Proof	82
Development Experts—MAHLE Powertrain	84
Drive for the Electrified Future	86

MAHLE Lifecycle and Mobility

Keep Everything Running	89
Workshop of the Future	90
Replacements Are Provided	92

36



24



48



72



42

52



1920

Here's Where it all Began

Today you would probably call it a start-up:

Hermann Mahle joined Hellmut Hirth's Versuchsbau (prototyping center) as commercial manager in 1920. Production started in an inconspicuous workshop in Stuttgart Bad Cannstatt. By the early 1920s, around 200 employees had already produced around 40,000 pistons.





2026

Here's Where the Future Lies

Today, more than 100 years later, a glimpse into the company's automated electronic production reveals: **MAHLE is a technology driver for the mobility of tomorrow.**

Three Paths to Green Mobility

MAHLE is focusing even more strongly on electrification and thermal management as well as components for highly efficient, sustainable combustion engines as these are the strategic future fields of the company. All three tracks have one goal: climate-neutral mobility of tomorrow.

Technological diversity is and remains the strategic approach of MAHLE and the most promising way to reduce greenhouse gases quickly and effectively. In view of the slow ramp-up of e-mobility in many regions of the world, MAHLE considers it necessary to offer other forms of electrification beyond purely battery-powered vehicles, such as hybrid vehicles or range extenders, and facilitate this politically. **The future of mobility is therefore battery-electric and hybrid. This is particularly true for Europe and China.**

Clean and efficient combustion engines and hydrogen drives are also part of the drive mix of the future. This is because developments will vary greatly depending on the region of the world. This applies equally to passenger cars and commercial vehicles. In emerging markets in particular, the market for vehicles with internal combustion engines is expected to continue to grow, for example in India or South America. Here, sustainable fuels such as biofuels will contribute to the rapid decarbonization of road transport.

Our **MAHLE 2030+** Group strategy combines all of the Group's activities in the three strategic fields and serves as the strategic lever for implementing the MAHLE Vision **"We Shape Future Mobility."** At the center of the company's corporate strategy is the MAHLE Mission **"Efficiency in Motion."** Efficiency in Motion means efficiency in everything we do, including in our business processes and in our products, with the clear target of reducing emissions in the global mobility sector as an innovative and strong partner to our customers.

Electrification:

Focus on drive and charging

Between 2026 and 2029, MAHLE technology and products will be used for more than 35 electrified vehicle platforms that will be launched on the market by leading passenger car and commercial vehicle manufacturers. Our strategy is primarily focused on e-driving and intelligent charging. **We electrify all vehicle classes—from e-bikes and scooters to passenger cars and commercial vehicles. MAHLE already sells more than eight million e-drives per year for automotive, industrial, and urban mobility applications.** We are developing not only vehicle-based technologies for charging electric vehicles, but also the infrastructure for wired and wireless charging.

WE SHAPE
FUTURE MOBILITY



A glimpse into the
mobile future: Video
„We Shape Future Mobility“

Open to technology in the future:

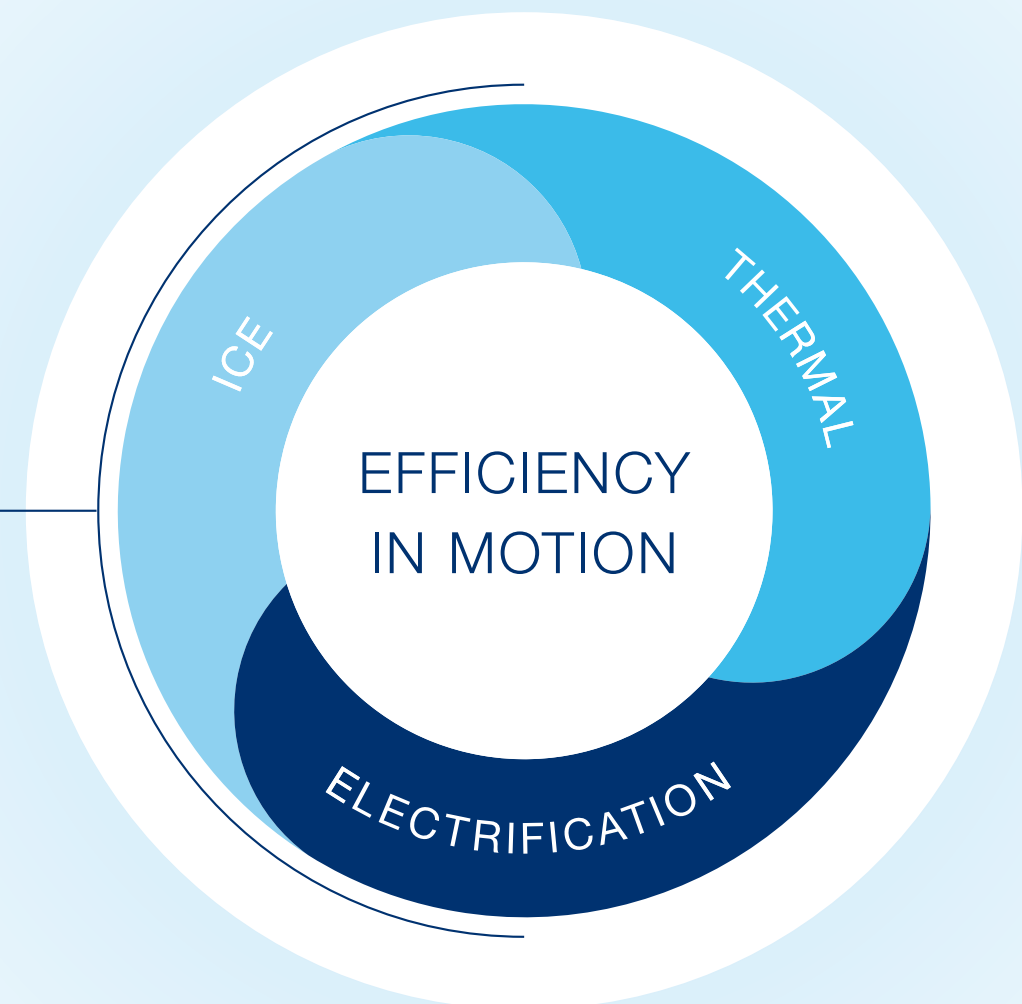
Modern combustion engines

Highly efficient and sustainable combustion engines will remain a relevant factor worldwide for years to come. MAHLE pursues a strategy of cost leadership in components for internal combustion engines and thus remains a reliable partner for its customers. Our lean structures and state-of-the-art products demonstrate our commitment to driving the progress of efficiency. **The internal combustion engine can make an immediate contribution to climate protection with renewable fuels such as hydrogen, biofuels, and e-fuels.** We see potential for the use of fuel cells and hydrogen engines, especially in the commercial vehicle sector.

More climate expertise:

Thermal management

Our in-depth expertise in thermal management, which is an important element of electrification, means we are a technology driver for e-mobility. Our strategy is aimed at further expanding our established status as a systems provider focusing on energy efficiency and air conditioning. **MAHLE is one of the largest suppliers of thermal management systems for batteries, efficient drives, and sophisticated cabin comfort with a global development and production network.**

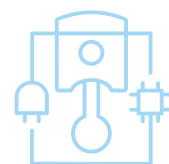


MAHLE Portfolio: For More Efficiency and Speed

The strategy MAHLE 2030+ ensures that MAHLE further strengthens its position as an innovative and reliable partner to its customers in the strategic fields of electrification, thermal management, and components for sustainable combustion engines. As such, we streamlined the Group structure in 2025 in order to become more efficient and faster. The number of business units has been reduced from five to three. Four of the previous business units have been merged into two new ones.



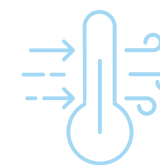
Powertrain and Charging



The **Powertrain and Charging** business unit combines our many years of expertise in conventional motor systems with innovative solutions for e-mobility. We are among the global market leaders in many product categories and offer a broad portfolio ranging from pistons, piston rings, cylinder liners and valve train systems to electric drives, actuators and auxiliary components, as well as control and power electronics. To consistently provide optimal solutions for our customers, we continuously develop our existing product portfolio,

focusing in particular on lowering energy consumption and emissions, the use of sustainable fuels, and the development of innovative Solutions for electric traction powertrains, on-board charging systems, electric pumps, and compressors. Our products are used globally in passenger cars, commercial vehicles, large engines, and two-wheeled vehicles, as well as in electric applications such as forklift trucks, golf carts, electric scooters, and e-bikes.

Thermal and Fluid Systems

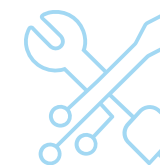


The **Thermal and Fluid Systems** business unit brings together our broad development and manufacturing competences in thermal and fluid management technologies. As one of the world's leading original equipment manufacturers, we position ourselves with innovative solutions in cooling and climate systems, filter technologies, and air and oil management for vehicles and industrial applications. Our portfolio



includes filter systems, engine and transmission oil coolers, cooling and air conditioning modules, and customized, comprehensive thermal management solutions. The products are used in a wide range of applications—from passenger Group management Report cars and commercial vehicles to mobile and stationary machinery in the off-highway area as well as industrial applications. Our products cover the full mobility spectrum, from the optimization of combustion engines to e-mobility and fuel cell technology, and support the transition toward sustainable powertrain technologies. We develop and manufacture complete filter and thermal management solutions for vehicles of all classes with our comprehensive Technology portfolio, and in doing so we actively contribute to the transformation of mobility.

Lifecycle and Mobility



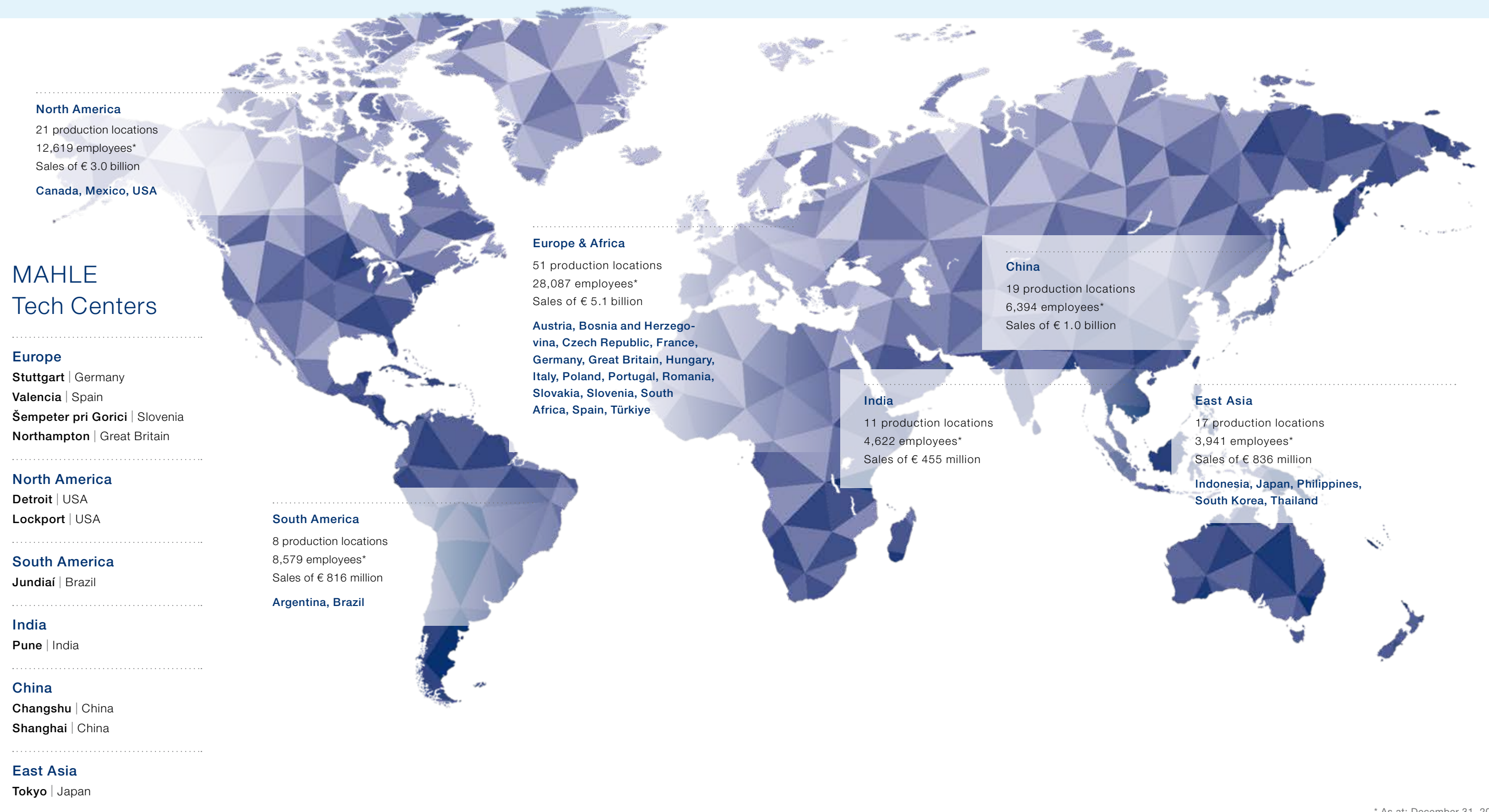
The **Lifecycle and Mobility** business unit supplies partners in trade, workshops and engine repair, as well as e-commerce worldwide with original equipment quality, service equipment and a full range of services. The parts we supply include efficient combustion engine products such as filtration and engine components as well as electronic components and parts for thermal management. MAHLE Service Solutions also supplies applications for workshop equipment such as vehicle diagnostics, battery diagnostics and service, emissions testers and equipment for the maintenance of air conditioning systems and automatic transmissions. The portfolio also includes comprehensive services, such as technical support through our worldwide network, customized training, and service information.

Given the diversity of today's vehicle technologies, we are expanding our service and product range with innovative solutions and positioning MAHLE as a full-service provider for workshops. We offer individual repair solutions and increase efficiency of workshops with demand-oriented product management, reliable logistic and market-driven pricing.



MAHLE on Site

127 production locations
11 MAHLE Tech Centers
64,242 employees*



* As at: December 31, 2025

E-volution With a System Solution

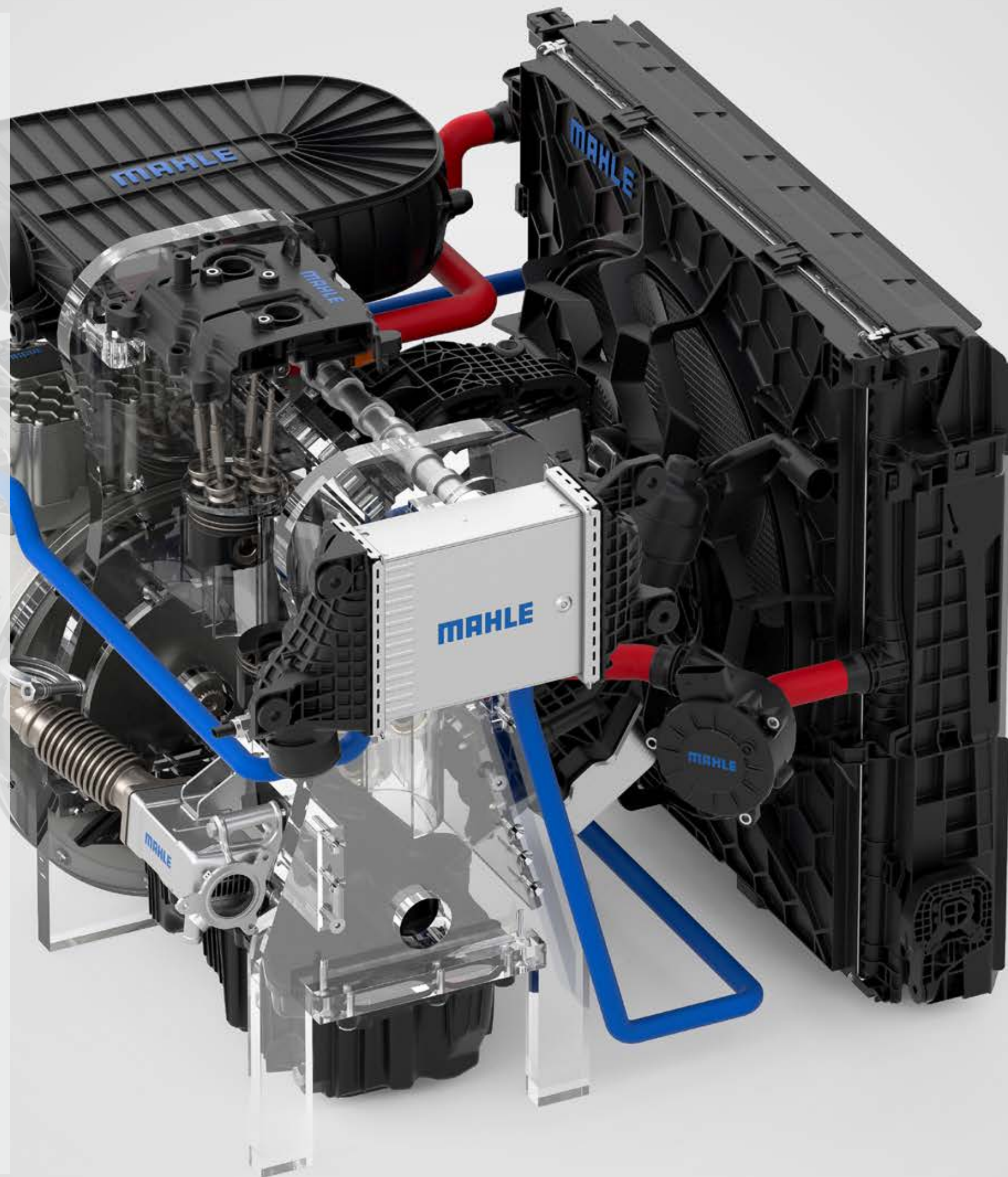
The number of electric vehicles on our roads is growing. Car manufacturers around the world are making further improvements to the technology this development requires. MAHLE is supporting them in this with its decades of experience with electrical, electronic, and mechatronic components from a wide variety of fields.

Range extender system for BEV trucks

more range, more flexibility

Range-extended electric trucks combine the environmental benefits of electric drive systems with the flexibility and range of internal combustion engines. The **MAHLE range extender system** increases the cruising range of battery-electric heavy-duty trucks to up to 800 kilometers. For operators and drivers, this creates additional flexibility in daily driving operations. At the same time, the system reduces CO₂ emissions by more than 80 percent in comparison with classical powertrains.

With a continuous output of 110 kilowatts and a peak output of 130 kilowatts, the high-voltage generator reliably supplies the drive with power even when fully loaded. The compact unit, comprising the generator, internal combustion engine, thermal and fluid management systems, fuel tank, AdBlue tank, and exhaust aftertreatment system, can be easily integrated into existing BEV platforms. The system replaces approximately one-third of the battery capacity of a conventional BEV truck, allowing the vehicle to be equipped with a correspondingly smaller battery pack. As a result, around 400 kilograms of rear axle load and approximately 600 kilograms of total vehicle weight can be saved.



Quiet Drives

Range extender system for passenger cars takes electric cars further

Battery-electric vehicles (BEV) with range extenders are becoming increasingly popular as an alternative to pure BEV. The range extender for battery-electric cars from MAHLE consists of a **particularly efficient high-voltage generator** driven by a compact internal combustion engine. **It engages as an energy supplier when the electric charge of the vehicle battery is exhausted, therefore ensuring more cruising range — up to over 1,000 kilometers.**



Technology kit for electric motors

the perfect electric motor

MAHLE has not only developed two benchmark technologies for electric motors in recent years—MCT (**MAHLE Contactless Transmitter**) and SCT (**Superior Continuous Torque**)—but has also combined both technologies in a unique modular system for electric motors that allows us to provide customized solutions for our customers.

The perfect electric motor combines permanently high peak power with a contactless, wear-free transmission of power. It dispenses with rare earths and shows highest efficiency at all operating points.

MAHLE M40

outstanding driving experience, leading lightweight performance

With the M40 mid-drive system, MAHLE SmartBike Systems has successfully entered the e-mountain bike market. The **MAHLE M40 full-power drive system** combines control, precision and performance to offer a natural driving experience even in the most demanding conditions. Its 48-volt architecture and ultra-lightweight design allow for an outstanding balance of performance and efficiency in a compact system designed for maximum performance without compromising on driving behavior.

The modular system design means it can be flexibly integrated into various bicycle platforms. The intelligent system management and seamless connection to the **MAHLE My SmartBike app** ensure a fully interconnected driving experience that meets the requirements of an increasingly demanding market. **Lightweight, efficient and versatile, the M40 represents a new generation of high-quality drive systems designed for maximum performance and versatility.**



Electric drives

magnet-free peak performance

As part of a development agreement, MAHLE and Valeo are jointly expanding their product portfolios for **magnet-free electric motors** to tap into the upper segments of electric vehicles.

The cooperation focuses on the **development of a magnet-free e-axle for electric vehicles with maximum outputs of 220 to 350 kilowatts**. Valeo is contributing its expertise in electric motors and highly efficient inverters, and MAHLE is pitching in with its magnet-free rotor technology (**MAHLE Contactless Transmitter**).

Electric? It Pays Off!

MAHLE shows how **electrification**, **efficiency** and **economic efficiency** can be combined in the transportation sector to accelerate the market ramp-up of battery-electric trucks.



“

Our goal is to make electrified heavy-duty transport more **efficient**, more **resource-efficient**, and **more economical**.

Dr. Marco Warth,
Vice President Corporate Research
and Advanced Engineering at MAHLE



“Electrified. Efficient. Economical.” — that is the MAHLE motto for this year’s IAA Transportation. What does it stand for? For the three crucial levers in future commercial vehicles?

Yes. The transportation sector is under enormous pressure to become more sustainable. At the same time, it must operate economically. That’s why at MAHLE we don’t “just” electrify drives. The solutions must offer clear economic benefits for operators and, of course, also deal efficiently with energy and resources. That is precisely our system expertise. Our innovations at the IAA show how electrification, efficiency and economic efficiency can be combined in the transportation sector. This is what we are focusing our developments on.

As Head of Development, what particular challenge are you facing?

The central question is how we can accelerate the ramp-up of battery-electric trucks. In our view, the electrification of heavy-duty transport must not depend solely on the pace of the charging infrastructure expansion. That is why we are presenting solutions at the IAA Transportation that enable more flexibility.

For example, the new MAHLE range extender system, which is making its world premiere at the IAA this year?

Exactly. For us, the range extender is key to decoupling the market ramp-up of battery-electric trucks from infrastructure expansion. It reliably supplies the electric drive with energy

even on demanding routes and in changing weather conditions and enables cruising ranges of over 800 kilometers. At the same time, it saves more than 80 percent in CO₂ emissions compared to conventional drives.

What sets your solution apart from a classical auxiliary unit?

The system is essentially an intelligent backup power source. Generator, internal combustion engine, thermal and fluid management, fuel tank, AdBlue tank and exhaust gas aftertreatment are integrated in a single “box”. As a result, the system fits into the usual battery installation space of a BEV truck and can be easily integrated into existing platforms.

You often speak of system-level efficiency. What does that mean in concrete terms?

For us, efficiency means more than just low energy consumption. Our range extender system can replace about a third of the battery capacity. This enables a smaller battery, saving around 400 kilograms of rear-axle load and reducing the vehicle’s total weight by approximately 600 kilograms, while increasing the range by 30 percent.

In addition to the range extender, MAHLE is also exhibiting a new MCT electric motor at the IAA. What is the message behind this development?

We want to make e-mobility both high-performance and resource-efficient. Our new MCT electric motor

works without permanent magnets and therefore no rare earths—this means up to 3 kilograms less rare earths per vehicle in comparison with a permanently excited synchronous machine. At the same time, it is 10 percent lighter and more efficient in real driving cycles than comparable permanently excited electric motors.

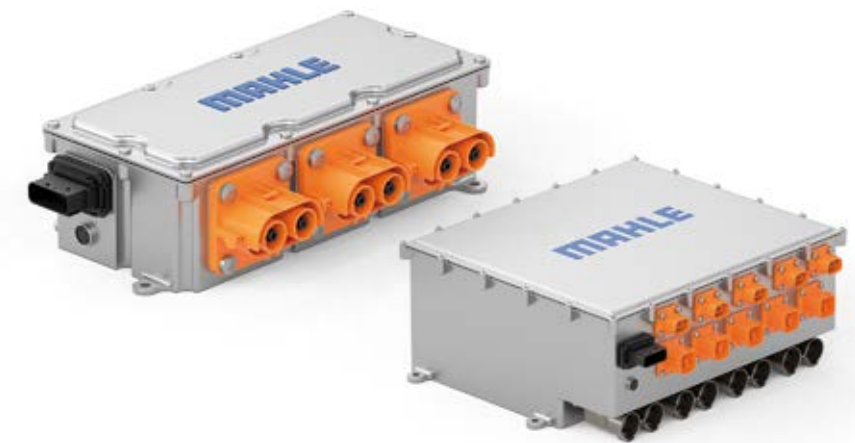
When visitors leave the MAHLE IAA stand, what should they ideally be taking away with them?

That we work on concrete solutions that combine technology, sustainability and economic efficiency. Whether it’s the range extender system, the MCT electric motor or the new engine components we are introducing: Our target is to make electrified heavy-duty transportation more efficient, resource-efficient and economical. And that’s not

just in the distant future. Because we already offer solutions that impress not only through their technology, but also through their efficiency and economic efficiency. For us, this is the practical implementation of “Electrified. Efficient. Economical.”

The Best for the Electrons

Proper charging is a crucial issue for the user-friendliness of electric vehicles. MAHLE is therefore focusing on smart charging solutions. They bring the electrons most effectively to where they are needed: from the charging point to the load unit in the electric vehicle, from there to the electric storage unit, all the way to the most important component, the electric drive.



Power distribution unit and cut-off box—safe and reliable energy management

The **MAHLE power distribution unit** and **cut-off box** control the power distribution in electric buses and trucks and ensure reliable operation as well as safe switching on and off of the high-voltage systems—while driving and when charging. Thanks to the advanced thermal concept, the cut-off

box handles currents of **up to 800 amperes** without liquid cooling, which saves on complexity, installation space and costs. Special security technologies meet the highest demands for functional safety (**ASIL B**) and cyber security (**UN ECE R155**).

High-power charging cooling unit—fast charging in all conditions

In order for fast charging stations to conduct the electricity to the vehicle batteries as quickly as possible, ideal temperatures are required, especially on hot days.

MAHLE has developed thermal management modules specifically required for cooling fast charging stations. This makes fast charging efficient and quieter in any environment.



High-performance cooling module for megawatt charging stations

MAHLE started series production of a new, high-performance cooling module at the end of 2025. This cooling module will be installed in fast-charging stations for electric commercial vehicles. The cooling module can be adapted to the installation space specified by the customer and is approved for ambient temperatures of -35° to 50° Celsius without loss of performance. **MAHLE is expanding its product portfolio for intelligent charging solutions and setting new standards in the charging infrastructure for electric trucks and electric heavy-duty vehicles with the innovative cooling module.**

Wireless charging—simple and convenient

The current features of smartphones will soon make it easier for electric vehicle owners to charge their batteries: **inductive charging**. MAHLE is developing the automotive engineering and the user-friendly positioning system for this. A “transmitter” coil is placed at the bottom of the garage or parking space for this. If a vehicle parks above it, a magnetic field is generated and transmits the energy to the “receiver” coil in the car. **The battery charges with a charging power of 11 kilowatts and a 92 percent efficiency factor, completely wirelessly.**

The American standardization institute SAE International has declared this technology the global standard for wireless charging. MAHLE is currently working on a new Park-&-Charge pilot project. In this system, a vehicle autonomously navigates and uses AI to

identify, select, and park in an available parking space equipped with wireless charging infrastructure. The charging process is initiated seamlessly by the vehicle, ensuring highly efficient wireless power transfer.



Scalable Charging Solutions for Everyone

MAHLE chargeBIG offers scalable charging systems from a single source. Four different solutions are available to municipalities, the housing industry, and fleet operators. All of them follow a new approach: the aim is not to charge as quickly as possible, but to provide as many charging points as possible in an intelligent and low-cost way.



Intelligent infrastructure for fleets and municipalities

Charging solutions for larger parking areas are an important factor for the spread of e-mobility. That is why MAHLE chargeBIG offers a scalable, centralized infrastructure for city centers, airports, trade fairs, or employee car parks with the chargeBIG18-36 system. It can be integrated into the existing network infrastructure and existing buildings easily and at low cost. The system is therefore the optimal solution for locations where electric vehicles are parked for extended periods. It offers 18 to 100 or even more charging points and operation and cost accounting work via an app on your smartphone, so it is intuitive and in compliance with calibration regulations. In addition to charging hardware, the complete package also includes installation, maintenance, service, and operation if desired.



For smaller requirements, there is the MAHLE chargeBIG6 variant. The system is optimized for the charging management of residential complexes, workshops, and smaller businesses. It can charge up to six electric vehicles simultaneously at an existing house connection with up to 11 or 22 kilowatts. ChargeBIG6 is simple to install, inexpensive, and easy to expand. The charging system consists of a central control unit: the chargeBIG6 charging distributor. Billing is done via the already installed electricity meter.

MAHLE chargeBIG presents the smallest wallbox in the world with its smallBox. It is available as a single or double charging station and charges electric cars with up to 22 kilowatts per connection. The system can be flexibly expanded by 2, 6 or up to 36 charging points. A central control system enables easy installation and reduces setup and maintenance costs. In order not to overload the house connection, intelligent charging management ensures that the existing power is optimally distributed to the connected vehicles. This also keeps electricity costs under control.

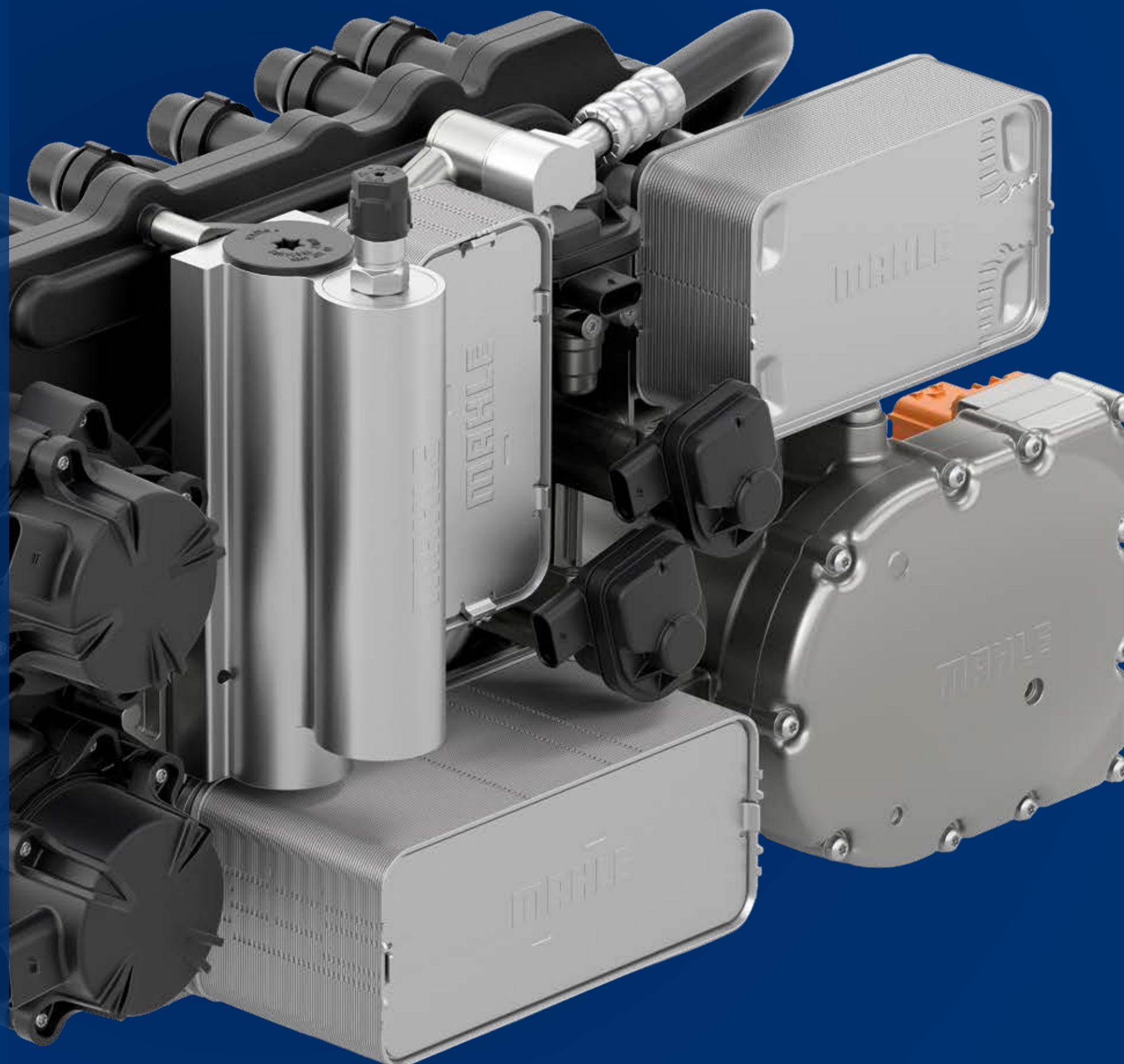
The smallBOX PORTABLE is a mobile charging solution that requires no installation and is therefore ideal for construction sites or as a charging park at events. It only requires a power cable of 63 amperes, which is connected to the underside of the housing and provides four charging points with a power output of up to 22 kilowatts each.



No E Without T

Heating and cooling in electric vehicles is an essential technology field for electrification — and a MAHLE core business. New innovations increase the cruising range and fast-charging capability of batteries and bring more comfort to vehicle cabins.

The thermal management module for electric vehicles is the central interface for the entire coolant and refrigerant circuit of the vehicle. It ensures that every component of the drive system has proper temperature control at all times and under all climatic conditions, and that there is a comfortable climate in the vehicle cabin at the same time.





Guided by the Intelligence of Nature

Dr. Roger Busch,
Corporate Executive Vice President
Sales and Engineering at MAHLE

60% quieter

The aerodynamic shape of the radial blower fan blades is modeled on the fins of the penguin—a master of efficient locomotion in the water. This bionic geometry reduces flow loss and turbulence. The blower is 4 decibels quieter in comparison with similar components, which corresponds to around 60 percent less sound output. It is po-

sitioned in front of the evaporator and means the air conditioner can have a particularly narrow design. This creates additional installation space for other components, which represents a significant advantage, especially in battery-electric vehicles.

3 questions for...

Dr. Busch, MAHLE is increasingly focusing on bionic principles in the development of new components. What exactly does this mean?

For us, bionics means using the intelligence of nature to make technical solutions more efficient and resource-efficient. Over millions of years, nature has produced high-performance structures—we are transferring these principles to our products. This can be seen in our battery cooling system, the bionic fan for electric vehicles and our newly developed bionic radial blower for vehicle air conditioning systems. Their geometries are in line with growth patterns from nature, which increases efficiency and reduces our environmental footprint.

What are the concrete benefits of the bionic approach in practical experience?

It results in solutions that are not only more efficient and sustainable but often also more powerful and durable. The owl-inspired fan increases efficiency by around 10 percent, reduces weight, and runs more quietly. The bionically optimized radial blower increases the

efficiency of the vehicle's air conditioning system and reduces energy consumption; at the same time, the sound output is reduced by around 60 percent, which represents major progress. A few years ago, MAHLE presented its battery cooling system as its first bionic innovation. Its design increases the cooling capacity and ensures a much more even temperature distribution, which is a core issue in electrified powertrains.

Artificial intelligence assists the development of bionic parts. How is it being applied?

Taking the radial blower as an example, a key development accelerator was an in-house AI tool. Our engineers fed the AI with specific data to guide it—resulting in over 30 million virtual design variants in a very short space of time. Internally, we call this “superhuman engineering.” The MAHLE engineers use this to determine the optimal shape and position of the impeller blades and quickly manufacture prototypes.





10%
more efficient

Designed for particularly demanding fuel-cell and battery-electric vehicles. When optimizing the blade geometry, the MAHLE engineers were inspired by owls, whose wing feathers allow them to fly extremely quietly—we transferred this principle to the fan design. The result is a MAHLE **bionic fan** that is up

to 4 decibels quieter than comparable models. As with the radial blower, this corresponds to around 60 percent less sound output. At the same time, the efficiency increases by 10 percent, while the weight decreases by 10 percent.



10%
greater cooling
capacity

The **bionic battery cooling plate** reliably keeps the traction battery in the optimal temperature range of 10° to 40° Celsius. In the plate, the coolant flows through channels whose geometry is modeled on flow patterns from nature. This reduces the pressure loss

by up to 20 percent, while simultaneously increasing the cooling capacity by 10 percent. The design enables faster charging and helps extend the service life of the battery.

Climate Specialists

Compared to combustion technology, the demands on thermal management in electric vehicles are significantly higher. MAHLE therefore already has new solutions that make battery-electric vehicles and hybrids more efficient and also help in conventional vehicle types.



Thermal management module-refrigerant ready for the future

The thermal management module-refrigerant (TMM-R) generates temperature-controlled coolant for electric drive and air conditioning in one compact system. It is designed for the R1234yf refrigerant, but can be converted to PFAS-free R290 (propane) with minor adjustments and is thus prepared for

future environmental regulations. Supplied pre-filled, it enables plug-and-play installation and thus shortens the assembly time for the vehicle manufacturers. The scalable system covers a wide range of applications from light- to medium- and heavy-duty commercial vehicles. The module can also be used

in megawatt charging applications. **Series production is set to start in 2027, paving the way for the next generation of electric commercial vehicles.**

R290 Refrigerant-Compatibility

800-volt PTC heater

comfortable temperatures, even in the cold season

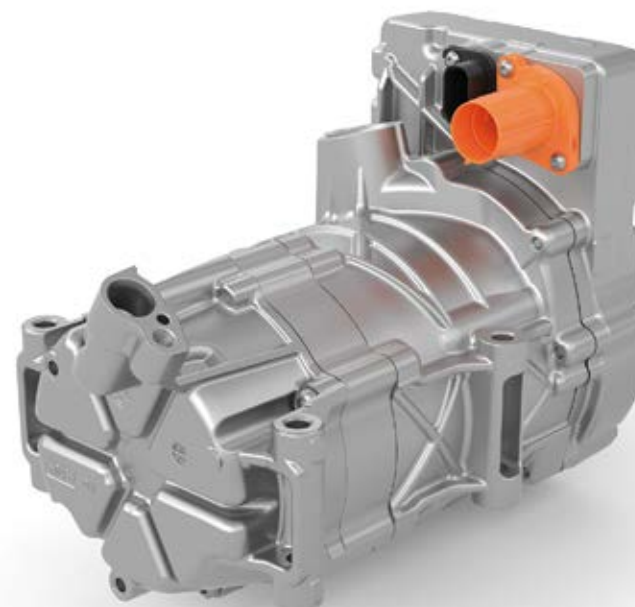
Battery-electric vehicles lack the heat from the combustion for interior heating in the cold season. Here, a highly efficient heat pump can often provide pleasant interior comfort. But every now and then, additional heating must be provided electrically. **The 800-volt PTC heater from MAHLE heats the interior air directly. This is fast and highly efficient, with up to 8 kilowatts of heating power.**



800-volt e-compressor

the heart of thermal management

The e-compressor is important for the temperature control of the e-drive and thus crucial for the service life, high charging speed and range of the battery. It also ensures the high level of interior comfort and pleasant interior acoustics. **MAHLE currently offers its extremely compact high-voltage compressor in voltages of up to 900 volts, displacements of up to 57 cubic centimeters and outputs of up to 18 kilowatts. Its compact design, combined with its high performance, means that it can be used in all vehicle classes—from passenger cars to heavy commercial vehicles.**

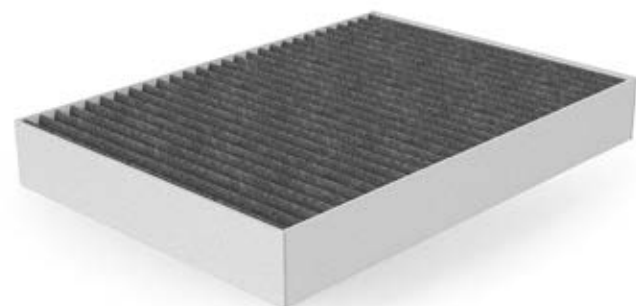




Oil management module

highly integrated,
extremely compact

The cooling of traction motors is of major importance. They are the true “power packs” and must be protected from overheating. **The MAHLE oil management module is a highly integrated, extremely compact component especially designed for this important task.** In a heat exchanger, the heat from the oil is transferred to the coolant circuit. The oil pump is integrated into the module.



Cabin air filter with nano-fleece and activated carbon layer

clean cabin air
for perfect cabin comfort

Perfect cabin comfort includes cabin air that is free of pollutants and undesirable particles. The new cabin air filter from MAHLE consists of two highly efficient filter layers: the nano-fleece and the activated carbon layer. The nano-fleece effectively filters coarse dust, soot particles, and pollen from the air. It separates the smallest fine dust particles in the size of one micrometer up to 99 percent. But it also retains even smaller particles of 0.1 micrometers very well. **The active carbon layer effectively adsorbs harmful gases such as hydrocarbons, nitrogen oxides or sulfur dioxide. At the same time, the filter medium is only around 2 to 3 millimeters thin, which means that the pressure loss of the conditioned air through the filter is extremely low.**

Fluid pump (12/24 volt)

as fast as necessary

The fluid pump from MAHLE drives the coolant circuits. The pump is operated demand-driven with up to 650 watts at 12 volts. Demand-driven means: **In order to save precious electrical energy, the pump always runs only as fast as conditions currently require.** In the MAHLE concept, the pump bearings are also actively lubricated and the electronics are cooled. This protects against wear and ensures a long service life. MAHLE also offers the pump in a 24-volt version.



Electric oil pump family

suitable for every application

Whether purely battery-electric drives, hybrid drive forms, or fuel cell drives: MAHLE offers the right electric oil pump for every application. The oil pump family from MAHLE is scalable in terms of power as well as the number of suction and pressure stages. Thus, power ratings of up to 250 watts are possible, with 24-volt drive power. MAHLE offers optional 24-volt and 48-volt systems. **Controlled via LIN or CAN interface, the product family covers all typical requirements of e-drive axles.** If necessary, the pump can be individually adapted to the respective customer requirements.

Comfort all Year Round

The inside temperature in a vehicle always runs contrary to the outside temperature: in cold weather it should be comfortably warm inside, and in summer pleasantly cool. Especially in the transformation to e-mobility, this presents engineers with new challenges.



No cold fingers in winter

Anyone who drives to work in winter or rolls through snow-covered landscapes wants to be warm in the cabin, even in an electric vehicle. Offering this comfort without much loss of cruising range is technically demanding. "The waste heat of an electric motor is not sufficient for a warm cabin," says Dr. Roger Busch, Corporate Executive Vice President Sales and Application Engineering and member of the Group Management at MAHLE. A heat pump helps with this. It draws energy from the ambient air and heats the cabin. Less energy from the high-voltage battery of the e-car is needed for heating. **"An efficient heat pump means the reduction in cruising range in winter is up to 20 percent less,"** says Dr. Busch. The heat pump does not provide the entire heating performance. The difference is taken over by a heater that reaches the desired temperature both quickly and efficiently. As soon as a charging stop is necessary, powerful high-voltage coolant pumps play an important role because battery cells also like to be pleasantly warm in winter. **Before the charging stop, the battery's cooling system is used to heat the battery cells up to temperature. Then the charged electrons find their place in the anode more quickly. The e-car reaches its maximum charging power faster. A charging stop with a preconditioned battery is shorter, gets you back on the road faster, and keeps you warm.**

A cool head during the summer

Especially during the peak of summer, when daytime temperatures rise above 30° Celsius, efficient cooling is one of the most important features of a vehicle. And for pleasantly tempered air to flow through the cabin, it needs energy from the high-voltage battery. Fortunately, higher temperatures make for somewhat less energy consumption. But there are other challenges. "In a quiet e-car, you don't want to hear the hum of pumps, compressors and fans," says Dr. Roger Busch, Corporate Executive Vice President Sales and Application Engineering at MAHLE.

The air conditioning auxiliary elements have to do their work as quietly as possible. And regardless of the temperature, perfect air conditioning also includes fresh air in the cabin. The nano-fleece and activated carbon in the air filters of the MAHLE solution frees the incoming air from pollutants and unwanted particles. So you can breathe freely with a relaxed ride.

From the manufacturer's point of view, there are two further points: every compressor and pump require valuable installation space and must be supplied with energy. The developers' challenge is thus to make them small, quiet, and energy-efficient. Our answer to this is the compact thermal management module. It combines, for example, a heat exchanger, coolant pumps, condenser, chiller, sensors and valves in one unit. This saves installation space, development effort, and costs.





Efficient in the future

Regardless of the powertrain technology, performance and efficiency play a crucial role in controlling temperature circuits. Electric oil pumps are indispensable in all vehicle types—whether in hybrid drives, pure battery-electric vehicles, or fuel-cell vehicles. They help reduce emissions by precisely adjusting the amount of oil and oil pressure to the respective operating condition. In the case of internal combustion engines, this control directly reduces fuel consumption.

“Oil pumps continue to play a key role in classical traction motors,” explains Dr. Roger Busch, Corporate Executive Vice President Sales and Engineering at MAHLE. He continues by emphasizing their holistic approach: “Thermal management also reliably protects the complete system from overheating.” To do this, the waste heat from the oil is dissipated directly into the coolant circuit.

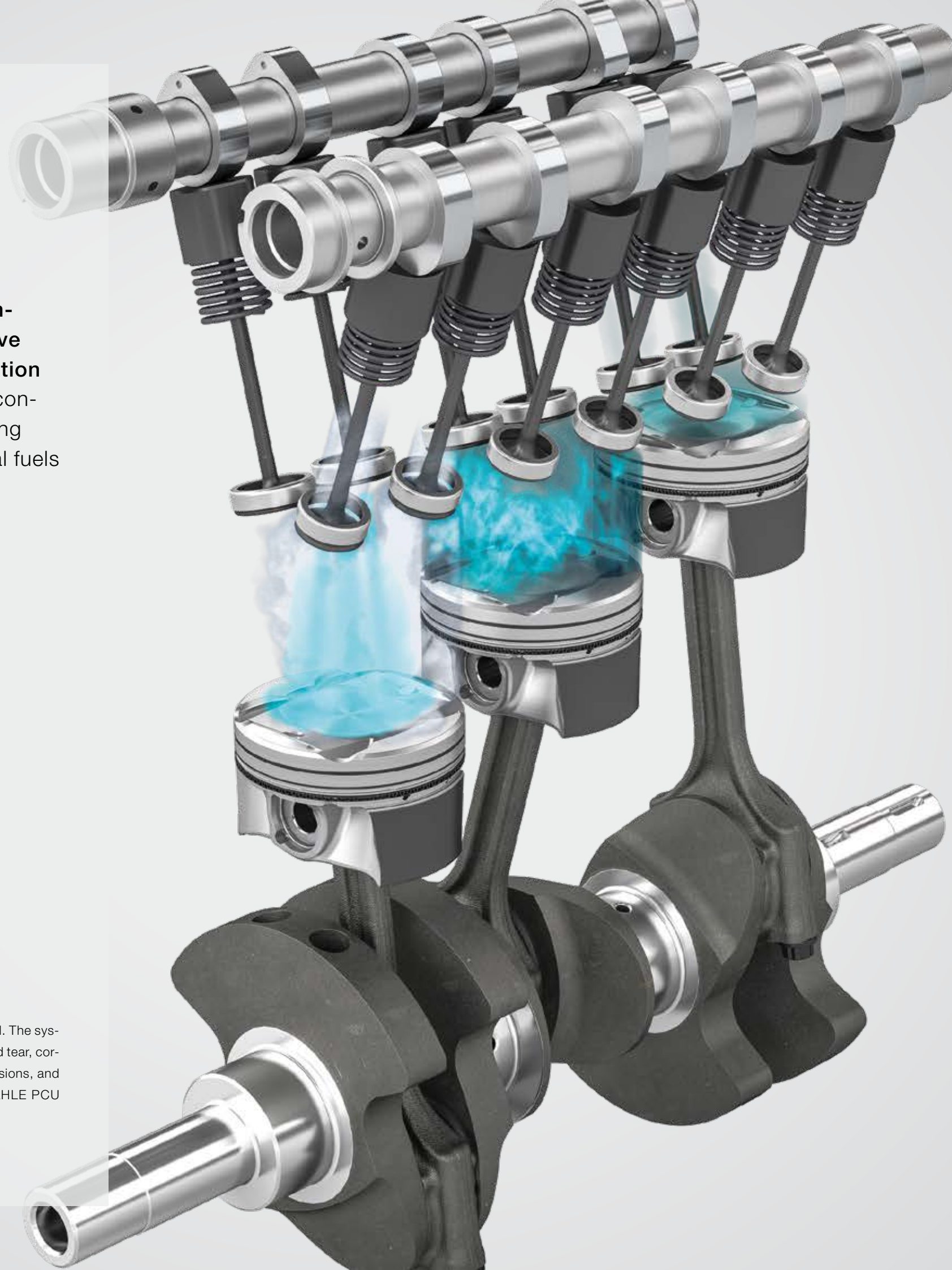
Thermal components also make a significant contribution to reducing emissions in modern combustion technologies. One example is the use of renewable fuels such as ethanol or hydrogen. Drawing on more than 100 years of experience, MAHLE has developed engine components that meet the special requirements of these fuels—in particular with regard to wear and tear and the so-called blow-by effect. These are gases that leak into the crankcase during combustion. A special high-pressure impactor enriches these gases with fresh air before returning them to the intake section. This means that no explosive gas mixtures are formed, which is an important safety aspect.

This means that the internal combustion engine becomes both a safe and clean solution that can also play a role in carbon-neutral mobility.

Ready for the Future

MAHLE uses its expertise in combustion engines to make components for classical drive systems fit for use as a carbon-neutral solution in global applications. This means they can continue to be used highly efficiently and with a long service life with sustainable and carbon-neutral fuels such as ethanol or hydrogen.

The power cell unit (PCU) is optimized for the specific requirements of ethanol. The system design ensures minimum oil consumption with high resistance to wear and tear, corrosion, and heat. The adapted piston ring package reduces friction and emissions, and a high compression ratio optimizes thermal efficiency. For example, the MAHLE PCU enables fuel savings of up to 1.5 percent in E100 operation.



Moving Faster Toward Sustainable Mobility

E-mobility is the key solution for climate protection in road traffic. However, to reduce CO₂ more quickly, all technically possible solutions are necessary. Above all, a clean existing fleet can have a huge effect.

Dr. Marco Warth,
Vice President Corporate Research
and Advanced Engineering at MAHLE



1.5% fuel savings are possible with the PCU for ethanol engines

The basic question for sustainable mobility is: Which powertrain technologies will get people and goods to their destinations reliably, efficiently, and cleanly in the future? Dr. Marco Warth, Vice President Corporate Research and Advanced Engineering at MAHLE, says: **“Electrification is undoubtedly the core building block for future sustainable solutions in road transport. However, the various regional prerequisites and requirements can only be addressed with the necessary technology diversity”**

In many countries such as India or Brazil, for example, green ethanol is available as a fuel. But green hydrogen is also part of the energy transition—for example for heavy-duty and off-road applications that are currently difficult to convert to battery-electric or fuel cell drives.

When it comes to decarbonization, clean combustion engines could help speed things up, as Europe is showing, for example. Here, the proportion of renewable fuels in road transport—i.e. biofuels and synthetic fuels—would have to increase to 30 percent by 2030 in order to achieve the climate targets.

Dr. Marco Warth says: **“The advantage is that the technology is ready. We have optimized the system of pistons, pins, piston rings, and valve sets for the specific requirements of operation using ethanol.”**

The power cell unit for ethanol engines from MAHLE can make a crucial contribution to improving efficiency as well as protecting the climate and resources—as Dr. Marco Warth points out: **“We can use our power cell unit to make fuel savings of up to 1.5 percent in pure ethanol (E100) operation. It can be used in combustion engines with and without hybridization as well as in range extenders for battery-electric drives.”**

This impressively demonstrates that even after more than 100 years of engine development, potential for improvement can still be exploited and CO₂ savings achieved.

Clean Addition

Optimized power cell unit efficiency

new consumption potential for the internal combustion engine

MAHLE is showing that the internal combustion engine still has a lot of potential with a power cell unit that is optimized in terms of efficiency and emissions. A specially adapted piston skirt profile reduces the hydrodynamic friction between the piston and the cylinder running surface. **Ultra-low-friction honing gives the cylinder running surface a variable macrostructure with defined roughness, resulting in less friction and wear and tear. The steel pistons have a low top land width design, ensuring fewer hydrocarbon emissions.** The optimized PCU makes it possible to reduce specific fuel consumption by up to 1.0 percent in comparison with Euro VI applications.

Initial features such as the low-friction piston skirt profile and the piston design with a low top land width are already in series production, and the product validation for the low-friction cylinder liner has been successfully completed.



Hydrogen power cell unit

efficiently to zero emissions

The MAHLE hydrogen power cell unit is a compact engine component that can be quickly and easily integrated into vehicles. Hydrogen is the key to climate-neutral mobility, especially where batteries reach their limits, such as in construction and agricultural machinery. **MAHLE is making entry into hydrogen technology easier, more efficient, and more economically attractive with the hydrogen power cell unit, and in doing so is actively contributing to the energy transition and the reduction of carbon emissions.** Battery-electric, hybrid drives, internal combustion engines, and hydrogen drives are the drive mix of the future.



High-pressure impactor for hydrogen power cell units

active and safe

During combustion in the cylinder, a small portion of the gases always enters the crankcase, the so-called blow-by gas. **The high-pressure impactor actively flushes the crankcase with air, therefore preventing alternative fuels (for example hydrogen) from accumulating here and igniting.**



Power cell unit for natural gas engines

robust solution for high performance and low emissions

Using natural gas (CNG) instead of gasoline or diesel reduces the engine's greenhouse gas emissions. If it is also adapted to the special conditions of CNG operation, efficiency and performance can be significantly increased while further reducing emissions. **MAHLE has developed optimized power cell units for these specific requirements. The concept enables peak combustion pressures of more than 200 bar for efficient combustion.** The use of steel pistons minimizes the risk of piston damage due to irregular combustion, especially with fluctuating gas quality. A specially adapted piston ring pack is used to decrease susceptibility to knocking and emission formation. A three-piece oil (control) ring reduces lubricating oil consumption and particle emissions. **Cooling channels in the pistons ensure lower component temperatures and enable more efficient combustion. A diamond-like carbon (DLC) coating on the piston rings increases abrasion resistance and durability.**

On Track

In 2025, MAHLE succeeded in almost achieving the emissions target set for 2030. We were able to reduce CO₂ emissions from the combustion of fossil energy sources (Scope 1) and the purchase of electricity procured externally (Scope 2) by 47 percent in comparison with the baseline year of 2019—the target is 49 percent by 2030. A prime example of these wide-ranging measures is the inter-plant transport between the MAHLE central warehouse near Stuttgart and the locations in Mühlacker and Vaihingen. There,

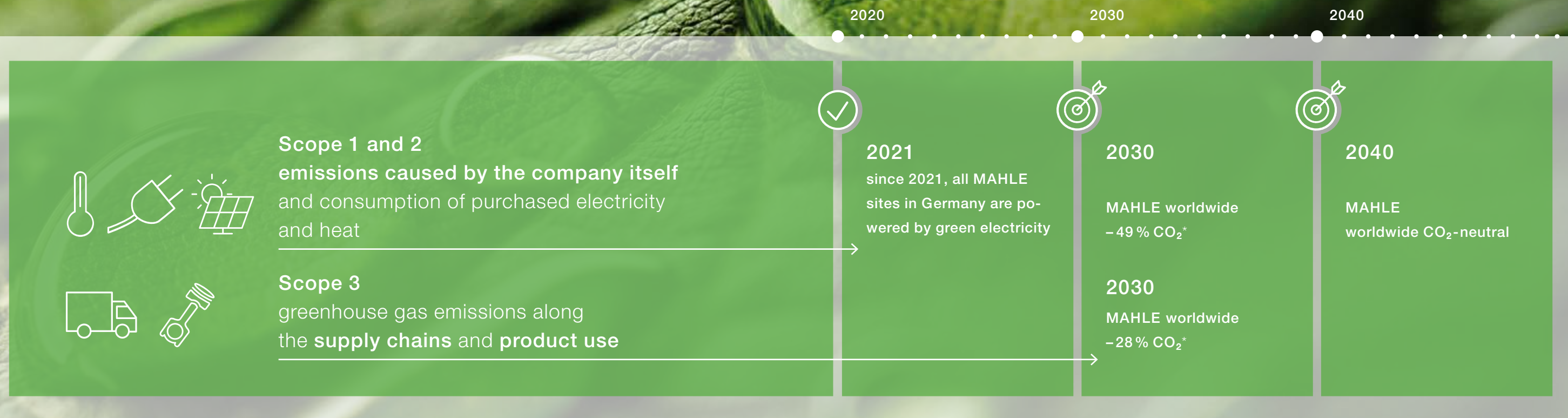
fossil diesel is being replaced by the biofuel HVO100, which reduces CO₂ emissions by more than 90 percent. Emissions from the upstream value chain and the use phase (Scope 3) were also reduced by 23 percent. In the area of supply chains, membership in the Responsible Supply Chain Initiative (RSCI) of automotive suppliers underlines our commitment to transparent procurement processes.

148

energy efficiency projects made it possible to save around 35 gigawatt hours of energy in 2025

47%

lower CO₂ emissions compared to the 2019 baseline year



* Relative to 2019

Moving Sustainably

It was already important to the founders Hermann and Ernst Mahle to combine entrepreneurial vision with social commitment.

That legacy continues today and will also determine our future path.

“

At MAHLE, sustainability is more than a target—it is our promise to be a reliable partner, protect resources, and create innovations that respect the environment and society alike.

Kathrin Apel,
Head of Sustainability, Health, Occupational
Safety & Environmental Management at MAHLE



Ethical attitudes and corporate governance, environmental protection, safety at the workplace, and economic efficiency are elementary values for our self-image as a foundation-owned company. We know that we bear a great responsibility for climate protection, society, our customers, and our employees. And we want to preserve what makes our lives worth living for the next generations. Due to our large portfolio, we can have a noticeable impact on CO₂ emissions. We are represented in almost all areas related to mobility, from automotive and urban mobility to industry. For our customers in these segments, we develop technologies that are as environmentally friendly and climate-conscious as possible.

**Comprehensive information
about our sustainability
activities can be found
in the current**

→ **Sustainability Report**



Our strategic focus is on e-mobility, thermal management, and clean combustion engines powered by renewable fuels. Because our goal is to transition the mobility of tomorrow away from fossil fuels as quickly as possible.

MAHLE—sustainability with distinction

The commitment of MAHLE to climate protection and responsible management is regularly confirmed by an independent body. As in the previous year, the Carbon Disclosure Project (CDP) awarded MAHLE an “A” in the climate protection category—a strong indication of effective environmental management. In the EcoVadis rating, MAHLE is in the top 5 percent of all automotive suppliers worldwide. In addition, the Group was honored with the ESG Transparency Award for its exemplary and transparent sustainability reporting. **These awards demonstrate that MAHLE makes sustainability measurable, credible, and a central component of its future strategy.**

Sustainable partnerships for a responsible future

Our supply chain is a key lever for sustainability. MAHLE relies on long-term partnerships with suppliers who actively live up to environmental and social standards. We foster responsible action along the entire value chain with global purchasing structures, clear policies, and targeted training. An intelligent risk management system helps us identify potential environmental and social risks at an early stage and take targeted measures to counteract them—for more transparency and security. We adopt initiatives such as the Responsible Supply Chain Initiative and the German Association of the Automotive Industry (VDA) Dialogue to help shape standards—for innovation, reliability, and to protect people and the environment.



For corrugated fins, which are used in coolers for example, material grades with a proportion of more than 70 percent of secondary aluminum are now available for series production. **The environmental footprint of the raw material for cooler components is improving significantly, while its high technical characteristics remain unchanged.**

Systematic environmental management

MAHLE relies on an environmental management system aligned with globally recognized standards. Currently, 123 MAHLE production sites and 9 Tech Centers are certified according to ISO 14001 or EMAS (Eco-Management and Audit Scheme). As a result, around 93 percent of the global workforce is employed at locations with a certified environmental management system.

Plastic with natural fibers

MAHLE aims to increase the proportion of recycled materials in metals such as aluminum and steel as well as in plastics. The proportion of recycled plastics in the total use of plastics was 3.3 percent in 2025, representing a slight increase in comparison with the previous year. For metals, MAHLE was able to significantly increase the recycled material content of certain products. For example, we have developed aluminum rolled strips with a higher proportion of secondary metal for our materials portfolio.



Freedom Ahead

Lightweight, sporty, and connected—these are the characteristics that set e-bike systems from MAHLE apart. New solutions for the smart mobility and a variety range of accessories complete our innovations for smart bikes. To date, 70 e-bike brands have opted for **MAHLE SmartBike Systems** solutions, which are now featured in more than 200 models worldwide. For urban, gravel, road cycling and in the mountains.

→ [MAHLE SmartBike Systems](#)

Drive for Every Situation



MAHLE offers a wide range of e-bike drive systems—for ultra-light city bikes as well as powerful e-mountain bikes or smart bike models with a total weight of less than 10 kilograms. The proven X35-system offers the ideal solution for everyday urban life. With a total weight of just 3.5 kilograms, it can be discreetly integrated into the frame.

The further developed X20- and the new X30-system are ideally suited for the more sporty routes. Weighing just 1.9 kilograms, they expand the possibilities for gravel or performance bikes.

A particularly flexible design is made possible by the new XS-system, which combines an X-motor with an external battery, so it is ideal for modular frame concepts with minimal overall weight.

If you're looking for maximum off-road performance, you'll find it in the new M-Series. The mid-drive motor design of the new M40-drive ensures control even under heavy load.

Overall, the MAHLE compact, intelligent systems open up new design freedom for manufacturers and create great riding experiences—efficient, light, and seamlessly integrated.

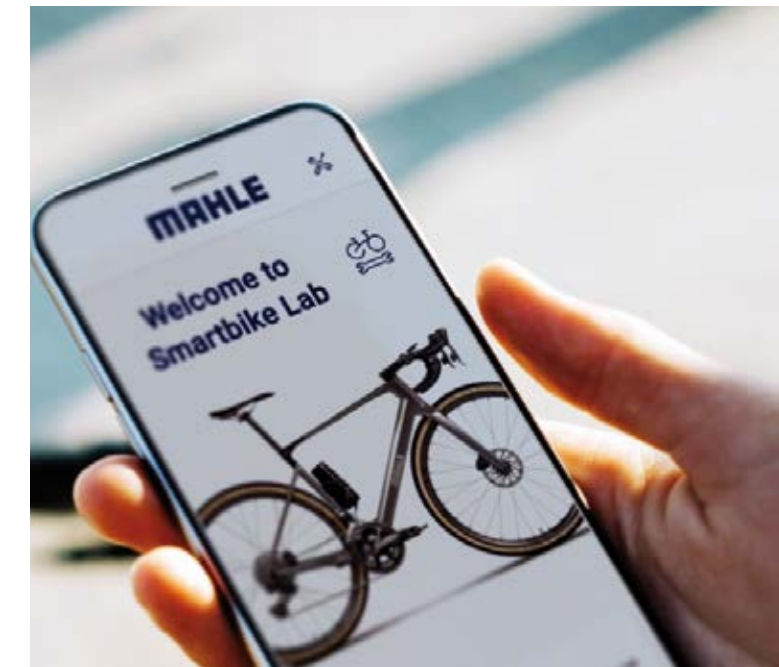


3 kg

is what the entire **X20-system** weighs, making it the lightest on the market

Smart biking

MAHLE offers three central components for the intelligent networking of modern e-bikes with the new gateway interface, the SmartBike Lab app, and the SmartBike app.



Gateway acts as a compact interface between the MAHLE drive system and external accessories. It converts the voltage of the main battery and supplies power directly to lighting systems, electronic circuits, or GPS. It also enables standardized data communication via CAN-BUS—a major advantage for manufacturers who want to integrate third-party components seamlessly.

The hardware is supplemented by two digital tools. Firstly, the SmartBike Lab app is used by workshops and manufacturers to diagnose, configure, and update the software of MAHLE systems. Secondly, the SmartBike app offers end users direct access to riding data, navigation, support levels, and system control. The app can be customized and is intuitive to operate.

Gateway and the SmartBike Lab app open up completely new possibilities for e-bike design because manufacturers can dispense with additional components, external access points, or special diagnostic plugs and therefore implement clearer, lighter framework concepts.



Power from the middle

With its first mid-drive system, MAHLE SmartBike Systems is now also represented in the e-mountain bike (eMTB) segment. The new M40 full-power drive system offers full control, high performance, and maximum efficiency—even in demanding environments and at high support levels and cadences. It is one of the most powerful systems on the market and is compatible with the entire MAHLE ecosystem.

M40 is the first drive in the new M-Series from MAHLE SmartBike Systems, which will be further expanded in the coming years—in addition to the existing X-Series with the X20, X30 and XS hub drives.

1 Trio Remote

Enhance your e-bike experience with the Trio Remote, a wireless and compact **3-button radio remote control** for flat handlebars. Designed for effortless operation, it controls the M-Series system as well as the head unit + monitor, providing intuitive access to key functions while keeping your hands on the handlebar.

2 Head Unit +

The control unit is equipped with a compact and modern 1.9 inch LCD monitor and is used to control the M-Series system. It supports **BLE and ANT+** and is designed for seamless e-bike integration. It has multiple mounting options and provides clear, customizable information at a glance.

3 iM5 (534 Wh) / iM8 (800 Wh)

The **48-volt iM5 accumulator battery (534 watt-hours)** weighs 2.5 kilograms and keeps the total system weight around 5 kilograms, making it one of the lightest setups. The **iM8 accumulator battery (800 watt-hours)** provides up to 150 kilometers cruising range or 2,500 meters of altitude gain.

4 M40 mid-drive motor

The motor weighs only 2.5 kilograms without compromising its performance capabilities: 105 newton meters of torque, **850 watts of peak power** at 340 watts per kilogram.

5 Speed sensor

The ultra-precise speed sensor can detect changes in speed within just **3 centimeters of movement**. It significantly enhances system accuracy compared to other brands on the market.



Expansion of New Business Fields

MAHLE is addressing the pressure that grew still further last year with continued diversification and risk distribution: in technologies, markets, customers, and its business fields. **The group is increasingly positioning itself outside the automobile sector: in solutions for stationary infrastructure, leisure and logistics applications as well as heavy-duty applications for maritime, mining, rail and defense segments.**

To offer customers the entire product portfolio in a more targeted way and develop new products faster in line with demand, MAHLE has reorganized its non-automotive business and established the "Industrial and Special Solutions" unit within group sales. In the future, existing capacities and plants can be used specifically for this purpose in a targeted way, which will allow more efficient control and more profitable production for smaller, more individual customer projects. **Currently, the focus is mainly on high-power and megawatt charging, on computer center cooling, power electronics and chip cooling, hydraulic systems and applications in defense and security technology.**



Scooters and Commercial Vehicles

Two-wheel drive systems for scooters

E-scooters are agile, lightweight, and flexible. But there's also very limited space for the drive system. That's why MAHLE offers highly **compact powertrain solutions** for these motorized two-wheelers. Less powerful models generally use air-cooled IPM motors (interior permanent magnet synchronous motors) and extremely space-efficient electronics.

Each scooter is also fitted with a **hybrid controller**. It combines rotational speed and torque control for a dynamic handling experience. **Larger and more powerful drive systems are usually liquid-cooled.**



Low-voltage drives from MAHLE for scooters and three-wheelers with outputs of 5 to 14 kilowatts



Induction motors for commercial vehicles and golf carts

MAHLE **induction motors** with the corresponding drive controllers are the ideal solution for electric micro commercial vehicles and golf carts. An algorithm regulates traction and adapts the torque smoothly and precisely to all

ground and load conditions. If required, the controllers can also contain drivers for braking resistors, which are used to brake the vehicle when the battery is fully charged.

Low-voltage drives from MAHLE for commercial vehicles and golf carts with outputs of 10 to 20 kilowatts



Reliable Mobility on the Railway Track

Steadily growing flows of goods and increasing mobility result in ever higher demand for performance and efficiency in railway transportation. Complex vehicle architectures and extreme operating conditions pose new challenges for the products and components. **MAHLE supplies reliable, durable, and high-performance vehicle components and systems for a trouble-free operation.**



MAHLE is constantly setting new standards when it comes to cooling diesel-driven and electrically powered railway vehicles. As a systems partner, it also understands the complex requirement profiles and different operating conditions on the railway track.

Excellent reliability

Cooling systems for high-speed trains that travel at up to 550 kilometers per hour offer high cooling performance with minimum weight and low operational energy consumption.

Compact cooling

Space-optimized cooling systems for multisystem locomotives (up to 6,500 kilowatts) and modern combustion engines (up to 3,500 kilowatts) can be operated at altitudes of up to 5,000 meters and at ambient temperatures ranging from -50° to 50° Celsius.

Sophisticated systems

Complete locomotive construction segments are equipped with coolant components, hydraulic drive equipment for blowers, compressors, and /or auxiliary generators.

In railway traffic, too, alternative drives and the further optimization of advanced combustion engines are the key to reducing emissions. With its cooling systems for all drive types, MAHLE is a strong development partner for the sustainable mobility of the future.

Dual-mode and last-mile cooling modules

The combination of catenary powered traction and low-emission combustion engines in one vehicle requires intelligent and compact solutions. MAHLE provides cooling modules for numerous dual-power vehicles and electric locomotives with auxiliary diesel power units in mainline and shunting operations.



Battery and hybrid drives

Efficient thermal management keeps batteries and power electronics within the optimum temperature range, thereby extending the service life of these components. MAHLE cooling systems thus enable the use of powerful battery and hybrid drives.



Fuel cell drive

High thermal loads are generated in modern fuel cell trains. For reliable operation, coolants with low electrical conductivity and precisely controlled temperatures are required. MAHLE cooling systems are made from high-grade materials and have a high cooling density. As a development partner for hydrogen-powered vehicles, MAHLE supports its customers from the initial concept phase through to series production. MAHLE components are already in use today on a production vehicle operating in the field.



Peak Performance for Drives and the Environment

In industry—whether ships, commercial vehicles, or trains—thermal management is essential when it comes to demanding industrial applications and special vehicles. Doing so not only reduces fuel consumption, but also cuts emissions and optimizes performance.

In addition to an extensive standard range, MAHLE offers cooling concepts for specific applications in various materials:

Disk-type charge air coolers (CounterFlow Charge Air Coolers)

- Charge air and coolant flow in opposite directions
- Made from aluminum and stainless steel
- Up to 70 % lighter and 50 % smaller than conventional coolers
- No heat protection is required on the component thanks to the circulating coolant flow



Charge air coolers in aluminum package design and fin and tube design

- Maximum flexibility to scale in size
- High power density combined with low weight
- Very good compressive strength and vibration resistance
- Long service life even at temperatures exceeding 250°C



Charge air and gas mixture coolers in nonferrous metal round-tube design

- Highly resistant to extreme stress
- Seawater or poorly maintained coolant may be used as cooling medium
- Can be used for natural gas, biogas, landfill gas, and special gas applications
- Choice of application-specific materials
- Mechanically joined (with no soldering process)



High-quality and durable components are indispensable for the reliable, safe, and environmentally friendly operation of industrial applications

Exhaust gas coolers

- As tube bundles for engines up to 560 kW
- With round tube and fin for engines above 560 kW
- Made of high-grade stainless steel



Battery thermal management systems

- Stabilization of the battery temperature in electronic applications
- Energy-efficient operation for maximum cruising ranges



Oil and fuel coolers

- Cooling by stacked-plate coolers at high thermal loads
- Can be mounted on the drive without additional housing
- Vacuum-brazed oil coolers, available in aluminum or steel/stainless steel
- Resistant to pressure and vibration
- Media counterflow (oil/coolant, oil/oil, and fuel/oil coolers)



Large Engine Components

The development and production of premium engine components has always been a core competence of MAHLE. In the large-bore piston segment, the company has successfully established itself as the market leader. Pistons, piston pins, and cylinder liners from MAHLE are the driving force behind the powerful engines used in shipping, construction, industry, power generation, and rail transportation. The engine components are also used worldwide in engines that run on alternative and CO₂-neutral fuels such as hydrogen.

Pistons

As the largest piston manufacturer worldwide, our portfolio includes a variety of product and material choices: cast or electron beam-welded aluminum pistons, as well as composite pistons with aluminum, nodular cast iron, and steel skirts. The MAHLE piston range for large engines includes products with diameters of up to 580 millimeters.



Power cell units

The power cell unit consists of the piston, piston pin, piston rings, and cylinder liner. Power cell units are developed as complete modules. They offer particularly high functionality and efficiency because the individual components are optimally coordinated. This saves time and costs—especially during the development phase. Nonetheless, all individual components can be tailored to the respective requirements. We consequently offer our customers maximum flexibility with the advantages of an integrated overall system.



Composite pistons

Steel-aluminum pistons

Composite pistons with a crown made of forged steel and a forged aluminum alloy skirt have established themselves over the whole diameter range from 150 to 580 millimeters. The pistons are suitable for low to medium peak cylinder pressures and are nowadays one of the standard piston design in medium speed engines.



Steel-steel pistons

Steel pistons meet the expectations for high end, highly loaded, and special applications. They provide ultrahigh component strength and an extended lifetime.

Steel-NCI pistons

The composite piston design with a forged steel crown and a nodular cast iron skirt is used for peak cylinder pressures exceeding the limits for aluminum alloy skirts. Key features include low cold piston clearance and the resulting low secondary piston motion as well as high seizure resistance. With an appropriate design, it is suitable for peak cylinder pressures higher than 20 megapascals. Compared with pistons with aluminum skirts, however, there is a mass increase due to the higher material density.



Monobloc pistons



Steel pistons

Steel pistons are also available as friction-welded (MONO-WELD®) or high-temperature brazed (HTB®) versions with a forged steel crown and skirt.

Aluminum pistons

Aluminum pistons nowadays are typically designed for diameters up to 260 millimeters. The low weight of the piston and the high variety of bowl geometries are just two big advantages of the design. Ring carriers for reducing the wear of the first ring groove as well as a saltcore cooling gallery for a better cooling of the ring land and the bowl rim can easily be implemented. Electron beam-welded aluminum pistons can be used for higher peak cylinder pressures. This piston design combines the advantages of a forged piston skirt with the benefits of cast ring bands.



Robust All-Rounders

Cold starts, high pulling, hydraulic and lifting power over a long period of time, precise maneuvering in even the most confined spaces, and high torque at low speeds—the **engines and transmissions** found in agricultural and construction machinery have to function reliably at all times.



The safety of the operators of these machines also has to be ensured. They must often contend with intense heat, dry cold, high humidity, or grain and road dust. Cooling and air conditioning systems, starter motors and alternators, and filtration systems from MAHLE get the job done on fields and construction sites around the world. The lightweight components and systems operate highly efficiently and can be tailored to customer requirements.



Modular heat exchanger platform (tube and fin)

- **Standardized systems** for radiators, charge air coolers, oil coolers, and **lightweight, high-performance**, and durable condensers
- **Modular concept** with tubes of various lengths as well as a flexible number of tubes in depth and width
- Broad output range for various applications (**ICE, FC, BEV**)
- Automotive technology adapted to the **specific requirements of agricultural and construction machinery**
- **Corrugated fins** to avoid contamination and for steam cleaning
- **Increased vibration resistance** and durability
- High power density due to **optimized fin geometry**



Battery cooling system

- Roof or chassis mounted
- **Passive cooling** for moderate ambient temperatures by means of a radiator
- **Active cooling** for higher ambient temperatures by means of a cooling unit
- **Standardized variants** and customized developments possible
- **Stepless heating** via electric high-voltage heater
- Cooling performance **up to 14 kW**
- Heating performance **up to 20 kW**
- **24 V** supply voltage
- **CAN bus** control interface
- High-voltage connection with **integrated distribution box**



Heat pump

- **Thermal management** of electric vehicles, especially for heating and cooling cabins and batteries
- Dimensions: 330 mm × 430 mm × 340 mm, weight: 16 kg
- Heating performance of **up to 14 kW**, cooling performance of **up to 11 kW**
- R1234yf or R134a refrigerant
- **800 V_{DC}** nominal current supply (full performance range 450–860 V)
- Control interface (for compressor and expansion valve) **LIN 2.1**

Future-Oriented Logistics

To safely transport materials and goods—whether textiles, food, or raw materials—you need powerful vehicles such as pallet trucks, tractors, and forklifts. By keeping the flow of goods and materials moving, these constitute an essential part of logistics, industry, and trade. MAHLE offers safe and efficient solutions for complex loading and unloading operations involving heavy loads.



**AC induction motors
for the traction system**

- Nominal voltage: 15–50 V_{AC}
- Nominal power: 4–18 kW



**IPM motors
for the traction system**

- Nominal voltage: 15–50 V_{AC}
- Nominal power: 4–10 kW



**AC systems
for the steering system**

- Nominal voltage: 24–48 V_{AC}
- Nominal power: 0,15–0,9 kW



**AC induction motors
for the hydraulic system**

- Nominal voltage: 15–50 V_{AC}
- Nominal power: 3–28 kW



**DC motors
for the hydraulic system**

- Nominal voltage: 24–48 V_{DC}
- Nominal power: 1,4–2,2 kW



**AC electronic control unit
for the hydraulic system**

- Nominal voltage: 24–80 V
- Max. phase current: up to 240 A
- Power supply outputs: 5 V and 12 V
- Sensorless controller available



**AC electronic control
unit for the traction system**

- Nominal voltage: 24–80 V
- Max. phase current: up to 450 A
- Power supply outputs: 5 V and 12 V

Individual complete systems

Electric drives for industrial vehicles are not only more environmentally friendly, but also wholly suited to use in enclosed spaces. MAHLE offers drive systems for electric forklifts such as pallet trucks (24/36 volt) and three- and four-wheel counterbalance trucks (48/72/80 volt). Different electric motors can be combined with the corresponding control units. Thanks to their modular design, the complete systems meet the specific requirements of each field of application, whether as traction systems, for power steering, for hydraulic pumps, and so on.

The right functions for each application

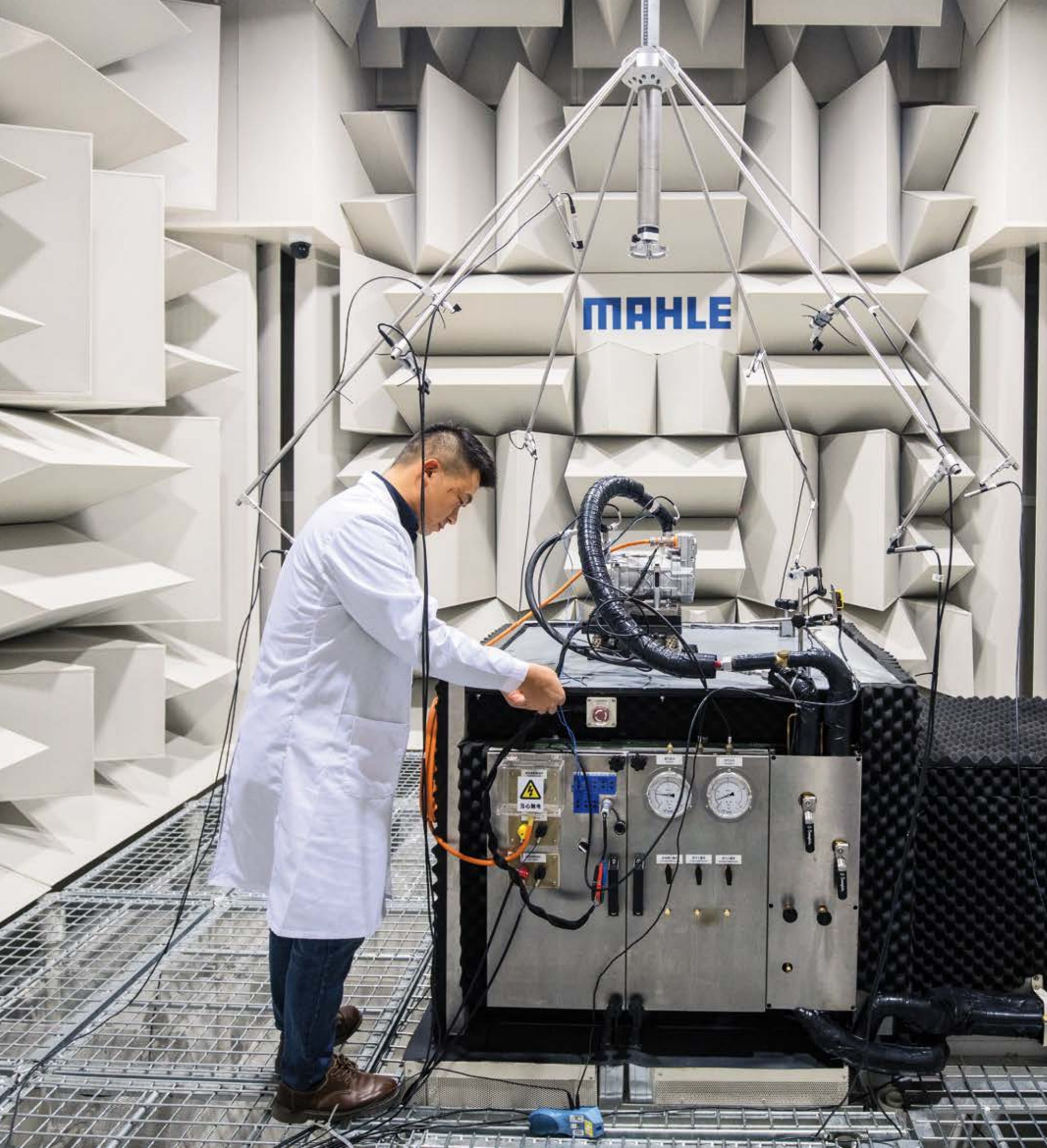
- High performance and precise steering when carrying heavy loads **thanks to double drive system**
- Excellent maneuverability and stability due to **coordination of the drive and steering controllers via the CAN unit**
- Multifunctional **master/combined control system**
- Support for peripherals through **digital and analog I/O modules**
- **Protection of all components** against thermal and other influences
- All components compliant with European **CE standards** as well as American **UL standards** and **compatible with auto-motive EMC standards**
- Possibility of **integrating accessories** into the system, such as steering units, drawbar boxes, CAN units, and graphic Displays



Developing the Future

MAHLE takes a holistic approach to research and development. The MAHLE development centers are based near the world's most important locations in the automotive industry and combine development with testing expertise. Products can therefore be improved in an agile way. This is evidenced by new developments in fuel cell technology and the traction motors for e-mobility. For example, MAHLE is able to test its traction drives over the entire development cycle: concept validation during the pre-development phase in Germany, along with performance testing on electric motor test benches in Slovenia, China, and Germany. MAHLE has been testing future topics, such as the use of hydrogen, in its own test center for several years.

In the eastern Chinese city of **Changshu**, there is a Tech Center where future-oriented technologies, such as the e-compressor, are developed and tested. **The focus here is on material analysis, performance and endurance testing, noise and vibration tests, as well as testing in climate and anechoic chambers (pictured).**



The MAHLE Tech Center in **Šempeter pri Gorici**, Slovenia, is completely geared towards e-mobility and offers high-precision test benches in a range that includes the smallest electric machines through to high outputs of hundreds of kilowatts. **MAHLE supports the development of new solutions for traction motors with further top-end test benches at many locations worldwide.**



The hydrogen test center in **Stuttgart**, Germany, is mainly focused on hydrogen applications. In addition to a state-of-the-art fuel cell test bench, testing is also underway with a 340 kilowatt hydrogen engine in Stuttgart. **The aim is to develop economical and robust systems solutions for the automotive industry.** MAHLE is also represented in all major hydrogen engine projects currently underway and in all fuel cell development projects, thanks to its development expertise.

The Street in the Laboratory

How can I increase the range of electric vehicles through optimal thermal management?

How must systems for the heat pump be set up?

Or: How do heat or cold affect the fast charging of Li-ion batteries?



The first of its kind

As early as 1937, Manfred Behr built the world's first wind tunnel for the automotive industry. A year later, he used it to help the legendary W 154 Silver Arrow achieve a radiator design that set standards. As a pioneer in this field, MAHLE has continuously developed the measurement section to this day. **The climatic wind tunnels enable realistic, precise,**

and repeatable measurement and test conditions for diverse applications. Therefore, they are the secure basis for smooth technology transfers, quality assurance, cost reduction, and time saving in the interest of the customers. In the highly modern system, all conceivable conditions in driving practice can be precisely configured and reproduced.

This means a wide variety of combinations and sequences of temperature, humidity, solar load, and street load are possible. Measurements can be carried out under real weather conditions for vehicle sizes up to trucks on the generously dimensioned measurement section. The facility is also used by companies from other industries.

These and many other questions are asked by developers of almost all vehicle categories. They answer these questions in the **MAHLE climatic wind tunnel in Stuttgart.**

For a clean future

Alternative drives based on hydrogen and electric drives will determine road traffic in the future.

The MAHLE climatic wind tunnel is ready for the future: Relevant tests, measurements, and simulations can be carried out there without any problems.

100 kilometer cruising range in 5 minutes

Over 40° Celsius heat, the sun burning on the car, almost no reprieve from the wind. These are difficult conditions for the temperature-sensitive Li-ion battery. If an e-car is then charged quickly, the battery can become too hot and be damaged. To be able to test this realistically, MAHLE has now equipped its climatic wind tunnel in Stuttgart with a direct current fast charging system. This allows up to 350 kilowatts of direct current and 1,000 volts to be charged in all climatic conditions. The 10 meter long cable reaches all charging ports without any issues. This allows the vehicle to be charged or discharged for a 100 kilometer cruising range in under 5 minutes. The fast-charging station offers individual solutions for the wind tunnel, including monitoring and control from the control room.

New test procedures with hydrogen

Dealing with hydrogen in vehicle powertrains poses new challenges for manufacturers and for the climatic wind tunnel. Due to the chemical properties of hydrogen, the security concepts must be realigned, since an explosive mixture already exists at a hydrogen concentration of more than 4 percent by volume. The MAHLE experts carry out the corresponding tests on air-gas concentration in the climatic wind tunnel. Air movements during critical driving conditions become visible and can be analyzed. The ultimate goal is to conduct the tests with future drive concepts safely and under all climatic conditions.



From Permafrost to Sahara Winds



Soak room—well prepared

Passenger cars and large components are pre-conditioned to between -40° and 50° Celsius in the antechamber. **Programmable temperature ramps and cycles** as well as **24-hour operation** by means of fully automated controls are also possible.



Turbine—from a gentle breeze to a hurricane

Air velocities up to 130 kilometers per hour can be produced thanks to the combination of a fan and a resizable nozzle. When used in conjunction with air humidity, temperature, and solar load factors, global weather conditions can be reliably reproduced on site.

In the MAHLE climatic wind tunnel in Stuttgart, climate zones around the world can be reproduced. This means that the entire vehicle's performance and efficiency is put to the test under a variety of extreme conditions. Some of the key research topics are the optimization of refrigeration and cooling circuits as well as the functional testing of electric vehicles.

You can find more detailed information here: → [MAHLE climatic wind tunnel](#)



Climatic chamber—from the Sahara to the Arctic

With various combinations of **temperature**, **air humidity**, and **solar load**, all weather conditions and climate zones can be reliably reproduced to obtain accurate measurements. Temperatures from -30° to 50° Celsius can be reached. And up to 95 percent relative humidity can be generated from 5° Celsius and above.



Chassis dynamometer—on the road

Two pairs of rollers, which can be adjusted independently and with millimeter precision, **simulate near-realistic road travel** with a brake power of up to 150 kilowatts per axle from 30 kilometers per hour. All vehicle drive types can be represented.



Measurement section—from small to large

The measurement section is designed for **all types of vehicles**. It is 10 meters x 2.65 meters x 5 meters (L x W x H) and can handle a weight of up to 10 metric tons.



A driving robot—for precise comparisons

The driving robot can be installed in almost any vehicle, which it controls according to the test requirements. With its three legs, it operates the clutch as well as the brake and gas pedal. **And with its arm, it can operate an automatic transmission selector lever as well as a manual selector lever with up to six gears. Due to its precision, sensitivity, and repeatability, this robot is ideal for comparative measurements.** In addition, numerous driving cycles are programmed (**NEDC**, **WLTP**, **SC03**, etc.) and customized driving cycles can also be integrated in a very short time.



AI Should Serve us. Not the Other Way Round.

Markus Bentele,
Vice President Information Technology
at MAHLE

The topic of artificial intelligence is gathering speed. This is also true at MAHLE. Markus Bentele, Vice President Information Technology, on how MAHLE is already embracing AI.

Mr. Bentele, the AI Acceleration Project at MAHLE is focusing on artificial intelligence (AI). MAHLE has also published its own AI policy for the first time. Could you briefly outline what this is?

The AI Acceleration Project aims to make MAHLE more efficient, digital, and agile—including through the use of AI. This technology can make our everyday work easier as we can use AI tools to create texts or automate tasks that were previously done manually, for example. **However, it is important that we do not rush into the current “AI hype,” but rather introduce AI at MAHLE in a considered and well-**

thought-out way. After all, AI should “serve” us and add value to our work. Not the other way around.

How is MAHLE going about this and what influence do new legal requirements, such as the AI Regulation of the European Union, have in this regard?

The most important thing is that we want and need to use AI at MAHLE securely and in compliance with the regulations. Naturally, the provisions of the European Union’s AI Regulation apply here. **One of the stipulations of the EU regulation is that from now on, all users of AI must be sensitized to the technology and its implications.** For MAHLE, this means setting up a training program on the basics of AI and the AI tools that MAHLE intends to use.

We as MAHLE, and therefore all employees, are responsible for protecting our data and interacting with the results of AI systems. Our own recently published AI policy sets out framework conditions, roles, and processes, specifies the margin for action, and provides guidance and clear instructions on how to use AI responsibly.

According to the AI Acceleration Project, which AI use cases are particularly relevant for MAHLE right now?

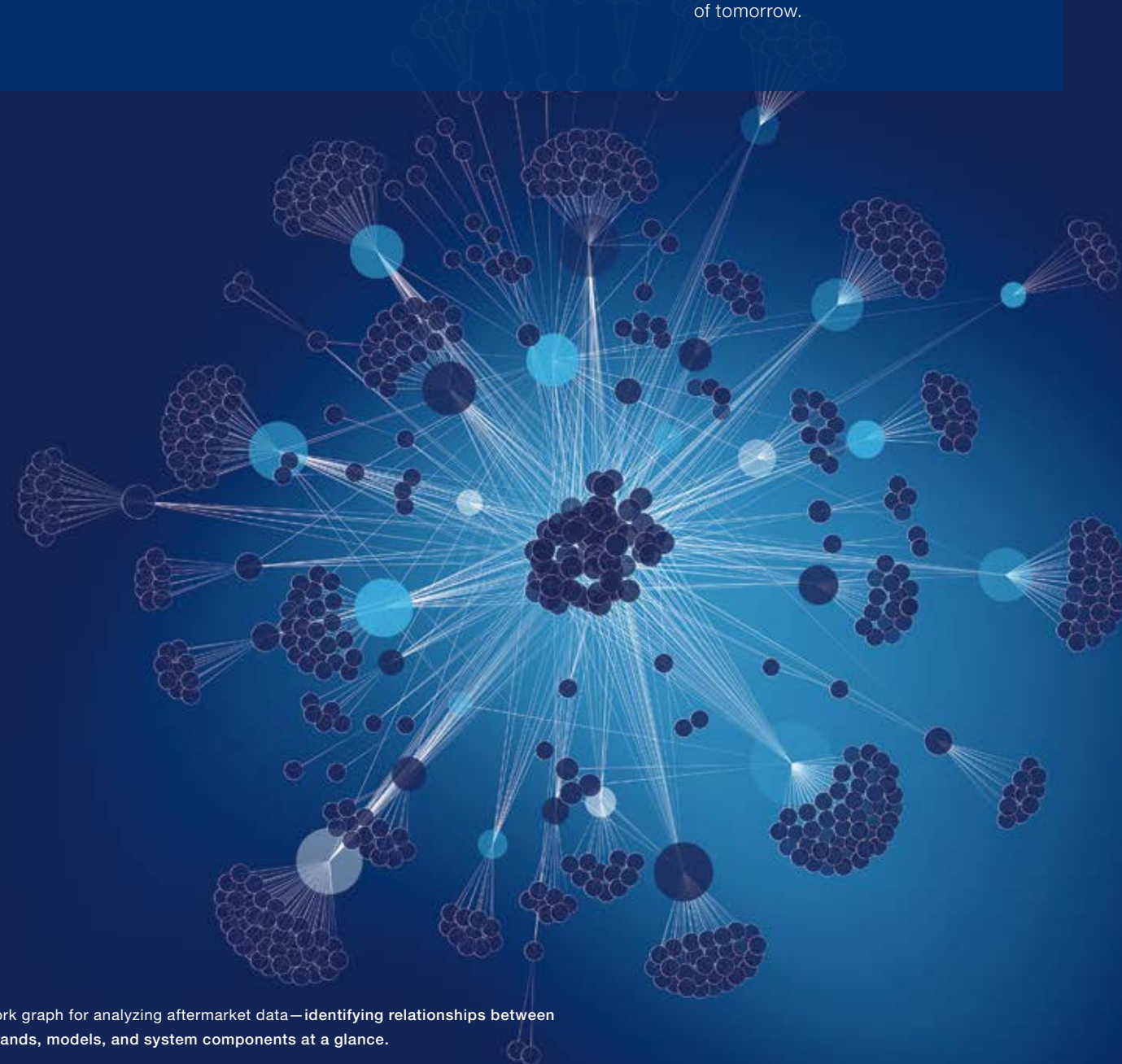
These include use cases from the area of product development, such as the AI-driven development of a significantly quieter fan for vehicle air conditioners. The use of AI in the engineering sector is a strategic necessity to maintain our competitiveness in the long term. We are also focusing on use cases in the area of knowledge management, such as AI-powered video generation and AI chatbots for conversational applications. Alongside many other equally interesting use cases, these now have top priority. **We will implement them promptly within our economic conditions and possibilities so that we can support our employees as quickly as possible.**

Data: the New Currency for Tomorrow’s Mobility

It is being treated as the new oil or the new gold—**reliable and intelligently interconnected data has become a strong form of currency. In the mobility of tomorrow, its value is even increasing at an above-average rate. Companies that collect data smartly and connect it in a smart way have a clear competitive advantage.**

After all, in a highly inter-connected world, it is important to react faster, make informed decisions, continuously build up expertise and thus be closer to the customer. Whether innovations, personalized product offerings, predictive maintenance, optimized production processes or resilient supply chains—**data drives the global economy. And the automotive industry is no exception.**

MAHLE recognized the value of data for the mobility of the future from an early stage. With its knowledge of data and sound analysis, MAHLE improves its existing products and services, spots new market opportunities more quickly, develops innovative data-based business models and conquers future markets. In this way, data becomes the foundation for new ideas. And the engine for MAHLE innovations of tomorrow.



Network graph for analyzing aftermarket data—identifying relationships between car brands, models, and system components at a glance.

The Driving Proof



MAHLE uses **demonstrator vehicles** to illustrate what is already technologically possible and what customers may soon be able to look forward to on the road

Active cabin air purification

The MAHLE active air purifier works by ionizing particles in combination with an activated filter. The particles are continuously negatively charged in the air-flow. The filter can also be electrically activated to keep the filtration efficiency consistently high over the entire service life of the filter. The result is first-class indoor air quality throughout the whole service life of the filter.

The MAHLE active air purifier can be operated with standard hybrid filters, so no complex special solutions are necessary. However, the filtration performance can be further enhanced with a filter optimized by MAHLE. The system is ready for series application and prototypes are available.



AI-controlled air conditioning systems

The AI climate control software module from MAHLE controls the vehicle's air conditioning system using artificial intelligence. The system learns the personal air conditioning preferences of the passengers. To do this, the individual climate settings are transferred to the cloud and combined with current weather and user data from the vehicle sensors and the cabin camera. This dataset is used to train a personal digital twin. After a short time, the MAHLE AI climate control adapts the air conditioning system to the individual preferences of the users so that they no longer have to make any manual in-

puts. This results in energy savings as inefficient climate settings are avoided, and safety is also enhanced as users are not distracted by operating the climate control.

The system is supplemented by intelligent voice control. The system also detects the cause of the change request, such as incident sunlight for example. These inter-relationships will also be processed in the digital twin and be taken into account for climate control in the future.



MAHLE A.I. Climate Control offers drivers significantly enhanced climate comfort. **Automobile manufacturers can spend less time calibrating the climate control in the plant because this is done individually while the vehicle is in operation.**

Development Experts — MAHLE Powertrain

The next generation of drives will be more diverse than ever before. As an experienced specialist in powertrains of all kinds, MAHLE Powertrain supports automobile manufacturers in their next step forward. Engine, transmission, hybrid unit, software, and operating strategy—everything here comes from a single source.

→ [MAHLE Powertrain](#)

If you are looking for engineering and consulting services from experts, MAHLE Powertrain is the right choice—for every drive system. Its broad range of services includes the design, trial, development, application, and integration of hybrid internal combustion engines and electrified powertrain systems. **The ultimate target in all projects is genuine innovations or the next level of technology for series-ready solutions. Along the way, the experts are always working alongside the vehicle manufacturers as partners for cutting-edge research, development, and application.**



Battery engineering partner

Our experts use their proven expertise in new technologies to support the international automotive industry as a development partner in e-mobility. MAHLE Powertrain is working on innovations in and around the battery at the company's two battery development centers—one in Stuttgart, Germany, and one in Northampton, England. At the same time,

engineering services are increasingly in demand in this area. The work on the new M3x battery pack is a successful example of this. It was developed by MAHLE Powertrain with optimized thermal management to enable fast charging and discharging rates in high-performance electric and hybrid vehicles.

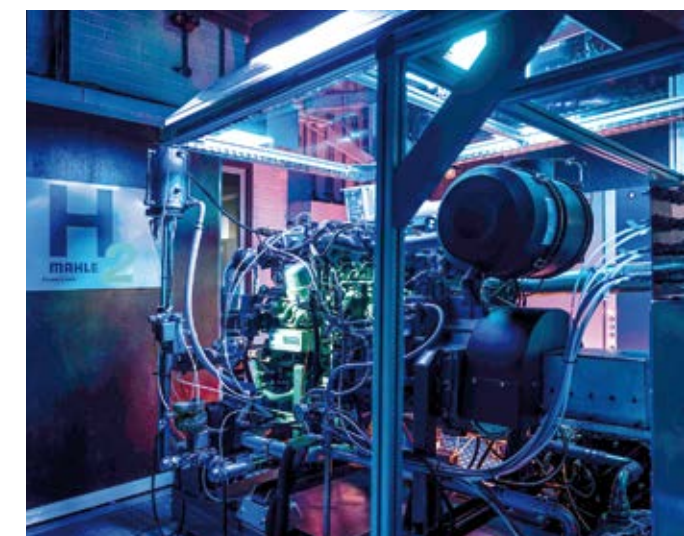
International presence

As an independent engineering services subsidiary of the MAHLE Group, MAHLE Powertrain supports customers worldwide in selecting the most suitable technologies or components for their respective needs

Vehicle chassis dynamometer with altitude and climate simulation, incl. solar load

Modern testing

In order to stay one step ahead of current technology trends, MAHLE Powertrain continuously invests in state-of-the-art development and testing infrastructure. This includes developing and testing electric drive units for a wide range of electric and hybrid vehicles. To ensure compatibility with all potential vehicle powertrain applications, systems are powered by high- and low-voltage batteries. Permanent-magnet synchronous electric motors replicate the loads applied by the driven wheels, while a thermal conditioning system allows electric drives to be tested over a broad temperature range.



Test bench for hydrogen engines

Drive for the Electrified Future

EcoRallies combine our passion for motorsports with the pursuit of sustainable and responsible action. MAHLE has been proving this for several years as part of the **FIA EcoRally Cup**.



The MAHLE team is led by Beitske Visser and Arthur Kammerer (left) and has already navigated its way through Europe multiple times in various vehicles.

The FIA EcoRally Cup is a series for electric cars and an impressive example of how motorsports is evolving. It relies on precision, efficiency, and sustainable innovation. Each rally takes place on public streets, using unmodified electric road vehicles. The 2026 season comprises eleven races in Europe and Asia.

MAHLE is the title sponsor of the 2026 EcoRally events in Valencia and Nova Gorica, which take place near our plants in Spain and Slovenia. The races begin there with technical inspections of all measuring instruments in the vehicles. This is followed by at least two days of racing covering a distance of 250 kilometers.

All teams compete in two categories. The first is called Regularity, where the aim is to maintain a constant and precise mandatory speed over all stages. The second category is Energy Performance, which evaluates driving with optimal fuel consumption throughout the entire event.

Endurance test for battery cooling

Driver Beitske Visser and co-driver Arthur Kammerer regularly participate in the series for MAHLE. Their current e-vehicle is equipped with a MAHLE low-temperature radiator, which keeps the battery coolant at exactly the right temperature, therefore ensuring maximum performance and longevity of the battery. The crew and technology will face a real endurance test in October 2026 when they head to the Dolomites in Italy, where steep climbs, icy temperatures,

and unpredictable conditions await. Another team sponsored by MAHLE secured the FIA EcoRally Cup championship title in both 2023 and 2024. The winning team covered over 65,000 electric kilometers per series, from the Arctic Circle to the heat of Portugal.

The racing series also provides important takeaways as the MAHLE Lifecycle and Mobility team can perform diagnostics on the high-voltage batteries, among other things.



>65,000 km

The winning MAHLE team covered more than **65,000 electric kilometers** per FIA EcoRally Cup season



Keep Everything Running

MAHLE offers its expertise throughout the life cycle of its vehicle technologies. That means high-quality spare parts and services from motorsports to workshop equipment. That is what the business unit for the MAHLE Lifecycle and Mobility aftermarket stands for.

→ MAHLE Aftermarket

Sustainable outfitters:

MAHLE Lifecycle and Mobility

With the growing series production of alternative drives, the spare parts and service business is also developing. Thermal management in particular is gaining in importance as the number of electric and hybrid vehicles increases significantly. Across all technologies, workshops can rely on MAHLE equipment for vehicle diagnostics, battery testing, and service work to maintain air conditioning systems and automatic transmissions.

MAHLE also supplies partners in the trade and engine repair, as well as electronic trading platforms worldwide with original equipment quality products. The aftermarket range is completed by services such as technical support worldwide as well as individual training courses and service information for all customers.

New challenges

The growth of e-mobility poses an unprecedented challenge to the automotive aftermarket and workshops in terms of the cost and complexity of battery systems. The battery itself can represent over 25 percent of the total vehicle cost. The share of vehicles with electric drive systems is rising in all relevant markets. Battery services could therefore soon account for half of the total services provided by workshops. This makes it all the more important to develop suitable diagnostic and maintenance solutions.

Training program extended

MAHLE supports workshops in mastering the challenges of new powertrain technologies. In addition to live online training, e-learning courses, and technical expertise, MAHLE continuously invests in on-site qualification programs. The new global training center in Stuttgart provides state-of-the-art training conditions across more than 1,300 square meters and enables training under real workshop conditions. Located close to the MAHLE battery center, it offers practical training in battery testing, diagnostics, and electric mobility. Further training centers modeled on the Stuttgart facility are already being established around the world.

Supporting the “Workshop Heroes”

MAHLE has responded to the ongoing transformation of the aftermarket sector with its global “Workshop Heroes” campaign. What began as a campaign at Automechanika Frankfurt 2023 has since evolved into a guiding philosophy. At its core are the people working in workshops who are driving the transformation from traditional repair shops to digital service centers every day. As a full-service provider, MAHLE supports workshops with expertise, OE-quality parts, and state-of-the-art workshop equipment designed for the mobility needs of tomorrow.

It conveys the message that every day mechanics ensure millions of people around the world remain on the move and keep a cool head when things get complicated.

ENGINE COMPONENTS · ENGINE PERIPHERALS · GASKETS · FILTERS · ELECTRICS · E-MOBILITY & ELECTRONICS
THERMAL MANAGEMENT (ENGINE COOLING & AIR CONDITIONING) · WORKSHOP EQUIPMENT & DIAGNOSTICS



mahle-aftermarket.com

MAHLE

Workshop of the Future

The workshop of the future will evolve from a traditional repair shop into a digital, customer-centric service hub. Through its holistic ecosystem, MAHLE efficiently connects vehicle parts, expertise, diagnostics, and workshop equipment. The new MAHLE Workshop Portal brings together technical information, training, repair solutions, and support on a single platform. The offering is complemented by **MAHLE Battery Workshop Support**, which enables safe and informed repair decisions for high-voltage batteries, and **MAHLE Mobile Service**, which brings professional workshop services directly to the customer. In this way, MAHLE empowers workshops of all sizes to benefit from the opportunities created by digitalization and connectivity through flexible and scalable solutions.



Calibrating with AI

MAHLE has released an update on the increasing calibration effort in workshops for driver assistance systems. The TechPro® Digital ADAS 2.0 system uses artificial intelligence. This recognizes the vehicle together with the control unit and automatically adapts the digital calibration panel from MAHLE to the respective vehicle. This saves several process steps per vehicle. To simplify the learning process for the service staff, the application features 3D tutorials.

MAHLE has expanded the possibilities of ADAS calibration with the new Digital ADAS 2.0 EXTRA. The system features a rotatable high-resolution 75-inch display that shows calibration targets true to scale. This enables the precise calibration of driver assistance systems in passenger cars and commercial vehicles and is particularly important for remote diagnostics.

Maximum diagnostic possibilities

MAHLE has introduced RemotePRO Air for the TechPRO® 2 diagnostic tool, giving independent workshops access to the data interfaces of modern connected vehicles for the first time without the need for additional hardware. The innovative remote diagnostics solution enables location-independent access to vehicle data and opens up new possibilities for faster and more efficient diagnosis. Workshops benefit from reduced repair times, optimized scheduling and resource planning, as well as improved customer communication. The solution is already available for numerous vehicle models and is being continuously expanded.

Healthy batteries

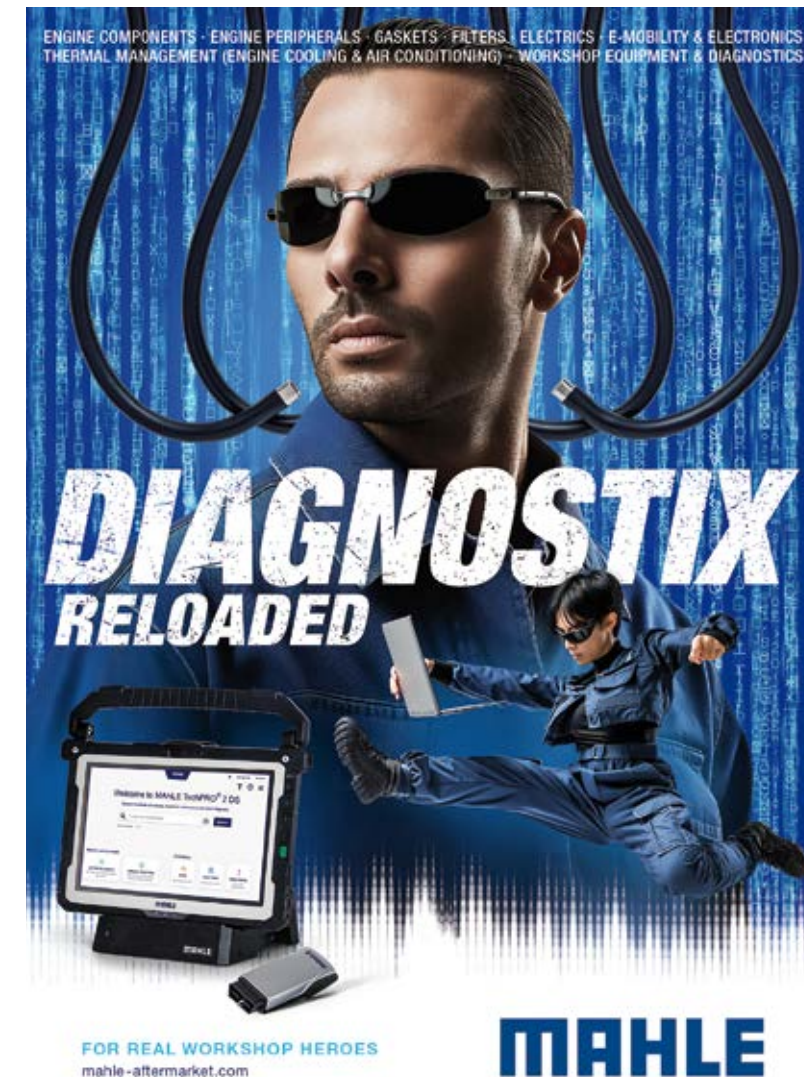
MAHLE enables independent workshops worldwide to carry out battery diagnostics on electric vehicles. For this purpose, our Aftermarket specialists have equipped their TechPRO® 2 diagnostic tool with new software. But there is more to the complete package for healthy batteries:

E-SCAN

With E-SCAN, the status of the battery can be monitored. To do this, the program reads all relevant battery parameters and creates a standardized report. The new function will be installed on the BRAIN BEE CONNEX and MAHLE TechPRO® diagnostic tools.

E-HEALTH Charge

E-HEALTH Charge provides reliable information about the health status and performance of high-voltage batteries in electric vehicles. With a test duration of no more than 15 minutes, it is one of the fastest static battery diagnostic solutions on the market. The system consists of the E-CHARGE 20 battery charger and the E-HEALTH app, combining battery charging and diagnostics in a single process. It is compatible with vehicles from all manufacturers. Data collected by the charger and the OBD interface are securely analyzed in the cloud, compared with datasets from batteries of the same type, and evaluated against the original capacity of the vehicle model. This enables a reliable assessment of battery condition and performance. E-HEALTH Charge can also be



used as a standalone DC charger. No prior knowledge or special training is required for operation.

E-CARE Fluid

Vehicle and coolant manufacturers set certain replacement intervals for the coolants used, depending on the available WLTP remaining range. MAHLE offers the new E-CARE Fluid service device for maintaining cooling circuits. This enables workshops to offer additional services related to the maintenance of electric vehicles.

Replacements Are Provided

ENGINE COMPONENTS · ENGINE PERIPHERALS · GASKETS · FILTERS · ELECTRICS · E-MOBILITY & ELECTRONICS
THERMAL MANAGEMENT (ENGINE COOLING & AIR CONDITIONING) · WORKSHOP EQUIPMENT & DIAGNOSTICS



As an original equipment manufacturer and development partner of the global automotive industry, we have built up comprehensive expertise over more than 100 years. MAHLE offers its customers a broad product portfolio covering engine systems and components, filtration, electrics and electronics, and thermal management. The global network provides customers with on-site support on many issues.

Filters

The complete filter program in original equipment quality. All filters are highly effective in protecting people, engines, and the environment. **Moreover: the portfolio is continuously expanded with innovative products such as the new CareMetix® Natural cabin filter featuring natural sheep wool.** Depending on the specification and application, our filter media range consists of specially treated papers, fleeces or multilayer filter media.



Thermal management

MAHLE is a global leader and supplier in the field of thermal management. We offer a complete range of products, services and workshop solutions for the reliable maintenance and repair of passenger cars and commercial vehicles of all drive types. **This includes around 8,100 spare parts and associated maintenance information. From the coolant cooler to electric water pumps and A/C compressors—MAHLE is a reliable partner for the key technologies of air conditioning and engine cooling.**



Engine and peripherals

MAHLE customers can rely on more than 100 years of experience and around 7,000 spare parts for engine components such as pistons and cylinders. **In the growing aftermarket for internal combustion engines, MAHLE continues to expand its offering in the area of engine peripherals. The portfolio includes repair parts such as air intake modules, cylinder head covers, and oil filter modules.** The range is continuously expanded in line with market requirements. The quality of products "Made by MAHLE" has clear advantages in the aftermarket: it ensures reliable function and a well-protected engine.



E-mobility and electronics

In the fields of e-mobility and electronics, MAHLE provides comprehensive technical support through dedicated product specialists. For the growing e-mobility aftermarket, MAHLE already offers a broad product portfolio. **This includes actuators, switches, and sensors, as well as high-performance electronics such as DC/DC converters and on-board chargers. The range is further complemented by input filters and charging cables for electric vehicles.** Customers benefit not only from a comprehensive product portfolio, but also from integrated development and manufacturing expertise as well as a global network with local points of contact.



Electrics

Whether it's starter motors, alternators, ignition coils, or starter batteries—our solutions stand for maximum reliability and performance. They are optimized for use in passenger cars, commercial vehicles, agricultural and construction machinery, as well as boats and golf carts. **All components are electromagnetically compatible, comply with international standards, and have an impressively long service life.** We offer OEM-quality solutions thanks to simple assembly, available spare parts, and the absence of a core deposit system.

MAHLE — A Journey Through Time

Strategic cooperation

In a competition organized by the Ministry of Transport, the Hirth aluminum pistons win second and third prize; the Chemische Fabrik Griesheim-Elektron takes first and fourth place. To be able to manufacture the product in series, the two prize-winners join forces.



1921

From managing director to entrepreneur

Hermann and Ernst Mahle acquire a 33 percent stake and a few months later become the sole shareholders of the company with four business areas: Pistons, filters, pressure die casting, and aircraft wheels.



1932

New paths

The war costs MAHLE 60 percent of its corporate value and assets. Ernst Mahle starts a piston production facility in Brazil under a MAHLE license. Metal Leve S.A. in Sao Paulo becomes the biggest manufacturer in South America. In Germany, his brother starts out again by manufacturing what is most urgently needed: repair pistons, handcarts and kitchen appliances—and then quickly becomes part of the “Economic Miracle.”



1945

Lifetime achievement

Hermann and Ernst Mahle step down from their company and look back on a great life's work. Meanwhile, MAHLE GmbH employs more than 6,000 staff and generates annual sales of over 400 million DM.

1971

1920



The beginning

In a backyard garage in Bad Cannstatt, Hellmut Hirth is developing two-stroke engines. Technical difficulties emerge, and the bank balance is melting away. Seeking commercial backing, he finds it in Hermann Mahle, who joins the company on December 1, 1920. This day is considered the founding anniversary of MAHLE.

1922

A strong duo

The company grows rapidly to 200 employees, who have already turned out around 40,000 pistons since its founding. Technical challenges, however, remain. To deal with them, Hermann Mahle brings in his brother Ernst, an engineer.



1938

MAHLE KG

After a change of name from Leichtmetall-Werke to Elektronmetall G.m.b.H., Stuttgart-Cannstatt, in 1924, the Mahle brothers now convert their company into a limited partnership: MAHLE KG. They also devise a new logo: the MAHLE logotype, which has remained virtually unchanged to this day.

1964



Social commitment

The common good is important to the Mahle brothers. After founding the EC Pension Association in 1935 and building settlements for their employees in 1938, they transfer their company to the MAHLE Foundation in 1964.

1972

Cornerstone

In 1941, MAHLE had to give up its filter division because of the war. Now, the company expands its range of products by acquiring a stake in Knecht Filterwerke GmbH. The filter division develops into a cornerstone of the Group on the path to becoming a systems provider.



Partners with a system

MAHLE develops from a components manufacturer into a development partner for systems and modules. After acquiring the companies J. Wizemann (1991) and Pleuco (1994), valve train systems are also added to the portfolio.



1991

Restructuring

In ten years, the number of employees has risen from 13,800 to 30,650, and sales have gone up from just under 1 billion to 3.25 billion. This calls for a restructuring of the global business areas. In 2005, MAHLE supplements its engine expertise with the purchase of the Cosworth Technology Group, now MAHLE Powertrain.

2003

Electric drives for two-wheelers

Acquiring the Spanish company Ebike-motion Technologies SL, MAHLE enters the e-bike business. Now called MAHLE SmartBike Systems, the company manufactures particularly light-weight and compact bicycle drives.



2018

Fresh ideas for e-mobility

MAHLE underscores its expertise in the e-mobility sector with the new corporate spin-off MAHLE chargeBIG. Founded in 2018 as a start-up from an internal innovation program, the division develops intelligent solutions for vehicle charging infrastructure.



2022

1975



Global presence

Until now, MAHLE has manufactured only in Germany, and cooperates with international licensees. There are no MAHLE-owned production locations outside Germany. **This changes in 1975, when the first plant opens in the USA, followed by a location in Brazil in 1978.**

1997

Commitment in Asia

The joint venture MAHLE MWP Migma Ltd. in India marks the start of business in the Far East. Acquisitions of the Japanese companies Izumi and Tennex follow in 1999 and 2001. **MAHLE becomes the world's biggest supplier of filter systems.**



2010



MAHLE + Behr = Mehr (More)

Engine cooling and air conditioning are important future issues. Behr is the ideal partner here with over 100 years of expertise in this field. **MAHLE gradually becomes the majority shareholder, and in 2013, Behr, with its 17,000 employees and 38 locations, forms the new Thermal Management business unit.**

2024

Pioneering Work in Brazil

At the Biomobility Center in Jundiaí, MAHLE operates its global competence center for sustainable fuels and materials. The aim of its research activities is to significantly increase the share of renewable fuels worldwide and thereby accelerate the decarbonization of mobility.



2025

New architecture for future success

MAHLE increases its stakes in MAHLE Behr GmbH & Co. KG to 100 percent. At the same time, the company is streamlining its group structure by reorganizing and merging its business units. MAHLE is thus taking an important step toward becoming more efficient and faster in the implementation of its MAHLE 2030+ strategy and strengthening its strategic areas.

MAHLE GmbH
Pragstraße 26–46
70376 Stuttgart/Germany
Phone: +49 711 501-0

www.mahle.com