

TEAM APPO

Engineering the Future – since 1758.

MAN SE



MP
TEA

TEMPO

We will see more changes in the next ten years than we have in the last five decades. Innovative solutions in the fields of transportation and energy are becoming increasingly important, and demand for them is growing rapidly.

We are putting this development to good use – with new concepts and products, cooperation initiatives and services. We are advising major cities on how to develop a modern transportation infrastructure. We are automating the transportation of goods. We are moving away from components to become a system provider, a one-stop shop for drives along with monitoring, consulting, and other types of services.

If we want to meet the challenges of the future successfully, we have to rise to them today – of that much we are sure. This is why we are engineering the future of MAN and our customers right here, right now.

By upping the tempo.

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A CITY IN MOTION

Setting the course for the future: Munich is aiming to electrify its entire public bus network. MAN Truck & Bus is on hand to provide help and advice for the transition.

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A modern way to manufacture: the MAN Latin America smart factory in Brazil has reached an automation level of 60%. Starting in 2020, it will manufacture the e-Delivery – a fully electric truck for urban logistics.

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Seizing opportunities: a road test involving MAN Truck & Bus trucks driving on the A9 in a platoon will begin in 2018. Platoons make the roads safer, while the minimal distance between the vehicles saves fuel, emissions, and space.

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Lowering fuel consumption: MAN's mechanical engineering companies make their customers more profitable – be it with the help of gigantic testing systems for aircraft engines or new propulsion systems for ships.

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Making customers' dreams come true: MAN Truck & Bus presents tailored transportation solutions in the form of new truck driver cabs, the TGE, a powerful tractor engine, and the new edition of the MAN Lion's Coach.

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Upping their game: MAN PrimeServ is using state-of-the-art sensor technology to monitor more than 200 power plants and marine engines worldwide, empowering customers like Stena Line to achieve optimum performance.

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WASTE TO WARMTH

Generating eco-friendly energy: a MARC4 turbine from MAN Diesel & Turbo will enable 25,000 households in the Ruhr region to be supplied with more district heating from waste recycling than was previously possible.



Soon blocked: late afternoon sees vehicle after vehicle line up on Munich's Ludwigstraße.

W

A CITY



A model for the future: separate bus lanes guarantee that the buses can get through quickly and are set to be converted into bus corridors.

Munich

4:30 p.m.

As soon as people start to finish work, things get really busy. Because Munich is expanding constantly, the number of cars fighting for space on its roads is also rising, which drives up pollutant emissions and makes the Bavarian capital even noisier. The City of Munich's public utilities provider and its transportation operator are working to solve this problem. Together with the MAN Transport Solutions consultancy, they are devising a future-proof concept to further expand the public transportation network.

MOTION



Working together toward an electric bus fleet: Stefan Sahlmann, Head of MAN Transport Solutions, Ralf Willrett, Head of MVG's Bus division, and Ingo Wortmann, SWM Director for Mobility and responsible for MVG (from left to right).

Stefan Sahlmann gets to the heart of the complex task ahead: "The future of Munich's transportation infrastructure lies in continuous renewal, in expanding the structures that are already in place, and in switching to new drive types." An industrial engineer by trade, he is heading up the team at MAN Transport Solutions, a consultancy created by MAN Truck & Bus to support transportation companies and fleet operators in navigating the path to alternative drives – be it for their buses or trucks. A team of six people develops solutions for infrastructure and fleet design, ascertains energy needs, and works out strategies to meet these needs in a cost-efficient way. The experts are also happy to answer any questions about maintenance concepts and service. As part of this endeavor, MAN Truck & Bus, Munich's transportation operator MVG, and its public utilities provider SWM have entered into an innovation partnership.

MVG has plans to gradually electrify its entire bus fleet. This requires electric vehicles to become just as cost-efficient as their diesel-powered counterparts, one step at a time. "This may happen by 2030 and is a big step for us," Ralf Willrett, Head of the Bus division at MVG, says. Another goal is to make public transportation even more flexible and attractive, especially for people who still prefer driving. Willrett explains that in light of these challenges, the partners are striving for a continuous expansion of the existing network. Ingo Wortmann, SWM Director for Mobility and responsible for MVG, says: "The existing transportation network is being pushed to its limits, so we believe urgent action is required. In order to make our services even more

attractive and efficient, we are focusing on dedicated busways and separate lanes for public transportation, to name a few."

Willrett describes this process, which MVG and SWM have initiated and which they hope to bring to completion with the help of MAN Truck & Bus, as the dawn of a new era. After all, simply replacing combustion engines with electric ones and swapping diesel tanks for battery packs is not enough. Electrifying an entire public transportation network is a mammoth task. "We are taking into account all aspects of the transition," Sahlmann, Head of MAN Transport Solutions, explains. This includes planning new routes and optimizing existing vehicle schedules – i.e., the number of journeys each vehicle has to complete. Charge management and new operating procedures also have a key role to play.

A system transformed

The MAN Truck & Bus portfolio already includes vehicles powered by gas as well as hybrid solutions and so-called bus trains. These buses with trailers attached to them are 23 meters long and can accommodate around 130 passengers, boosting the city's transportation capacity by up to 30%. Around 50 bus trains from MAN Truck & Bus are now in operation in Munich, dispatched primarily to relieve pressure on heavily frequented routes. However, Stefan Sahlmann stresses that at the end of the day, the decisive factor in creating future-proof public transportation is electric mobility. MAN Truck & Bus's first generation of electric city buses is due to launch before 2020 – after which the buses will also be in operation on the roads of the Bavarian capital.



The bus train can accommodate 130 people: the number of these blue tractor vehicles and trailers is on the rise in the Bavarian capital.



Raising the profile:
MVG plans to offer
its customers an
even more extensive
network in the
future.

The MVG experts and the team at MAN Transport Solutions come together in regular workshops in a quest to fully electrify Munich's bus operations. Sahlmann is clearly confident: "If you want to master the complex requirements of electric mobility, you have to prepare for the introduction of electric buses meticulously and plan their deployment extensively." The work his team does is based on data – mobility data. "The first thing we need is a fundamental analysis: how do the buses drive, how are they used? What parameters have a particularly strong impact on how much energy they use? What does the profile of the journey look like? How much traffic is there on that route at a particular time of day? We basically have to map the worst-case scenario," Sahlmann explains. The worst-case scenario is a traffic jam, which is where energy use is particularly high.

Naturally, an electric vehicle can get stuck in a traffic jam the same way a car running on fuel can, which is why the MAN Transport Solutions team is focusing on developing solutions to make public transportation not just more eco-friendly, low-emission, and quieter, but also more intelligent. Along with new, innovative solutions for energy management, this also includes proposals for shorter routes or optimized bus stop networks. "If I only have to change twice instead of four times, that saves me a lot more time than if the bus goes three kilometers an hour faster," Sahlmann says, while Ingo Wortmann, who works for SWM, adds: "That is exactly how we are going to make our public transportation more attractive."

Driver training

When it comes to large-scale projects like this one, ultimately every detail counts. "The buses' range is something we are devoting a lot of attention to," says Willrett, who works as Head of the Bus division at MVG. This is because the buses would normally charge overnight and is something Sahlmann is keeping an eye on: "If it so happens that after charging overnight, the bus runs out of battery before it can complete the journeys required for the day, we will look for the right time to charge it between vehicle rotations, either en route or at the depot." Be that as it may, there are plenty of other hurdles to overcome – from the route in question and time spent on the road through driver training. With that in mind, MAN Transport Solutions also offers training measures enabling drivers to make the most of the efficiency gains expected from their vehicle in their daily work. After all, it is also about the person behind the wheel.

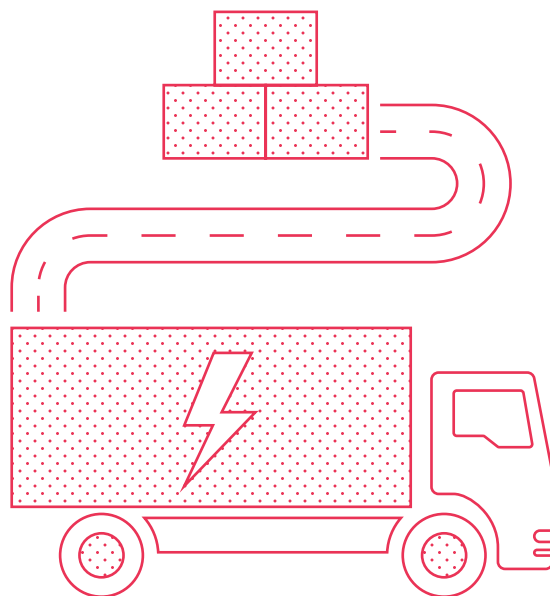
Full of energy: setting the course for the future

Electric platform for trucks and buses

Growing cities, booming online sales – no wonder alternative drives that make intercity traffic less noisy and lower emissions are becoming increasingly important. MAN Truck & Bus is focusing on electric drives when it comes to last-mile distribution and urban transportation. The company is working on a comprehensive range of electric vehicles for medium- and heavy-duty distribution, as well as for city buses. At the heart of these vehicles is the electric drive-train. It is designed in a way that means it can be used to power both distribution trucks and city buses of the future electric generation as a universal modular element.

A field test for electric trucks

The Council for Sustainable Logistics (Council für nachhaltige Logistik – CNL) and MAN Truck & Bus are working together to develop electric trucks for inner-city delivery operations. CNL's members include 17 of Austria's largest retail, logistics, and production companies – with names like dpd, Hofer, Metro, REWE, and Spar. In 2018, these companies will receive nine battery-driven trucks from the TGM range to road test in real-life everyday conditions. MAN Truck & Bus intends to use the insights gained as a result of this process to develop this new technology further. Serial production of electric trucks is scheduled to start in 2021.



QUIET

Resende, Brazil

6:00 a.m.

A prototype worth seeing: the fully electric e-Delivery has a range of 200 kilometers and will be launched in 2020.



Morning has barely broken, and high-tech robots are already hard at work. MAN Latin America of today is showing what truck production of tomorrow could look like.

There is whirring and clattering going on. All of a sudden, sparks begin to fly as one of the welding robots gets to work. Together with other fully automatic helpers, it has 2,500 positions to weld every five minutes. The new smart factory in Resende, a town located between Rio de Janeiro and São Paulo, is a precision lab. An advanced Industry 4.0 concept steers 38 robots, making the smart factory's manufacturing process for driver cabs on the new Delivery series 60% automated. The production space at the Resende plant was expanded to almost 5,000 square meters in 2017. The area where driver cabs for the Delivery range are produced, alone, has grown by one third.

REV

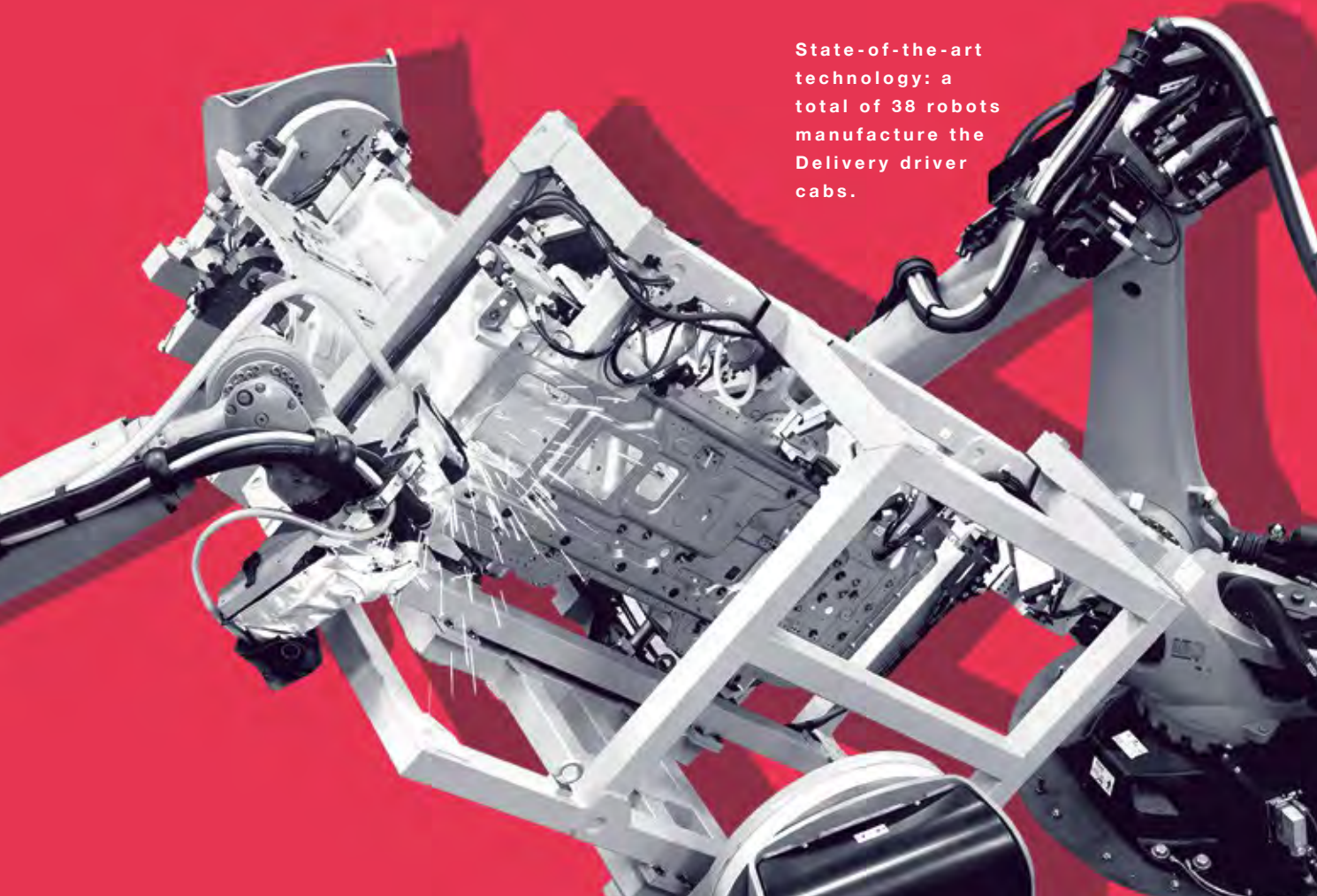
The new Delivery vehicles were presented at the 2017 Fenatran, Latin America's key trade show for commercial vehicles, their weight ranging from 3.5 to 13 tons. The Resende plant will begin production of the e-Delivery, a fully electric truck with a total weight of between nine and eleven tons and the first of its kind in this category, in 2020. Until production gets underway, prototypes will be road tested in major Brazilian cities.

MAN Latin America plans to move development up a gear after CEO Antonio

Roberto Cortes forecasted high growth in the light-duty commercial vehicles segment in Brazil – and, indeed, the rest of the world – in the years to come. With this in mind, MAN Latin America intends to increase the percentage small trucks make up of its total revenue from just under one third to 40%. “The e-Delivery marks a milestone in our history,” Cortes makes clear.

The growing demand for light-duty trucks is linked to the gradual recovery of the Brazilian economy. For the first time in two years,

the country's gross domestic product headed north again in 2017. At the same time, rapid growth in online sales is fueling the delivery and parcel service boom. Vans with a load capacity of up to 13 tons are in particular demand in these segments. With a driving range of some 200 kilometers, the e-Delivery also appeals to suppliers of beverages, with brewery Ambev one of the first to test it. By developing this electric distribution truck, MAN Latin America is making a giant leap toward a digital and ecological future.



State-of-the-art technology: a total of 38 robots manufacture the Delivery driver cabs.

EVOLUTION

ON

From steering actuators and cameras all the way to radars: a whole range of control units and assistance systems are required to securely connect two semitrailer combinations in a platoon.

A9 near Ingolstadt

9:20 a.m.

Revolution has come to the cockpit – to the digital test field on the highway between Munich and Nuremberg, to be precise. Two MAN Truck & Bus semi-trailer combinations will move in so-called platoons here, driving at up to 80 kilometers an hour, only about 15 meters apart. An electronic drawbar connects the vehicles to each other safely, which is what makes this space-saving and fuel-efficient convoy possible. Special WiFi enables them to communicate with each other and makes automated driving possible.



THE

1 Antenna

Antennas transmit signals – which is how the vehicles exchange data. The signal is transmitted via ITS-G5, a WiFi standard that was developed for vehicle-to-vehicle communication.

2 Camera

Other road users have an impact on the semitrailer combinations' driving. Cameras record what happens around the vehicles, evaluate the images, and forward the data to the semi-automated system.

3 Brake system

As soon as the first semitrailer combination brakes, the second one also has to react, which is why, as part of this project, MAN is upgrading its brake system to include an interface connecting the vehicles together.

4 Radar

Radars transmit electromagnetic waves. These are reflected off other vehicles or objects and provide information about their location and speed.

5 Lidar

To make driving in platoons possible, MAN is equipping the vehicles with lidar sensors, which measure light pulses to calculate the distance between the semitrailer combinations and the distance to the surrounding objects down to the last centimeter.

6 Steering actuator

In order for automated driving in platoons to be a viable option, the vehicles' movements must be coordinated, which is why MAN is installing actuators.

GO

A semitrailer combination driving on a highway in Germany has to stay 50 meters behind the vehicle in front of it. Vehicles in a platoon can move closer together until they are about 15 meters apart – a distance guaranteed by the electronic drawbar.



The two semitrailer combinations will be driving on the A9 highway from May 2018 onward, just once or twice a week at first and without any cargo. As the year goes on, the scope of the testing will be expanded to include regular distribution runs with boxes and parcels. The idea is for these high-tech semitrailer combinations to then shuttle between the DB Schenker Logistics Centers in Munich and Nuremberg up to three times a day. The driver behind the wheel of the first semitrailer combination sets the direction and speed, while the second one follows in its slipstream.

The pilot project forms part of a cooperation initiative in place between MAN Truck & Bus, DB Schenker, and the Fresenius University of Applied Sciences. Its aim is to test how practical platooning is as a solution and how safe the corresponding system is – both on the roads and as part of logistics processes. Gerhard Klein, Engineering Central Head at MAN Truck & Bus, is confident: “Projects like this one make us forerunners in researching the scope of automated driving, which will contribute considerably to improving safety and taking the pressure off the driver in the future.” The project partners have plenty of questions to clarify: in what conditions does it make sense to use platoons? How can the vehicles be linked together in moving traffic? And: how much fuel can you save depending on different weather and wind conditions? Initial answers to these questions will be available in December 2018.

The studies MAN Truck & Bus has carried out so far show a lot of potential. “The extent to which platooning can lower fuel consumption depends on the position of the vehicle in question,” says Klein. This also goes hand in hand with cutting CO₂ emissions. Since the semitrailer combinations drive very close to each other, they also need less space on what tend to be congested highways.

Gerhard Klein believes that “Autonomous driving is an important asset we have for optimizing the entire logistics chain further.” As its cooperation with DB Schenker continues, MAN will combine platooning with digital solutions to develop customer-focused business models. Ewald Kaiser, Chief Operating Officer responsible for Freight at DB Schenker, also believes platooning presents considerable opportunities for the freight industry: “Connected and autonomous driving will revolutionize the transportation of the future.”

Automation in test mode

Construction: safety first

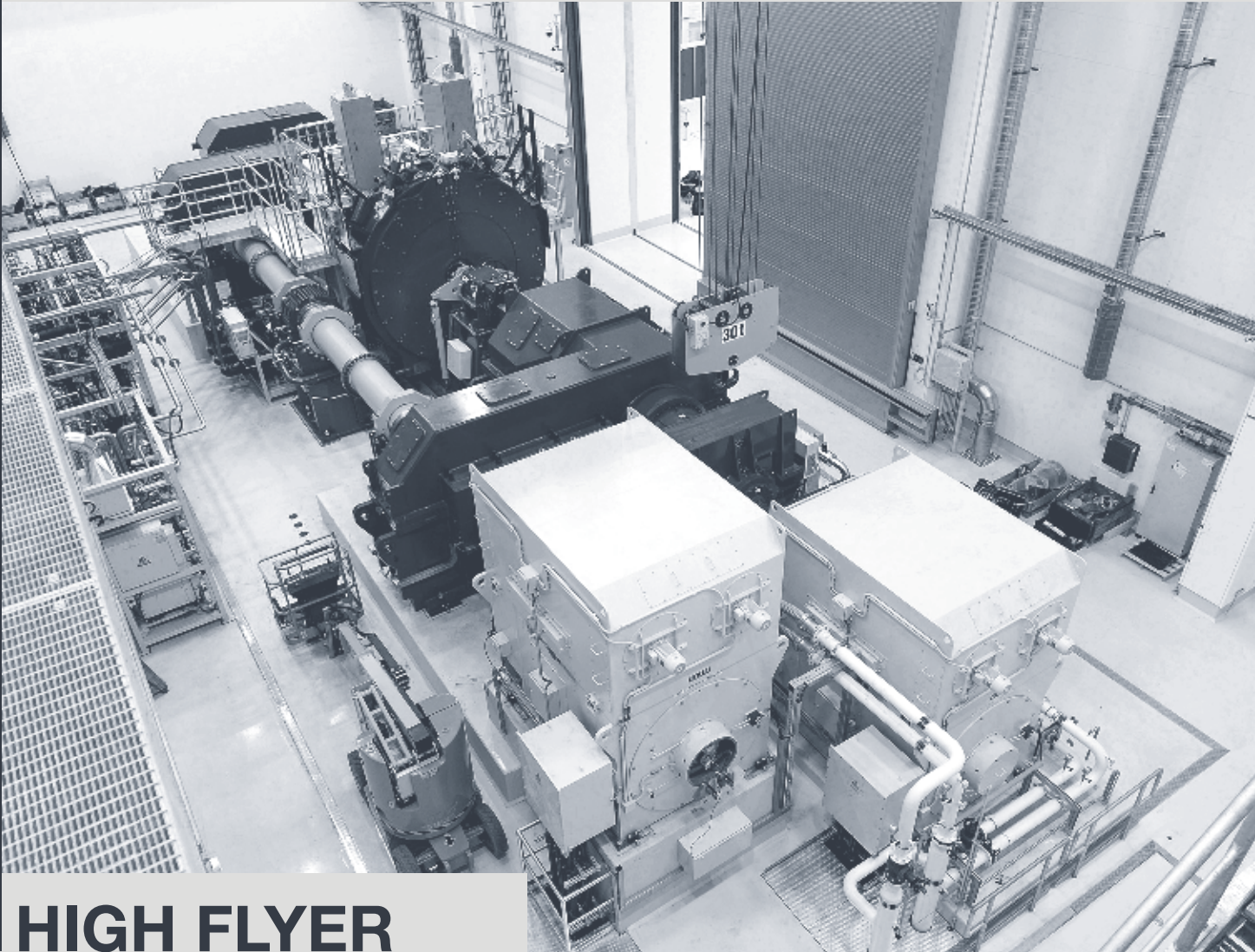
MAN is also playing a pivotal role in a project that focuses on automated and driverless safety vehicles for roadwork on highways. The project, known under the aFAS abbreviation in German, is funded by the German Federal Ministry for Economic Affairs and Energy. Even though they have highly visible warning equipment, safety vehicles are still frequently involved in rear-end collisions. MAN has therefore joined seven other partners from the fields of industry, research, and administration to develop a prototype driverless safety vehicle that follows the machinery used in mobile roadwork. As part of this cooperation, MAN is responsible for the driving function, the radio communication, the human-machine interface, and the vehicle as a whole. The plan is to road test the prototype at the start of 2018.

In the Port of Hamburg without a driver

Preparations are underway at MAN Truck & Bus for another pilot project: autonomous trucks are due to be road tested as part of a pilot run in an area of the Port of Hamburg from 2020 onward. The first stage of the testing will take part in a closed area in the container terminal, while the second step is set to involve the use of driverless MAN Truck & Bus vehicles as shuttles to the empty container depot. The Port is particularly well-suited for this road test – after all, it has a less complicated architectural design than a city does, the traffic flow is less dense, and there are fewer road users such as cyclists. The project has been brought to life in conjunction with one of the main themes of the Intelligent Transport System World Congress, which Hamburg will host in 2021.



HIGHLIGHTS 2017



HIGH FLYER

A milestone for MAN subsidiary Renk: the testing system it built for engine manufacturer Rolls-Royce is the largest and most powerful in the world. “This is a unique piece of equipment capable of testing gear units with an output of up to 100 megawatts,” Jens Schneider, Project Manager at Renk Test System GmbH, says. He adds: “It is the largest order in our company’s history.” The testing system was initially built at the Augsburg plant, and summer 2017 then saw the first engine gearbox tested at the customer’s facility in Brandenburg – just 36 months after receiving the order.

Rolls-Royce is working on the next generation of aircraft engines. Renk built the giant testing system, which weighs 400 tons, for the world’s most powerful aerospace gearbox: Rolls-Royce intends to use its UltraFan engine to make aviation history. The engine is due to launch in 2025 and is set to use less fuel than its traditional counterparts thanks to improved efficiency and reduced weight.

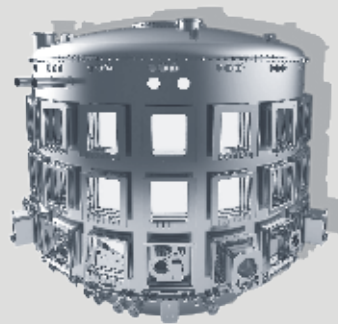
Giant gearbox testing system: produced by Renk, for Rolls-Royce.

THE POWER OF THE SUN

A new way to generate electricity: why bother splitting atoms when you can melt them, releasing enormous quantities of energy in the process? The zero-emission and resource-efficient fusion reactors would be the perfect solution to meet global energy needs. That is exactly what the International Thermonuclear Experimental Reactor in Cadarache in the south of France is working toward. MAN Diesel & Turbo has also been involved in the development process since 2012. It signed another contract to manufacture central components in the summer of 2017. MAN is to provide 13 port stubs that will then be installed in the reactor's vacuum vessel. "Our experts are involved in building a fusion reactor that might soon show us that we can generate energy from atoms the same way we do with the sun," Dr. Uwe Lauber, Chief Executive Officer of MAN Diesel & Turbo, explains.

"We're proud to be part of what is currently the most ambitious energy project in the world."

Dr. Uwe Lauber, Chief Executive Officer of MAN Diesel & Turbo



The reactor's vacuum vessel weighs around 8,000 tons and shields the plasma from the outside world.

RIDING THE WAVES

Sailing along the Strait of Messina at 15 knots: the first LNG-fueled ferry has been in operation between Sicily and mainland Italy since 2018. The MAN Cryo system supplies fuel for its three dual-fuel engines and was delivered in November 2017. The ferry can carry 1,500 passengers and 290 vehicles.

MAN Cryo is based in Gothenburg and is one of the world's leading manufacturers of cryogenic equipment for the storage, distribution, and transportation of liquefied natural gas (or LNG for short). This MAN Diesel & Turbo brand does not just develop equipment for marine gas fuel systems, it also works on offshore and onshore bunkering solutions.



MARITIME ENERGY

Investing in the future: in

early 2017, MAN Diesel & Turbo acquired a 40% stake in Aspin Kemp & Associates (AKA), a Canadian family-run company specializing in onboard power supply, energy management, and electric propulsion systems for maritime applications. "AKA's specialized expertise links battery storage systems and marine engines, bringing us one step closer to our strategic goal of further establishing ourselves as a principal system supplier for energy management on board ships," says Dr. Uwe Lauber, Chief Executive Officer of MAN Diesel & Turbo.

QUITE THE

Highly complex guide vane segments for gas turbines are the first components in serial production that MAN Diesel & Turbo has produced using 3D printing.

Oberhausen

9:45 a.m.

A sunny spring morning at the turbomachinery plant in Oberhausen. Dr. Christopher Antes is ready for his interview. Today, the spotlight is on 3D printing. As far as the Senior Vice President for Turbomachinery at MAN Diesel & Turbo is concerned, additive manufacturing is the future. Not only does it enable the company to speed up its development processes and save money, it also opens up a whole new world of geometries and structures for components.

SMA

Eyes firmly on the road ahead: Dr. Christopher Antes sees major potential in industrial 3D printing. 3D technology makes swift development, greater efficiency, and new geometries a reality for components.



SMART PART



3D printing means the guide vane segments that go into an MAN gas turbine can be printed in a single piece. In the past, they would consist of twelve separate guide vane parts.

Dr. Antes, MAN Diesel & Turbo is the world's first manufacturer to produce guide vane segments for gas turbines using 3D printing. Out of all components, why that one?

It makes the most financial sense to use 3D printing for components weighing one kilogram or less. Guide vane segments, which regulate the flow of air in a gas turbine, lend themselves exceptionally well to this: they are ten centimeters long and weigh around 300 grams. Our tests have shown that the material quality and functionality of a 3D component are just as good as those we see in parts produced using traditional manufacturing methods. That was an important achievement and the first step toward serial production.

So you are saying that quality and functionality hold up well. Does this new technology offer any other advantages?

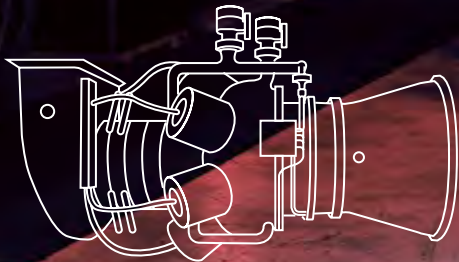
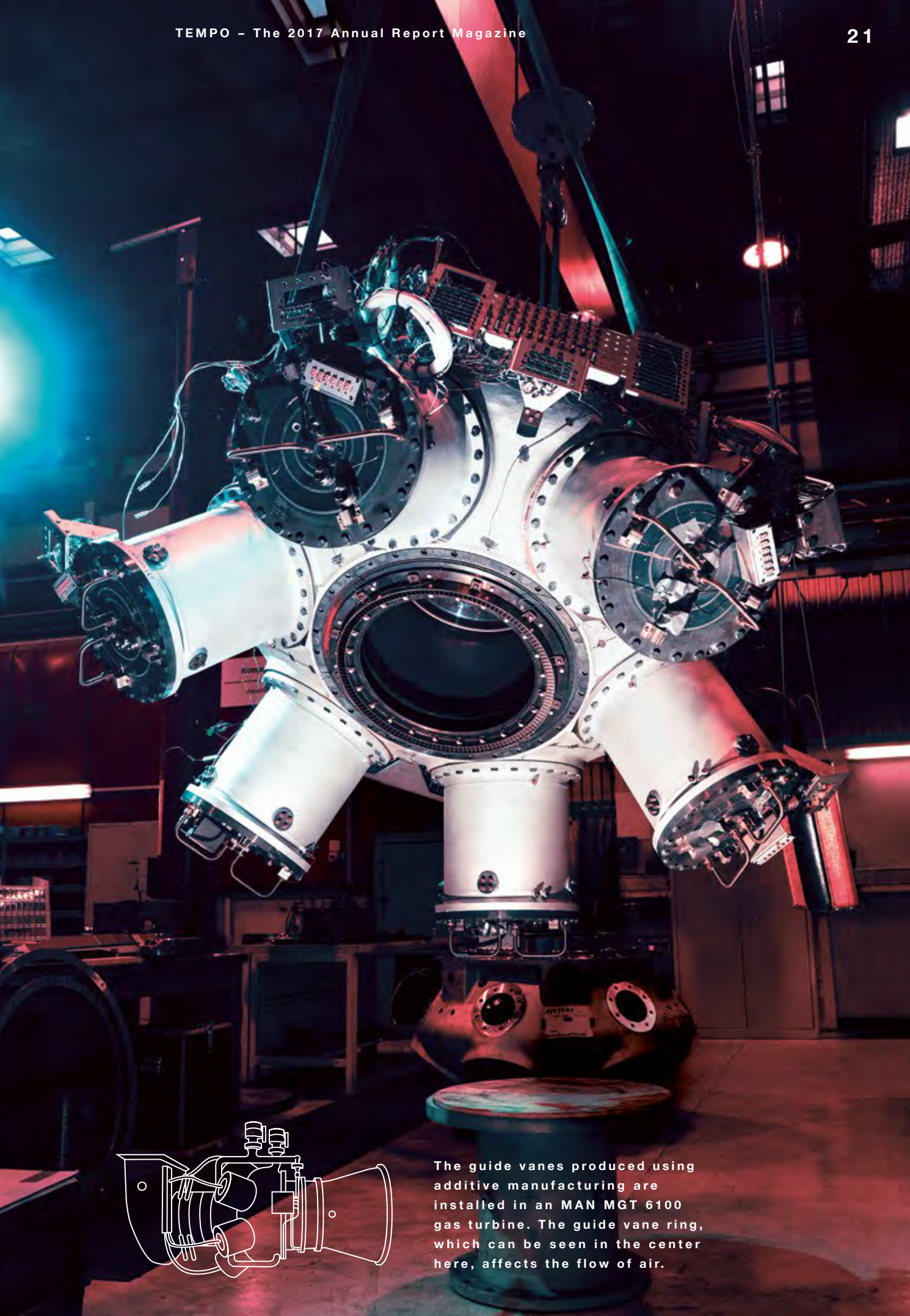
In the past, we would first shape the individual parts of the guide vane ring from a block of metal using lathes and milling machines before assembling them together. 3D printing enables us to create completely new geometries: in a single piece without any seams. We build up larger parts of the ring using a high-power laser to melt the powdered metal, which then forms several layers upon solidifying and gives the object its desired shape. The guide vane ring has gone from having 144 parts to just twelve, which reduces gaps between the components of the gas turbine and helps to seal the air in. This gives us a huge advantage because it makes the turbine more efficient.

What does 3D printing mean for the production process?

It means we can manufacture products like the guide vane segments quicker, more efficiently, at a lower cost, and with more flexibility. The benefits can already be reaped during the development period. It takes around 18 months to develop a new guide vane using traditional production methods. With 3D printing, we can halve the time to market, or in our case, the time to serial production. To do this, we work with a so-called digital twin, a virtual model of the real-life machine we use to design, simulate, and optimize the guide vane, which we can then print out and test as a prototype. The fact that all our processes are digital and that we have slashed the number of interfaces also saves us time.

Up until now, you have only used additive manufacturing for serial production of guide vane segments. What other products are suitable for 3D printing?

For the time being, the use of 3D printers will pay off anywhere we can develop structures that would have been impossible to realize using traditional methods. For example, we are currently trialing 3D printing for compressor impellers, one of the key components of MAN turbomachinery. Using additive manufacturing, we can cut material usage by 15 through 30%. Not only does this drive down the price, it also improves functionality: the lighter the impeller, the quicker it can rotate, provided it is still just as stable. In turn, this improves efficiency while letting us use smaller engines, which also saves energy.



The guide vanes produced using additive manufacturing are installed in an MAN MGT 6100 gas turbine. The guide vane ring, which can be seen in the center here, affects the flow of air.

Fascinating precision: inside the 3D printer, a high-power laser melts the powdered metal into several layers, creating complex geometries that would not have been possible with conventional methods.



You mentioned greater flexibility. At what point will you achieve more flexible processes?

For example in the after-sales business: in the future, we will be able to produce spare parts on call worldwide, cutting delivery times. It also means we will be able to cut our stocks and free up capital. Plus, our customers will benefit from improved efficiency and lower costs as a result of us being able to reprint worn-out components instead of having to replace them completely.

3D printing is evolving constantly. How do you build up the expertise you require?

That is exactly why we have set up the MAN Center for Additive Manufacturing here in Oberhausen. We are investing some €2.6 million in this product- and location-independent expert center, where a team of materials engineers, component designers, and production technologists will be testing the different areas the benefits of additive manufacturing can be extended to. At the same time, we are in a constant dialog with scientists – one of our cooperation partners is the Fraunhofer Institute for Laser Technology in Aachen.

So you have the researchers on board. Do you already know to what extent 3D printing will shape the production of tomorrow?

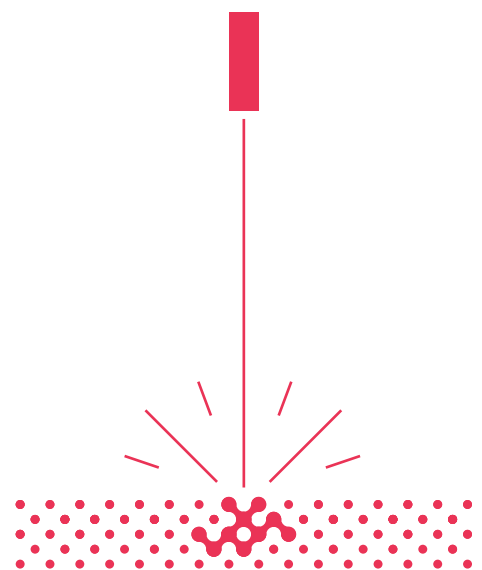
Its technology has the potential to grow by between 20 and 35% a year. Additive manufacturing is an integral part of our journey toward a smart factory and the industrial Internet of things. It will help us to achieve individual mass production. Plus, the fact that the entire workflow is digital, from developing the CAD model all the way to printing it out, makes our processes simpler, quicker, and safer. Identifying and making the most of the opportunities offered by digitalization while developing new production methods is pivotal as far as MAN is concerned. It is a fascinating job.

3D printing

“Additive manufacturing” refers to a process where metal, plastic, or ceramic materials are used to manufacture a three-dimensional model layer by layer, which is where the term “3D printing” comes from. This method is worlds apart from traditional techniques like lathing and milling, which start with a block of metal and cut away the excess to create the product. Additive manufacturing is evolving at the speed of light and is used increasingly in areas like mechanical and automotive engineering, aviation, or medical engineering.

Selective laser melting

3D printing covers a range of processes. MAN Diesel & Turbo uses selective laser melting, which accounts for an 80% share of the market. This involves a high-power laser that melts metal powder, which then takes the shape predefined in the CAD model when it solidifies. Another method that is commonly used is additive manufacturing by powder nozzle, which allows the metal powder to be injected into the nozzle using the flow of air, melted with a laser, and deposited into the desired structure.



Last check: the 3D-printed guide vane segments fit perfectly together. The components make sure the gas turbine can work efficiently.

QUICK AND

Stuttgart

12:00

Germany is working hard: machines and computers are running, canteens and household kitchens are a hive of activity. By the time midday rolls around, demand for electricity reaches its peak. Time for quick-response power plants.

Hajo Hoops is proud – you can hear it in his voice. The Senior Sales Manager for Power Plants at MAN Diesel & Turbo in Augsburg has every reason to be – after all, his company is not just supplying components for this type of plant, which can be started up in just a few minutes if needed. MAN Diesel & Turbo is also planning and building a comprehensive gas-engine combined heat and power plant for energy provider EnBW in Stuttgart-Gaisburg. “Okay, not the bricks and mortar, but we are responsible for the entire technical solution, the interior, so to speak,” says Hoops.

The project includes three gas engines supplying over 30 megawatts of electricity. The waste heat generated as a result is also converted into up to 30 megawatts

of district heat. Along with additional new peak load boilers, the plant will replace an old coal power station as of the beginning of 2019. This project is a radical modernization of the EnBW site on the Neckar river, a contribution to the energy transition as far as Diana van den Bergh, a project manager who works for the energy provider, is concerned. “The modernization will reduce CO₂ emissions at the site by up to 60,000 tons a year,” she says. And since the 75,000-square-meter coal pit is no longer needed, the city can find an alternative use for it.

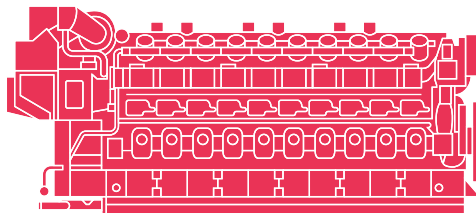
Hoops believes decentralized cogeneration of the kind that is implemented in Gaisburg to be a “key component for the future supply of energy.” Quick-response gas power plants can be turned on and off in no time at all, for instance if renewable energy supply starts to fluctuate or peak loads are reached. “Generating electricity and heat together makes sense both financially and ecologically,” Hoops explains, adding that this is a considerably more efficient use of fuel. Hoops is adamant: “Plants like this one are more than just technology to bridge the gap – they will be needed for the foreseeable future, and for that reason demand will also rise.” There is another advantage, too: no modifications are required to run the plants on biomethane or synthetic natural gas in the future.

Three MAN Diesel & Turbo gas engines will power the new plant in Stuttgart-Gaisburg. The plant can

then be turned on and off in no time at all, which makes the site considerably more flexible.

5 MIN

30 MW



EFFICIENT

HIGHLIGHTS 2017

HOME AWAY FROM HOME

Offering even more comfort and a practical, top-of-the-range interior: the new driver cabs of the latest TG series from MAN Truck & Bus make truckers feel at home wherever they are. The MAN TGX cab comes, among others, with a fully retractable fridge, new storage and lighting features, and an acoustic package that considerably reduces noise levels further. Upgraded safety and assistance systems, along with the RIO Box, an innovative telematics module, round off the range of features on offer.



The upgraded MAN TGX driver cab offers comfort and security behind the wheel.

YEAR OF THE LION

It looks even more formidable, radiating power and efficiency: the new edition of the MAN Lion's Coach was presented in the summer of 2017 – equipped with technically innovative features like an optimized drivetrain and a large number of assistance systems. It took part in the 2017 Busworld Awards Competition, beating eleven opponents to come out on top and scoop the Grand Coach Award, as well as other accolades in the Comfort Label and Design Label categories. The next coup came in November 2017: the Lion's Coach won the 2018 Innovation Prize awarded by busplaner, the German trade magazine.

Very popular with the customers: the new MAN Lion's Coach



Boasting an impressive low-end torque while drastically reducing noise pollution and saving fuel: with a 12.4-liter engine boasting up to 517 horsepower, the Fendt 1000 Vario is the world's most powerful series-produced tractor. The engine was designed by the Engine Competence Center of MAN Truck & Bus, and its supporting structure providing maximum impact to the front wheels gives the tractor outstanding maneuverability. It is also extremely fuel-efficient. The thousandth Fendt 1000 Vario was delivered in December 2017: all the way to Canada.

OUT ON THE FIELDS

The Fendt 1000 Vario is powered by a specially designed MAN engine.



State-of-the-art maintenance management, MAN workshops with flexible opening hours, 24-hour roadside assistance: customers of the new MAN TGE benefit from many advantages.



A NEW KIND OF VARIETY

Tailor-made to suit customer requirements: available as a closed panel van or a combi van with windows, with a crew or a chassis cab and with a permissible gross vehicle weight of 3.0 to 5.5 tons, the MAN TGE from

MAN Truck & Bus is the company's answer to the countless challenges arising in day-to-day transportation and haulage tasks. In launching this model, the company has expanded its portfolio, which now includes vehicles with a permissible gross vehicle weight of 3 to 44 tons, thereby

evolving into a full-range supplier. The first mass-produced TGE rolled off the production line in 2017 and launched in Germany, Austria, the Netherlands, and Switzerland. It is now available in another eight European countries. The TGE is assembled at VW's brand-new plant for commercial vehicles in Września, Poland.

TGE

SERVICE FROM

Hook of Holland, Netherlands

2:15 p.m.

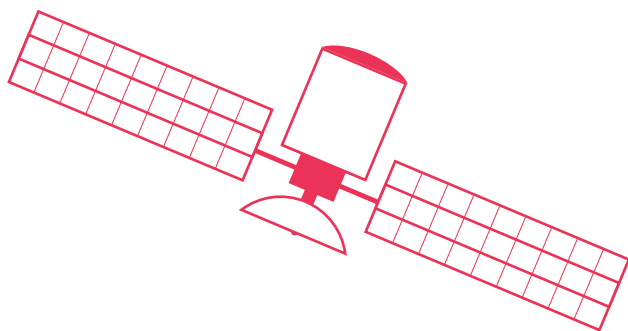
Passengers are gathered on the ship's rail. Seagulls circle. The engines are making the ship vibrate slightly. The Stena Hollandica casts off. Its helmsman skillfully maneuvers the ferry through the harbor. Depending on wind and current, it will take five and a half to eight and a half hours to get to the port of Harwich, England.

The Stena Hollandica's voyage across the North Sea is powered by four MAN 48/60CR engines. The crew on board is predominantly responsible for monitoring the engines. Since January 2017, the chief engineer on the bridge has had another special card up the sleeve of his navy blue uniform. The engines are equipped with over 200 sensors constantly measuring all key operating values before transmitting them to MAN Diesel & Turbo.

Centers all over the world

The parameters that have been measured can be accessed by all PrimeServ Online Service Centers in Germany, Australia, and the U.S.A. The employees work around the clock to monitor the connected engines and to analyze the data that is transmitted. They track the functions of over 200 power plant and marine engines all over the world on their screens, including the engines of the Stena Hollandica, which cuts through the waves at a speed of up to 22 knots. The information that is collected and transmitted via satellite includes the fuel used and, of course, the exhaust gas temperature and the charge air pressure.

Continuous monitoring: the employees working at PrimeServ Online Service Centers in Germany, Australia, and the U.S.A. track the performance data and functions of over 200 marine and power plant engines across the globe.



Extensive transfer of data

All the relevant parameters of the marine and power plant engines monitored are transmitted to the MAN PrimeServ Online Service via satellite: speed, the number of hours the engine is in operation for, fuel used, current consumption, the efficiency, temperature, and air pressure of the turbocharger, the engine's charge air parameters, as well as the operating temperature of the lubricating oil, fuel, and coolant.



SPACE

Key operating values are also recorded, allowing conclusions and inferences to be drawn about the individual components. “We receive reports containing these and many other parameters just after midnight,” Michael Aichner, a manager at the PrimeServ Online Service Center in Augsburg, says. “They are first transmitted in encrypted form to our data center in Copenhagen, where they are put through a limit analyzer that flags unusual information, which we then look at in more detail in Augsburg.” The PrimeServ Online Service Center technicians then decide what needs to be done. Although this often entails giving recommendations to help optimize performance, it may sometimes involve identifying mistakes.

Rapid support

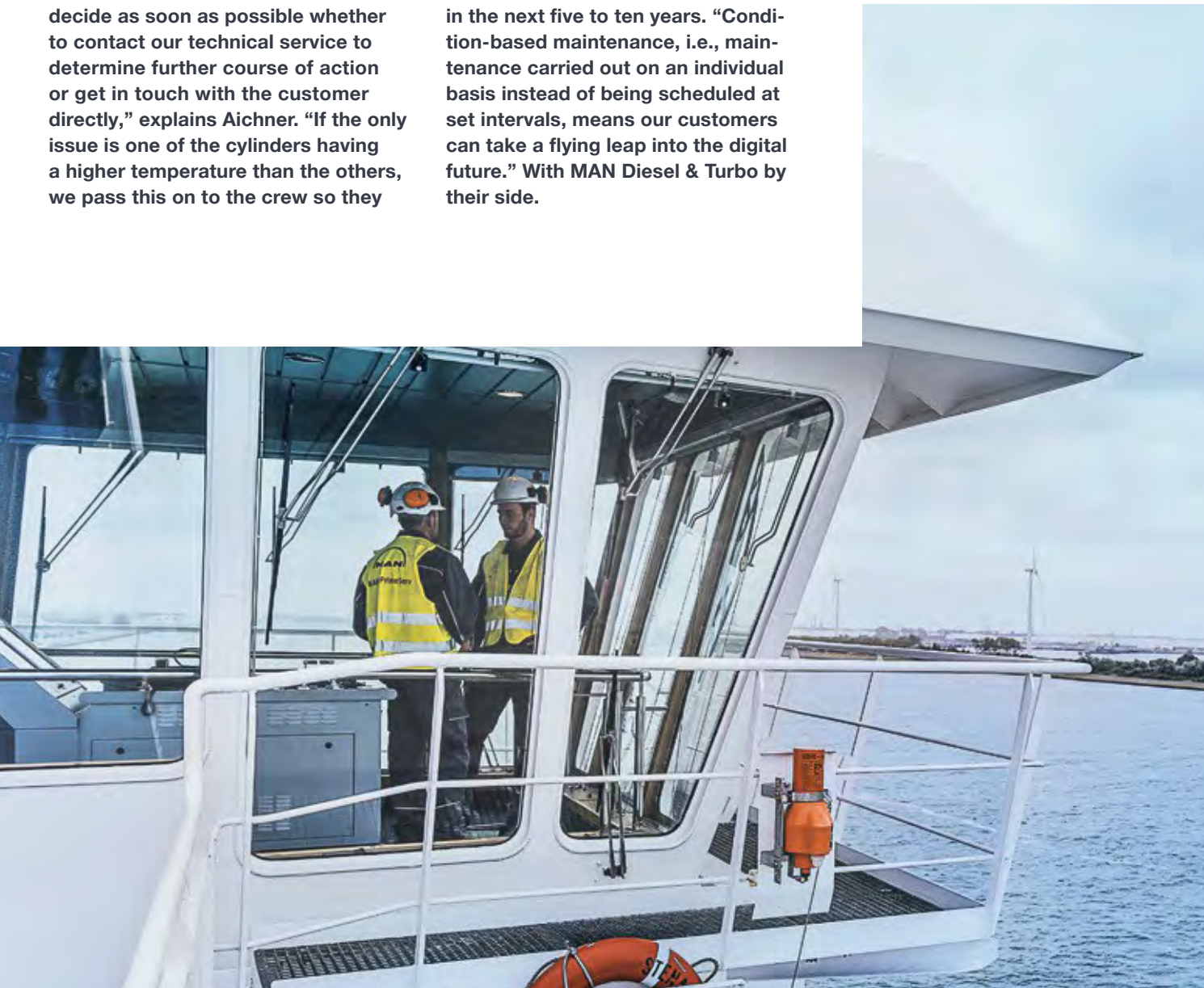
Why did the crew throttle back one of the four engines? Are there signs of wear and tear in a component? “In such cases, we have to decide as soon as possible whether to contact our technical service to determine further course of action or get in touch with the customer directly,” explains Aichner. “If the only issue is one of the cylinders having a higher temperature than the others, we pass this on to the crew so they

can review the problem on site. We can make specific suggestions on how the engineers on site should respond so as not to lose any time.”

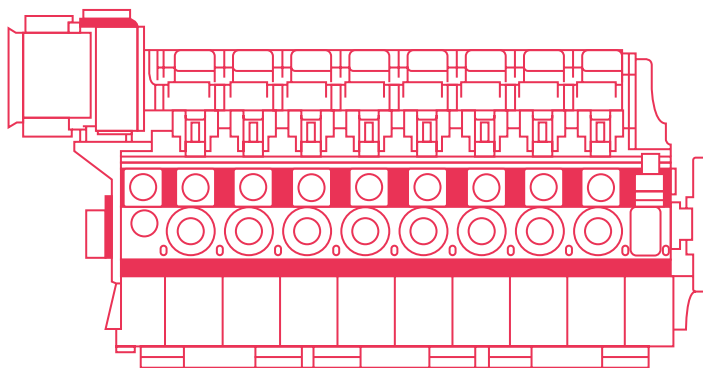
Digital future

MAN Diesel & Turbo is actively pressing ahead with digitalizing its processes. There are plans to expand the existing monitoring process in 2018. MAN customers can then contact the PrimeServ Online Service technical experts directly to get help with optimizing the performance of their vessel and remedy irregularities – around the clock.

MAN Diesel & Turbo has set its sights on fully automated data evaluation as the next step – a development that will revolutionize the traditional concepts of service and maintenance. Stefan Eefting, who works as Head of MAN PrimeServ Diesel in Augsburg, expects automated monitoring – which goes hand in hand with solid advice – to become the norm in the next five to ten years. “Condition-based maintenance, i.e., maintenance carried out on an individual basis instead of being scheduled at set intervals, means our customers can take a flying leap into the digital future.” With MAN Diesel & Turbo by their side.



What does the PrimeServ Online Service offer?



Braving the North Sea with 45,683 horsepower

The *Stena Hollandica* and her sister ship, the *Stena Britannica*, have four MAN 48/60CR engines each. With a total of 45,683 horsepower, they can reach a speed of up to 22 knots. At 240 meters long, the two ships are some of the world's largest mixed freight and passenger ferries and can accommodate 1,200 passengers and 230 vehicles.

Performance curves

Algorithms are used to evaluate the performance of the engines that are monitored, which is transmitted on a daily basis. After that, the PrimeServ Online Service Center employees receive performance curves they can use to identify whether the engine complies with the required parameters.

Remote support

Should irregularities occur, the expert responsible determines their cause, contacts the customer, and discusses possible solutions. With the customer's consent, experts can access the engine remotely and remedy the defect themselves.

Condition reporting

The customer receives a summary of the assessment of the engine's performance and condition from MAN Diesel & Turbo specialists on a monthly basis.

Trend analysis

The Online Service also monitors the engine's running performance over a longer period of time and, where necessary, gives the customer recommendations on how to make it more efficient.

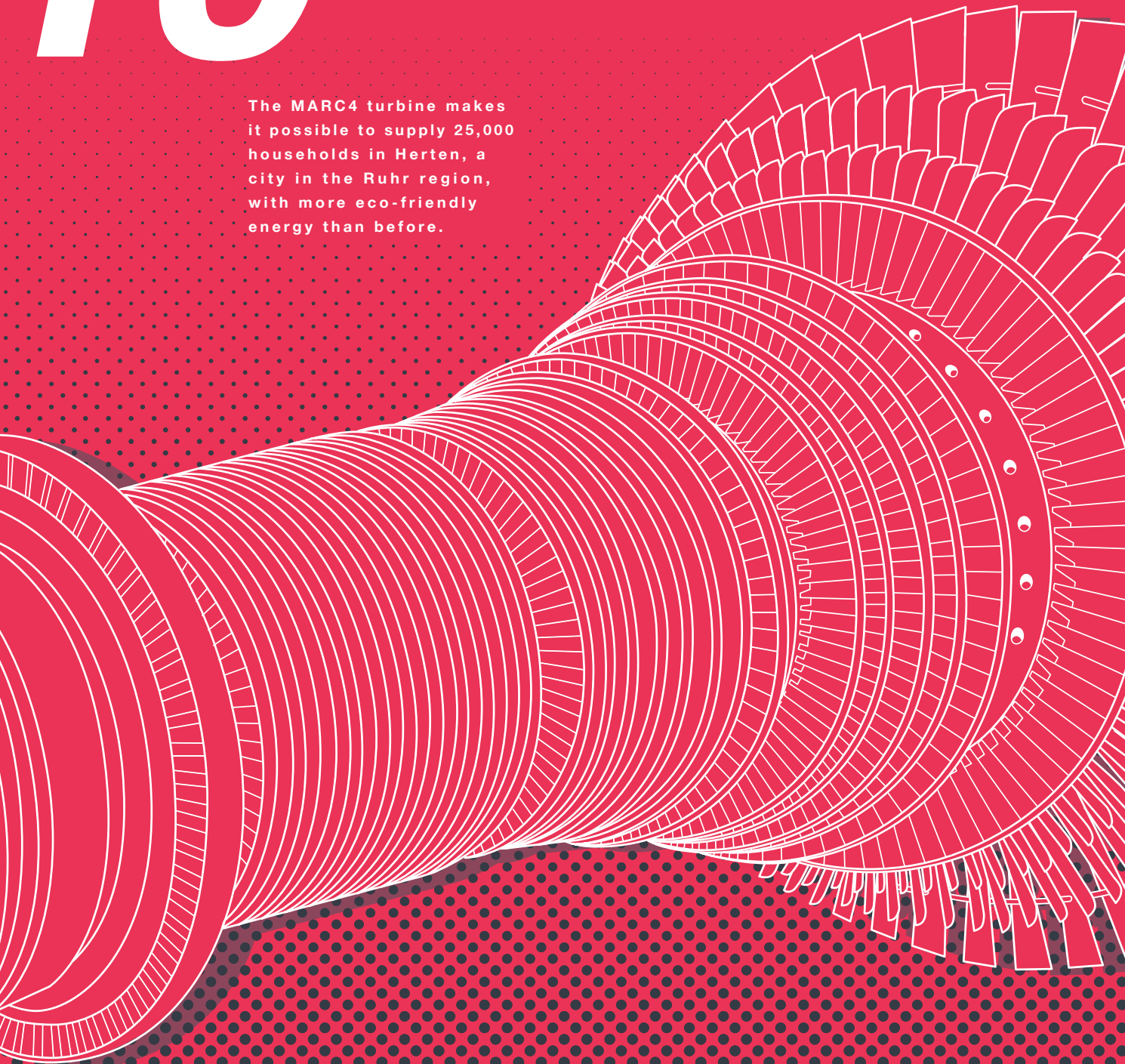
Live data indicator

The new live data indicator app lets the customer view the engine's performance data. Work is currently in progress to expand the app to include real-time transmission of all recommendations and warnings. The customer is then also able to contact the Service Center directly via chat or video chat.

Leaving the mainland behind: the *Stena Hollandica* heads for Harwich. The sister ferries set off for the UK and the Netherlands twice a day. They have been sailing this route since September 2010.

WASTE TO

The MARC4 turbine makes it possible to supply 25,000 households in Herten, a city in the Ruhr region, with more eco-friendly energy than before.



Herten

7:30 a.m.

It is surprisingly cold in the Ruhr region this April morning. The thermometer reads four degrees. Many households decide to turn the heating up. The demand for heat is unexpected given the time of year – but where does that heat come from? A waste-to-energy plant on the outskirts of the city.

Flexible plants like this one can respond to a change in needs within a space of a few minutes, and demand for them is on the rise. The operator of the plant, Abfallentsorgungsgesellschaft Ruhrgebiet, ordered a MARC4 turbine from MAN Diesel & Turbo in February 2017. The steam turbine generator set will enable 25,000 households to be supplied with more district heating than was previously possible.

In other words, the garbage you took to the can in the evening might be making your living room warm and cozy the following morning. Indirectly, at least, since the Herten plant converts 20 tons of waste an hour into heating and electricity. A total of six combustion lines generate high-energy steam, which, in turn, powers the turbines and generators required to produce energy.

There has been a drastic shift in how energy is produced in the Ruhr region. While coal mines used to be a distinctive feature of the landscape, the region's inhabitants are increasingly turning to new ways to generate energy. This creates opportunities, which MAN Diesel & Turbo is grabbing with both hands. "Projects like the one in Herten demonstrate the transition that is going on in the energy landscape," explains Holger Kube, Head of Sales for Power Generation at MAN Diesel & Turbo in Oberhausen. "Our steam turbines help regional suppliers and industrial companies, among others, to be highly efficient when generating heating and electricity." Away from large-scale power plants, they make low-emission generation of heating and electricity possible – both for the companies' own needs and to supply power to the grids. As well as waste, the fuels that can be used for this decentralized form of energy production are diverse: biomass or waste heat from industrial processes are just two examples.



WARMT