VOITH

ontrack

by Voith Turbo — N° 04

Voyage into the new Mobility

Innovative System Solutions Make Conventional and Alternative Drive Concepts Fit for the Future

Editorial
ontrack N° 04

New concepts will be needed to meet the economic and environmental demands of the future.

Enhancing the mobility of people and goods while increasing efficiency and reducing emissions – the challenge our industry faces is enormous. New concepts will be needed to meet the economic and environmental demands of the future. The best way forward is still a matter of debate among experts, but most agree that every path leads through the electrification of the drivetrain. We want to successfully shape this transformation together with our customers – on the road, the rails and the water. Voith uses its expertise to supply the market with groundbreaking concepts and innovative drive solutions for all segments. One example is the Voith Electrical Drive System, a flexible drive system for electric buses that achieves particularly long ranges thanks to the optimized compatibility of its specially developed components. Another is the eVSP, the electrified version of the tried-and-tested Voith Schneider Propeller that can also be used for propulsion and steering on future battery-powered or fuel-cell-powered ships. And the water-based Voith ECO Retarder, that replaces the engine brake of electric-powered heavy trucks and also achieves a higher sustained braking torque than conventional oil retarders.

These and other solutions herald a new era of mobility and are presented in the current issue of ontrack. They reflect our mission of combining efficiency with performance to create an individually optimized overall system and not only address current applications but also anticipate future ones. Our magazine contains information that will help you move forward. With this in mind – Drive New Ways! And enjoy reading this issue!

Cornelius Weitzmann
CEO, Voith Turbo Mobility

Publishing Information

Publisher:
Voith GmbH & Co. KGaA
St. Pöltener Strasse 43
89522 Heidenheim, Germany
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Responsible for Content:
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Voith GmbH & Co. KGaA

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Editorial work:
Faktor 3 AG,
Hamburg/Berlin, Germany

Design:
stapelberg&fritz gmbh,
Stuttgart, Germany

Printing:
EBERL PRINT GmbH,
Immenstadt, Germany

Photo credits:
Cover page, pp. 3–7:
Dominik Wellna /s&f (illustration),
p. 8: Reederei Østensjø,
pp. 12–17, 20–21: Jan Steins (illustration),
pp. 18–21, 22–25: Rafael Kroetz,
pp. 26–27: s&f (illustration),
pp. 28–31, 32–35: Dominik Wellna,
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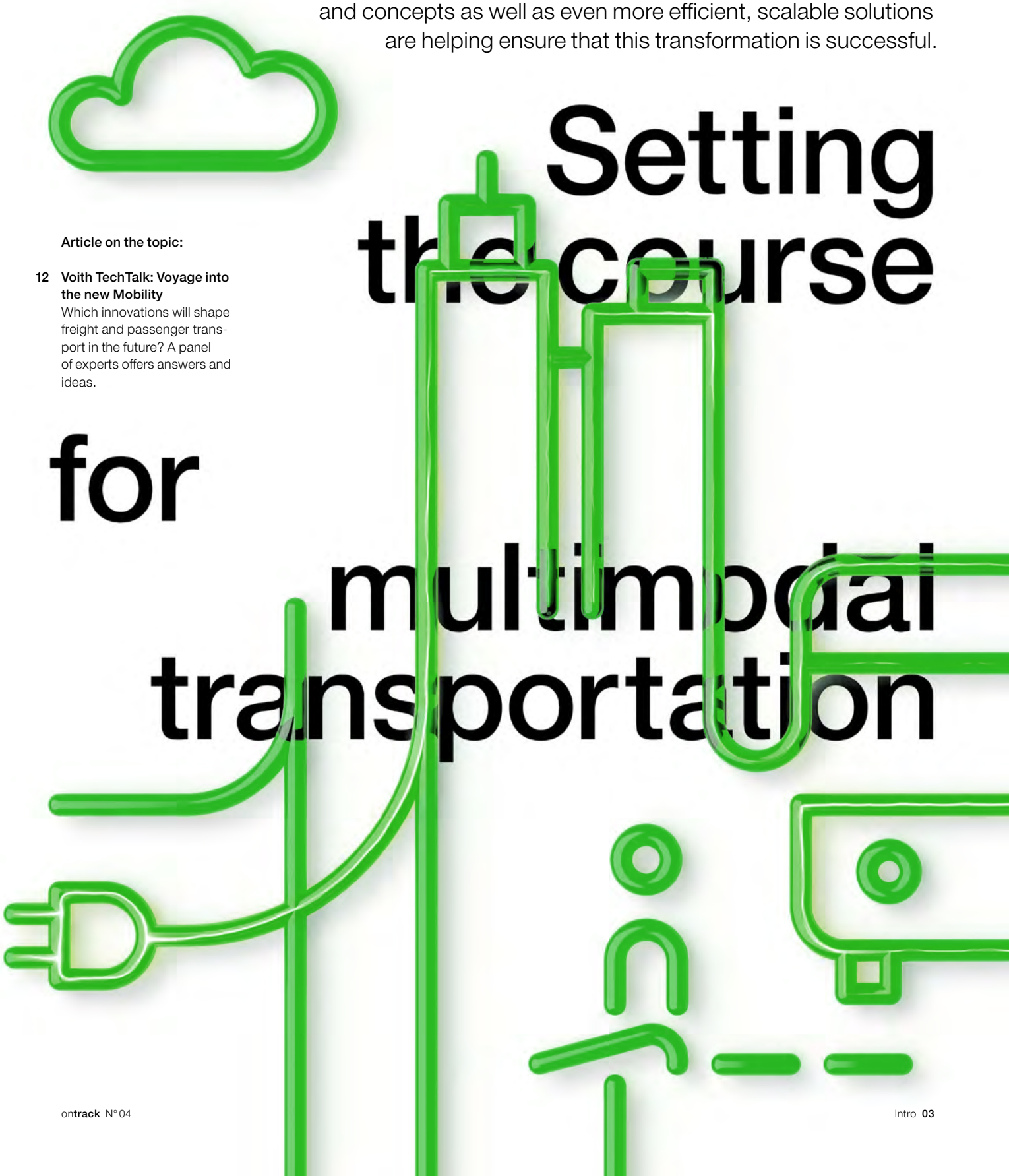
#drivenewways

Expanding Mobility

Global challenges, such as urbanization and the proliferation of megacities require new mobility concepts for people and goods. Innovative drive technologies and concepts as well as even more efficient, scalable solutions are helping ensure that this transformation is successful.

Setting the course for multimodal transportation



Article on the topic:

#drivenewways

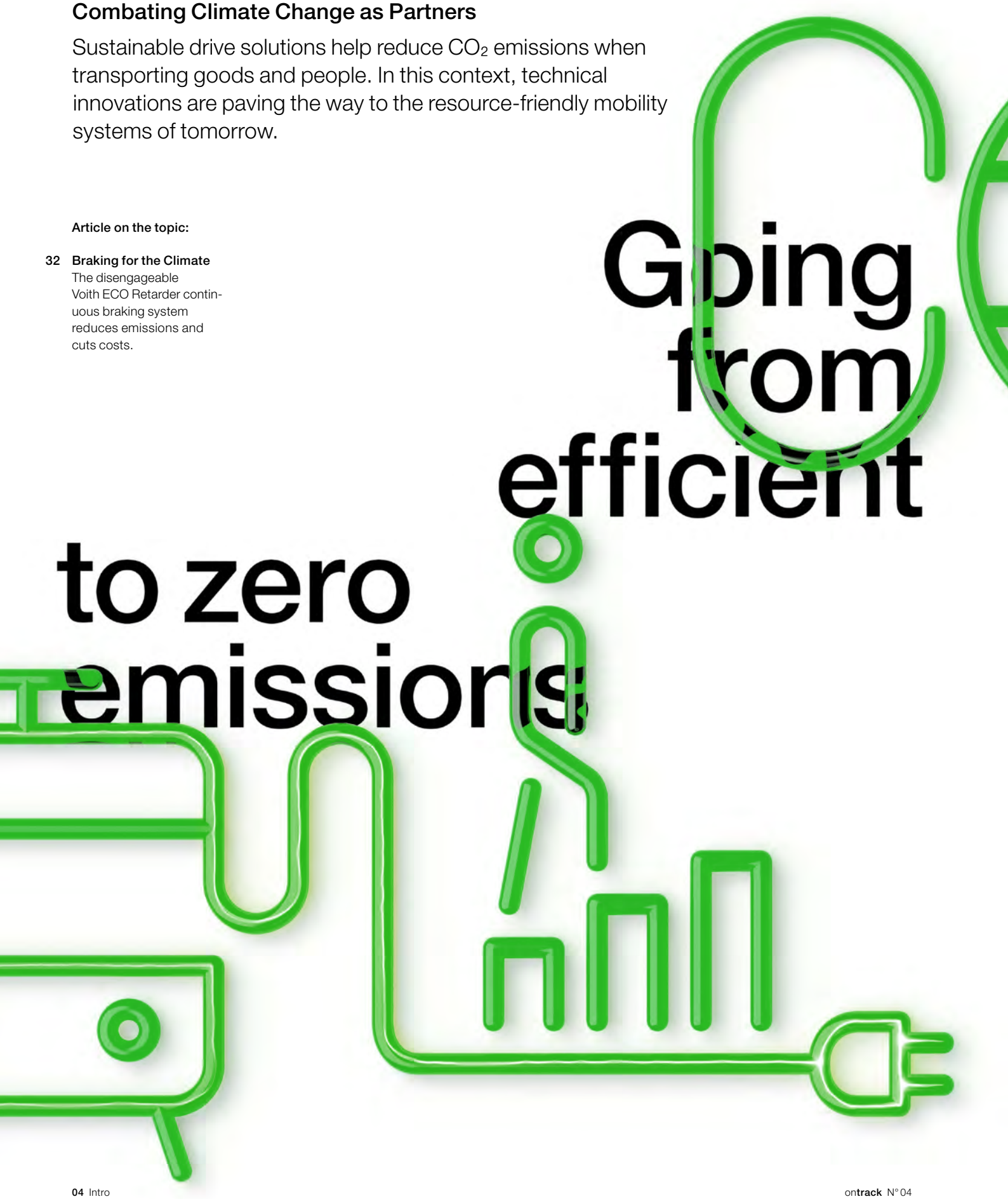
Combating Climate Change as Partners

Sustainable drive solutions help reduce CO_2 emissions when transporting goods and people. In this context, technical innovations are paving the way to the resource-friendly mobility systems of tomorrow.

Article on the topic:

32 **Braking for the Climate**
The disengageable Voith ECO Retarder continuous braking system reduces emissions and cuts costs.

Going from efficient to zero emissions



#drivenewways

Alternative Drives

An electrified drivetrain is the basis for the further decarbonization of passenger and freight transport. Whether on the roads, rails or water, state-of-the-art systems and optimized components increase efficiency to effectively reduce emissions.

New impetus for change

Article on the topic:

Article on the topic:

#drivenewways

Digital Value Creation

Digital solutions can help operators and manufacturers in the mobility sector significantly improve efficiency. In this process, data-supported systems will unlock new opportunities for them.

Accelerating people and goods with data

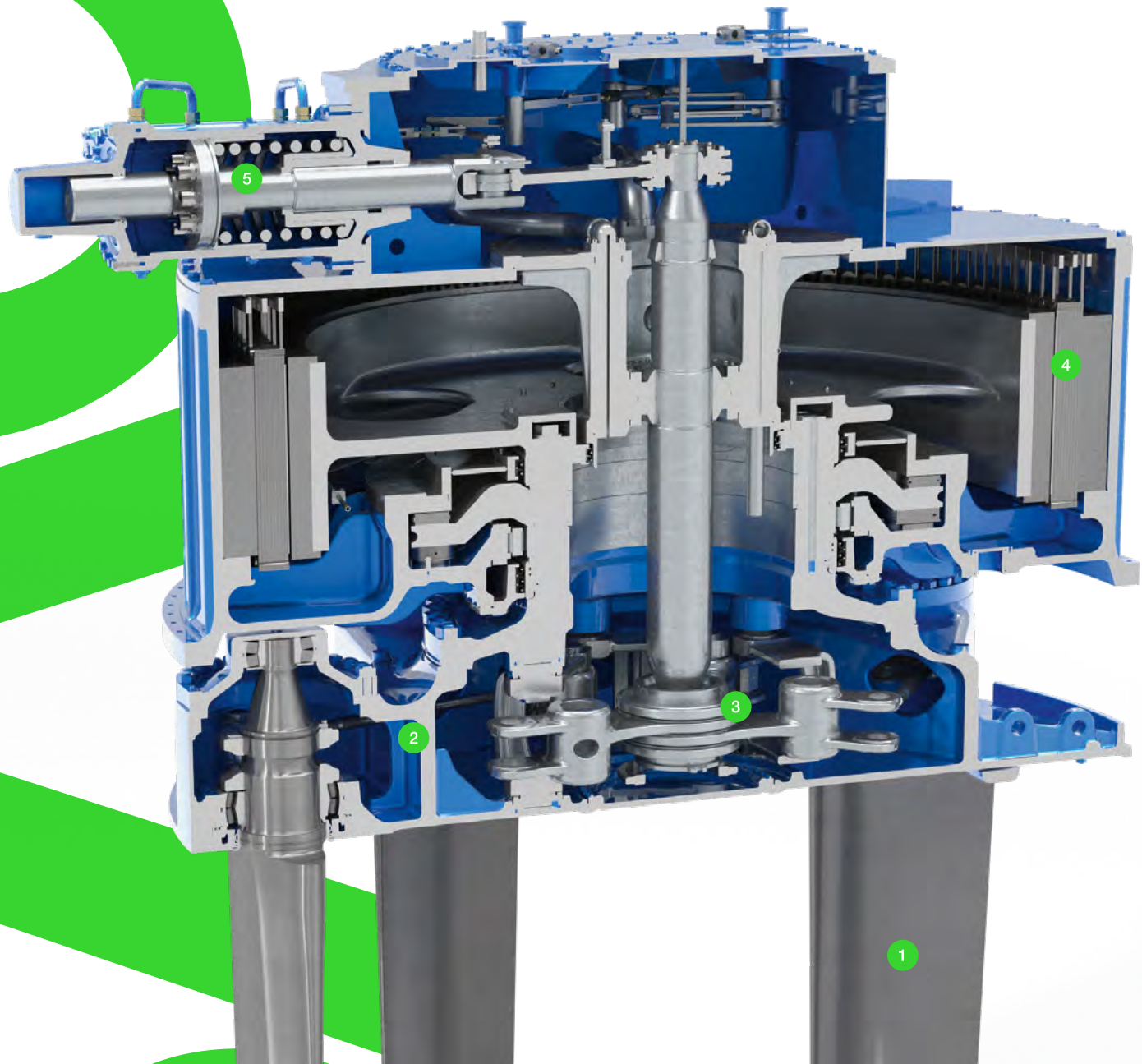
Article on the topic:

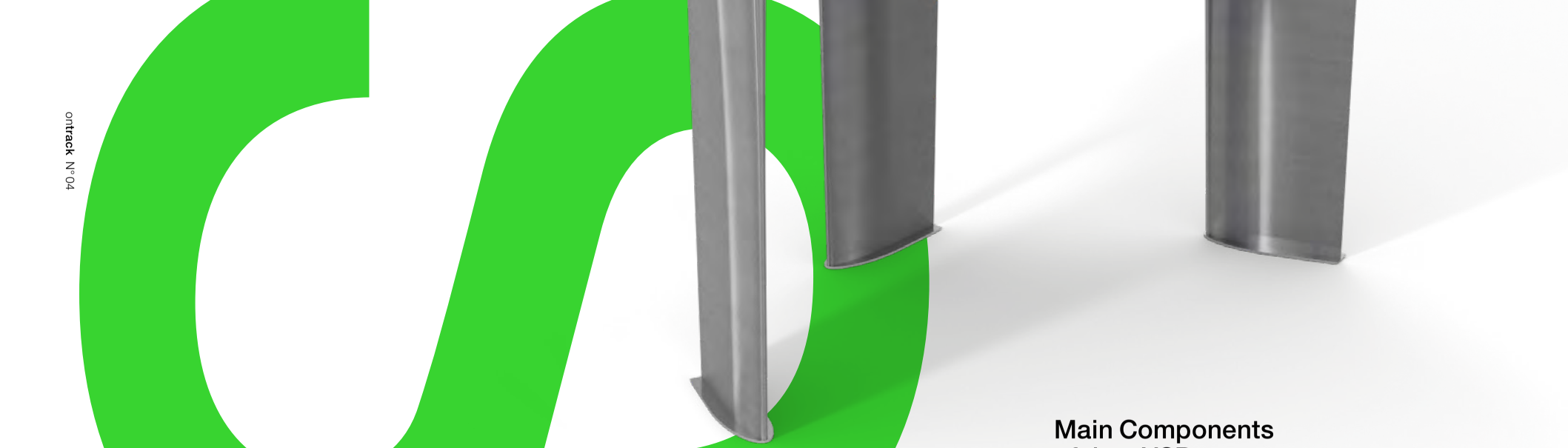
#drivenewways

The Human Factor

New sales and service models support customers 24 hours a day, while state-of-the-art technology ensures that the right representative is always available. This dynamic transformation is creating the conditions necessary to take the "human factor" into account more effectively and develop customized solutions together.

The electrified version of the tried-and-tested Voith Schneider Propeller not only increases efficiency and sustainability but also opens up completely new freedom in marine engineering.





The Voith Schneider Propeller (VSP) has always combined vessel propulsion and steering in a single unit, enabling harbor and escort tugs, ferries, special-purpose ships and offshore supply vessels to maneuver with maximum precision and minimum reaction time without a separate rudder. While the technology has been continuously improved over the past 90 years, the underlying principle remained unchanged. But now the engineers have succeeded in translating the benefits of the mechanical VSP to an electrified version – the eVSP. It sets new standards in terms of performance, efficiency and sustainability.

To achieve this, the permanent-magnet synchronous motor that has already proven itself in the Voith Inline Thruster was fully integrated into the eVSP. This results in a number of distinct benefits: “It operates extremely efficiently over nearly the entire power range and also proves to be a very efficient drive concept in the important partial-load range,” explains Jörg Maier, Vice President CCE Marine at Voith, who was in charge of the design. Because the electric motor is also designed as a direct drive system, there is no need for a gearbox. And since Voith has succeeded in supplying all of the propeller functions with just one oil circulation system for the first time in this field of application, the number of system components, such as filters or tanks, has also been reduced – cutting maintenance costs accordingly. The same applies to space requirements, because neither an external electric motor nor a shaft line have to be accommodated and therefore no additional substructures require installation space. “The eVSP can be positioned flexibly in the vessel – you only need to run cables and hoses to it,” emphasizes Maier.

The newly developed propeller is more environmentally friendly thanks to the fact that it can be operated with biodegradable lubricants, and the lack of a gearbox means that it produces less noise and also vibrates less. These improvements open up additional areas of application.

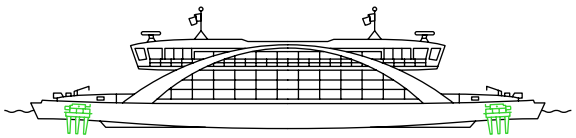
“The eVSP is better suited for sensitive applications such as research and offshore vessels of all kinds and passenger ships,” explains Maier, as well as for future vessels that use batteries or fuel cells as an energy source. “Theoretically, there isn’t a single use case that couldn’t be served by the eVSP.”

Main Components of the eVSP

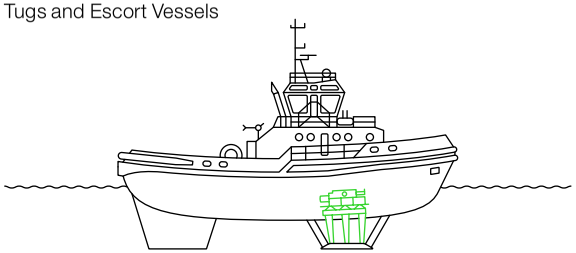
1 Blade
2 Rotor casing
3 Kinematics
4 Electric motor
5 Hydraulic cylinder

The VSP in Operation

Ferries and Passenger Ships



Tugs and Escort Vessels



Innovations on Board

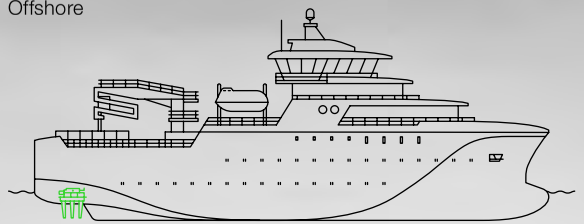
First-time use with excellent prospects for the future – the eVSP will power four state-of-the-art vessels operated by the Norwegian shipping company Østensjø.

To propel four service operation ships for the offshore wind industry, the Norwegian shipping company Østensjø is going in a new direction – it is relying on the eVSP. The ships, which are over 80 meters long and displace more than 6,000 tons, will be propelled and maneuvered by two eVSPs with an electrical input power of 1,850 kilowatts each. At sea, the electrified Voith Schneider Propeller will automatically and precisely hold them in position, even in heavy swell.

And even beyond the drive and control concept, having a future-proof solution is extremely important to Østensjø. After the ships are completed, the power required will initially be generated conventionally with diesel generators, but all are already equipped for conversion to fuel cells. In addition, they each have four tanks that can store hydrogen in an explosion-proof manner in a carrier medium. “We view this is a major technological breakthrough and a prototype of the ship of the future,” remarks Dirk Jürgens, Vice President Design Technical Sales at Voith.

x 4

Offshore



News

from the World of Voith Turbo

Retarder Record in the Southeast Asian Market

2018/19

The truck market in the Asia-Pacific region continues to grow, driven by urbanization and increasing investments in infrastructure and logistics. As a result, Voith Turbo is now delivering record numbers of retarders to OEM customers – the number of Voith retarders sold in China in fiscal 2019/20 alone is expected to be significantly higher than in the previous year. The modification of the VR 115 CT retarder to many models newly released on the Chinese market is also contributing to its success. In order to meet the demand, Voith Turbo has brought a new, more intelligent production line into operation at its Shanghai plant.

2019/20

Voith expects to see significant growth in retarder sales in China in fiscal 2019/20

Alstom Awards New Major RailPack Contract

Alstom has ordered additional Voith RailPack 400DM drive systems that will be installed in 30 Coradia LINT 41 railcars. This is the second release order following the initial order the company placed in 2019 and encompasses a total of 60 of the particularly fuel-efficient, low-emission RailPacks that already meet the EU Stage V emissions standard. They are scheduled for delivery starting in June 2021 and will be used in trains operated by Hessische Landesbahn in the Wetterau region of Germany.

The RailPack 400DM consists of the diesel-powered Voith Rail Engine with a power density of up to 480 kW and a maximum torque of 2,800 Nm, as well as an innovative mechanical transmission based on the tried-and-tested DIWARail. The RailPack-powered regional trains feature 120 seats and a maximum operating speed of 140 km/h. Alstom manufactures them at its facility in Salzgitter, one of the French railroad supplier's largest production sites worldwide.

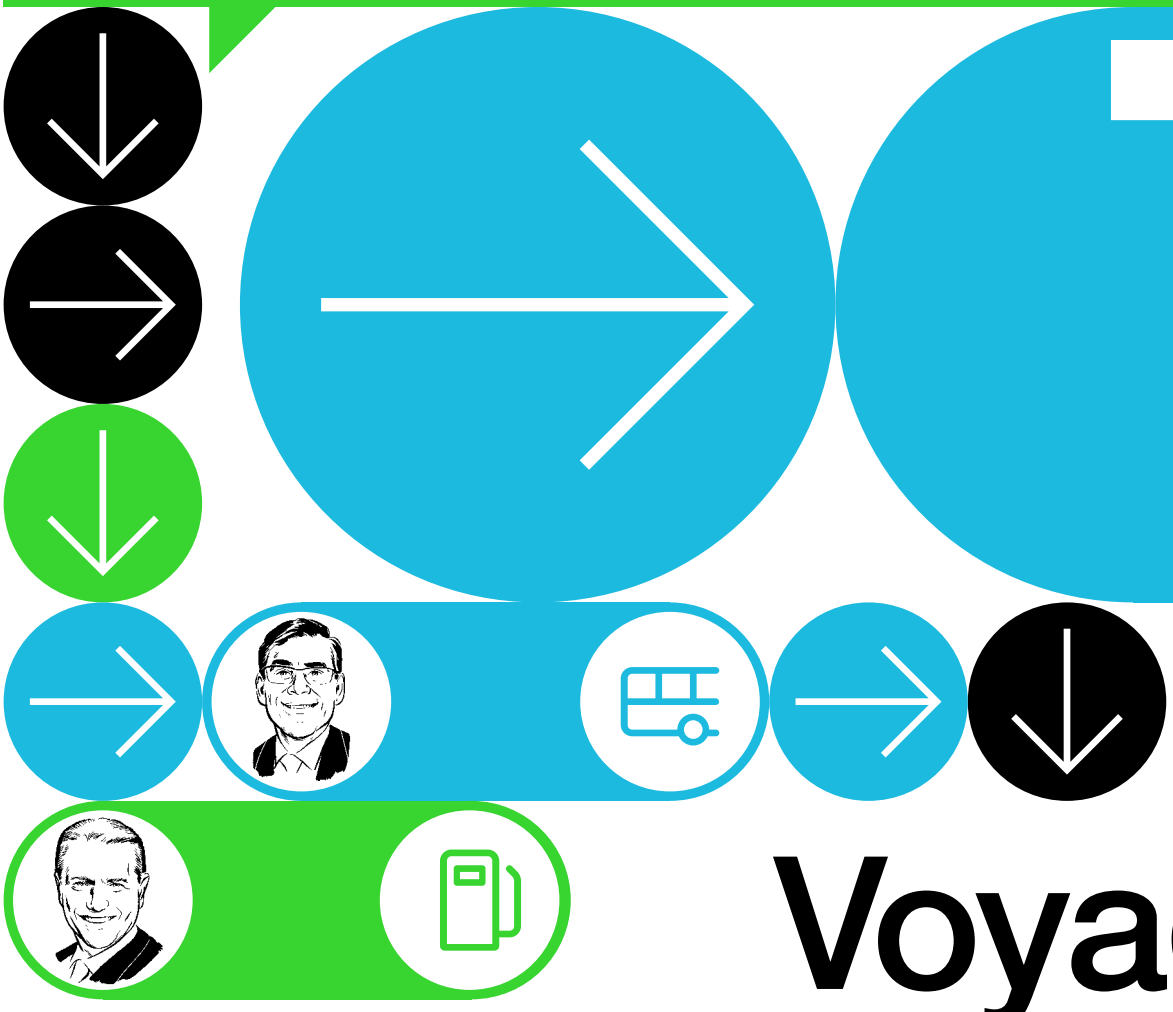
Alstom has ordered a total of 60 RailPacks, which also include the new DIWA NXT transmission, from Voith.

60×

Further U.S. Orders for Voith Schneider Propeller

Voith is supplying two 18R5 EC/120-1 Voith Schneider Propellers to the U.S. company Fraser Shipyard for the construction of a new double-ended ferry. To ensure that the units, each with an input power of 560 kW, achieve a particularly low rate of fuel consumption in addition to the high degree of maneuverability and robustness typical of their design, the partners began collaborating closely early on during development of the ferry. With the help of numerical fluid mechanics, they succeeded in optimizing the hull to such an extent that it reduced the power requirements by 25 percent. The 50-meter-long and 18-meter-wide ferry is scheduled to enter service in June 2021 in the Canadian province of Ontario.

Tech



Voyage into

Which scientific, economic, and social conditions will shape the mobility systems of tomorrow? Which innovations will shape the technology sector in the future? Featuring a distinguished panel of experts, Voith's TechTalk event at the end of the year will provide answers and fresh ideas.

Martin Kaufmann
Chief Technology Officer Voith Turbo

talk

Simply scan the QR code
for all the details of the TechTalk event.

In the context of the energy and transportation revolution, a heated debate is currently taking place around electric drives with batteries or fuel cells and the use of power-based and biomass-based synthetic fuels in internal combustion engines. As a result, a robust dialog between industry and academia is becoming increasingly important. “Technological leadership requires up-to-date knowledge and a constant stream of new ideas in the minds of our employees,” notes Martin Kaufmann, Chief Technology Officer Voith Turbo. “Actively engaging with the research community plays an essential role in this regard.”

Tobias Weber, Senior Vice President R&D Mobility at Voith, developed the perfect platform for this purpose – the Voith TechTalk series was designed to bring leading industry representatives and researchers together. The objective is “to recognize what is worthwhile from the company’s point of view and to use this knowledge to develop marketable products,” says Weber, describing the overarching goal.

The next event will focus on the current state of research into the mobility systems of tomorrow. To this end, four leading researchers will be speaking in Heidenheim on “The Future of Mobility – Innovation or Disruption?” Some of their key findings and predictions are presented herein.

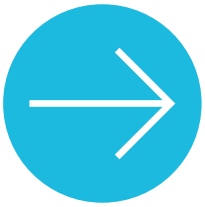
the new Mobility

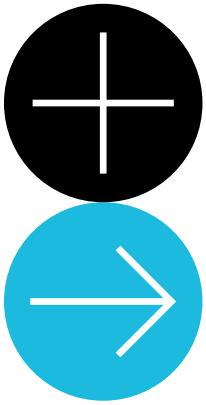
A transportation company with 50 buses could incur additional costs of

25 to over 40 million euros

for “zero-emission” electric vehicles compared to clean diesel by 2030.

Professor Ralph Pütz holds a doctorate in engineering and lectures on commercial vehicle technology, internal combustion engines, transmission technology, and motor sports technology at the University of Applied Sciences in Landshut and heads the BELICON Institute for Applied Commercial Vehicle Research in Bayerbach-Greilsberg, which focuses on electromobility and mobile machinery.





We Need Openness to Technology Again

When it comes to road transportation, we are currently seeing a politically propagated paradigm shift towards electric drive systems for both passenger cars and commercial vehicles. EU Directive 2009/33/EC explicitly aims to ensure that every bus service operator systematically and successively migrates to buses powered by batteries or fuel cells (including hybrids), because these are the only vehicles with zero tailpipe emissions.

But exclusively focusing on these vehicles’ use out on the road in isolation – and thereby completely ignoring the other stages of the life cycle – can lead to fatal conclusions. The “zero emissions” generated by electric vehicles in operation can, for example, result in significant environmental drawbacks due to potentially higher emissions during vehicle production or within the fuel supply. This results in the wrong environmental standards being applied to buses used for public transportation. As a technology-neutral researcher, I consider the disruptive strategy of European and German politicians to be irresponsible and call for a technology-agnostic approach based on regulations that stipulate the end result to be achieved rather the technology to be used.

A comprehensive environmental assessment of public bus transportation systems requires that all stages of the life cycle be included in the analysis, as well as local and global emissions from these processes. Then the life cycle assessment would show that with Germany’s current electricity mix, the use of alternative electric drive systems wouldn’t result in any improvements.

Electric bus development is still in its infancy for the most part, whereas conventional diesel and natural gas-powered engines for urban buses have reached a high degree of maturity. Modern combustion engines with exhaust aftertreatment systems that meet the Euro VI emission standard operate virtually emission-free. The only action needed is to conserve fossil fuels. In the case of internal combustion engines, synthetic fuels (also known as “e-fuels”) are the most promising option, as they can use the existing infrastructure for energy distribution and refueling without any modifications.

Although the energy efficiency of the electrified path is disproportionately higher than that of liquid or gaseous synthetic fuels, it plays a marginal role in the case of infinitely available renewable energy sources in other regions of the world – meaning the existing infrastructure also makes e-gas and e-fuel concepts promising.

The additional cost of a charging infrastructure for battery-powered vehicles compared to a hydrogen infrastructure:

Source: Study by the Institute for Techno-Economic Systems Analysis (IEK-3): "Transformation Strategies for the German Energy System between Now and 2050"

11 billion euros

Professor Detlef Stolten holds a doctorate in engineering and is head of the Institute for Electrochemical Process Engineering at the Jülich Research Center and holds the chair for fuel cells at the Faculty of Mechanical Engineering at RWTH Aachen University. His research focuses primarily on electrochemistry, process technology for fuel cells, and electrolysis.

Hydrogen is the Fuel of the Future

According to a study by the Institute for Techno-Economic Systems Analysis, reducing Germany's greenhouse gas emissions by 80 percent by the year 2050 is feasible from both a technical and economic perspective. Achieving a 95 percent reduction results in considerable additional costs.

Both battery electric and fuel cell vehicles require substantial investments in new infrastructure concepts. For a market penetration of 20 million vehicles, the cost of a charging infrastructure for electric vehicles (approximately 50 billion euros) is significantly higher than for a hydrogen infrastructure (approximately 40 billion euros).

Compared to battery electric vehicles, the energy density of the power generation system is five times higher in fuel cell models. Furthermore, fuel-cell drives are energy efficient, although their efficiency is lower than that of battery-powered vehicles. The fact that hydrogen produced from green electricity can be stored for an extended period of time and is also available when no solar or wind power is generated and fed into the grid is important in power systems with a high percentage of renewable energy sources.

Hydrogen is an excellent transport medium for importing renewable energy from distant locations that produce solar and wind power. This would create a flexible "hydrogen pool" from local and national sources. If existing natural gas pipelines were used to transport hydrogen, pipeline costs over long distances would be reduced by 50 to 80 percent and lead times for planning, approval, and construction by about half.

Hydrogen technologies harbor considerable regional value creation potential. The market for battery technology is largely dominated by China and the United States. In contrast, Germany and Europe have good chances of playing a leading role in fuel cell technology. →

We Need a Completely New Understanding of Mobility

Univ.-Prof. Dr. Marion A. Weissenberger-Eibl

Professor Marion A. Weissenberger-Eibl is head of the Fraunhofer Institute for Systems and Innovation Research ISI in Karlsruhe and holds the chair for Innovation and Technology Management at the Institute for Entrepreneurship, Technology Management, and Innovation at the Karlsruhe Institute of Technology (KIT). Her research focuses on the conditions under which innovative solutions are produced and their effects.

Developing New Concepts through Open Innovation

The mobility revolution requires a fundamental change in thinking. We lack experience for the extremely complex tasks, particularly since a well-established and successful system like the automotive industry is very stable and difficult to change. However the enthusiasm for sustainable technologies and green innovations is growing, and the economic potential is becoming apparent. At the Fraunhofer Institute for Systems and Innovation Research ISI in Karlsruhe, we were able to prove that although electric transportation requires an investment in power grids, electricity prices for households fall when there are a large number of electric vehicles on the road. In another study, we showed that plug-in hybrid vehicles have the same potential to reduce CO_2 emissions as electric cars powered entirely by a battery.

Looking to the future of mobility, it isn't enough to limit research and development to alternative drive technologies, sensor systems, and the integration of vehicles into data networks. Societal developments and real-world problems demand new concepts.

Sustainable innovations must, first and foremost, provide solutions to human needs. We need a completely new understanding of mobility – the focus is no longer on the car as a stand-alone product, but on a service, namely mobility. It means self-determined participation in social life. The transformation is not merely a technological and economic challenge, but a social one.

We need a research infrastructure that brings together academia, industry and the general population. This dialog requires open-mindedness and the recognition that knowledge from other areas is valuable and useful. This can lead to achievements such as the georeferencing of worldwide locations accurate to three meters by the London-based startup what3words – within a year the system had been incorporated into Daimler's mass-produced vehicles.

Opening up organizational boundaries, open innovation, in order to use external knowledge and external technologies or to apply unused internal knowledge outside of the organization's core field of business, is becoming increasingly relevant. An organization's ability to combine ideas from customers, suppliers, researchers and startups with internal expertise is referred to as its absorptive capacity. It can be characterized as a dynamic capability that allows companies to react flexibly to environmental changes. Environmental changes, for example, that led to the need for a mobility revolution.

AI in Automotive Engineering Is Still in Its Infancy

Prof. Dr.-Ing. Eric Sax

Professor Eric Sax holds a doctorate in engineering and heads the Institute for Information Processing Technology (ITIV) in Karlsruhe. He is also director of the Research Center for Information Technology (FZI) in Karlsruhe and Berlin, which is dedicated to contract research and the transfer of information and communication technologies. His work is primarily focused on processes, methods, and tools for automated driving functions.

Opportunities for Buses and Trucks

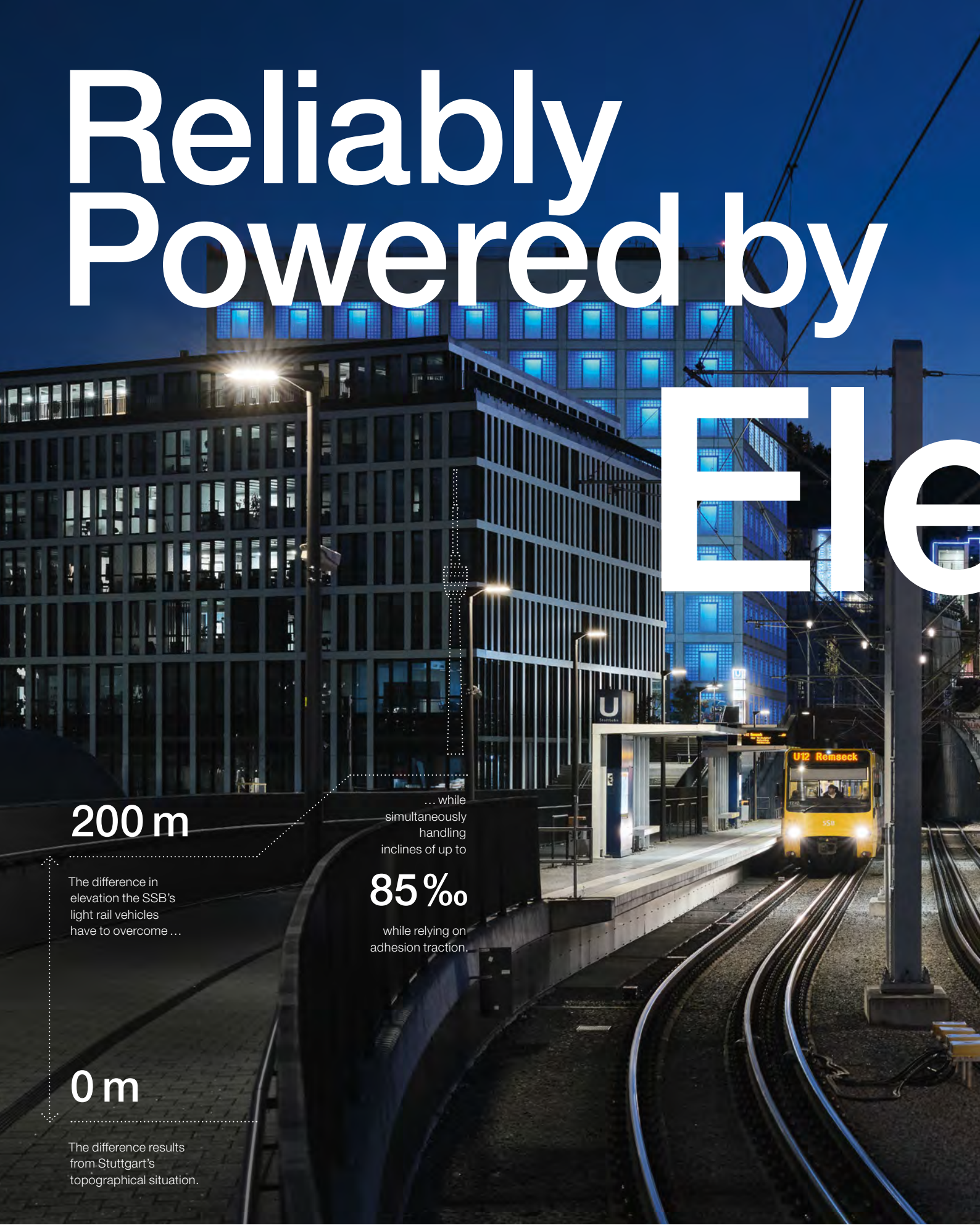
Artificial intelligence (AI) is still in its infancy in automotive engineering; the completely driverless car is still a long way off because of the countless eventualities on the road. Buses, on the other hand, could operate autonomously and at a higher frequency around the clock in their own dedicated lane. This is equally conceivable for trucks driving autonomously as part of a convoy.

Within the scope of the INTERACT project, we are currently studying the integration of autonomous trucks into the operations of modern, restricted-access container terminals at the Port of Hamburg. In contrast to trucks operating on public roads, vehicles in these closed-off areas are highly automated. The biggest problem is the communication between vehicles of different manufacturers and operators, as well as the insufficient infrastructure – the large amounts of data that AI has to process require a high-performance cellular network that covers the entire area. There is also still a long road ahead in terms of safety and general testing procedures.

I believe automated bus depots have outstanding prospects, as automation can offer major competitive advantages. Operators really only need a small amount of equipment to cut costs. As confined, controlled areas with highly predictable traffic flows, bus depots are currently among the places best suited to the introduction of driverless vehicles.

One of our research teams recently conducted a study at a bus depot in Stuttgart-Gaisburg. Every day, 150 public transit buses pass through here and stop at several different locations. Apart from cleaning the inside of the buses and maintenance, nearly everything else can be automated. Our projections showed that the depot could save over 100,000 euros in personnel costs annually as a result of automation, while simultaneously increasing throughput and decreasing the number of collisions. Many other depots could achieve even greater savings. We are now working with a select group of German public transportation authorities to implement the concept in real operations.

Reliably Powered by El



200 m

The difference in elevation the SSB's light rail vehicles have to overcome …

0 m

The difference results from Stuttgart's topographical situation.

… while simultaneously handling inclines of up to

85 ‰

while relying on adhesion traction.

Detailed information
about the EmTrac traction inverter is available on the Voith website via this QR code.

Stuttgarter Straßenbahnen AG (SSB) is working with Voith to modernize the traction inverters of 50 light rail vehicles – reduce malfunctions and increase availability. This major project is also a logistical challenge, as it cannot interfere with ongoing operations.

ectricity

Engineer **Roland Jauß** works for SSB in the Systems Engineering department and also lectures on rail vehicle technology at the University of Stuttgart.

Carrying out this modernization project is akin to performing open-heart surgery on our vehicles.

Mr. Jauß, Mr. Gmeiner-Ghali, Stuttgarter Straßenbahnen AG (SSB) has contracted Voith to overhaul and upgrade the traction inverters of 50 light rail vehicles. What do you consider the greatest challenge of this major project?
Roland Jauß: SSB currently operates 204 light rail trains of the unique Stuttgart type S-DT 8. The challenge when retrofitting the traction inverters lies in the fact that the entire process, from preliminary testing to upgrading the vehicles, needs to be carried out without taking them out of service. In addition, this modernization project involves a wide range of different activities, from the new development of components such as the power modules, including the fiber-optic cable connection, to traditional maintenance work, such as on the brake resistors. In this respect, even preparing the specification sheet was a challenge.
Alfred Gmeiner-Ghali: A key stipulation is that the existing vehicles are only taken out of service for as short a time as possible. This is why we are using existing replacement power inverters to switch out the units on the fly – the traction inverters will be removed from the vehicles, delivered to Voith, assessed, refurbished, and tested before they are returned to Stuttgart and installed in the next vehicle.
The greatest challenge is that we won't have any information about the condition of the units being delivered to us prior to their inspection, and as such, the extent of the modernization measures each will require – but we will still need to remain on schedule. The upgrade includes the mechanical refurbishment of the housings, switching components and inductors as well as the replacement of the power electronics. The entire modernization project, including the test runs, is on a tight schedule and tailored to our customer's operational requirements.

What concrete benefits does SSB hope to gain from upgrading its light rail vehicles?
Jauß: By modernizing the traction inverters, we expect to significantly reduce their susceptibility to malfunctions. We were no longer able to respond to the units' increased susceptibility to failure through maintenance activities alone, so we decided to upgrade them. The traction inverters have reached half of their useful life; for the second half after refurbishment, we expect high availability and low susceptibility to malfunctions until the end of their service life.

The project includes replacing the existing power electronics with a new system from Voith. What is particularly important to you in this regard?
Jauß: Carrying out this modernization project is akin to performing open-heart surgery on our vehicles. All of the new components and technical solutions installed by Voith must fit into the existing technical environment perfectly. Furthermore, it's important to us that Voith uses proven technology. This is why Voith developed a power module that uses proven components, but also takes all of the existing inverter module's mechanical and electrical interfaces into account. In addition, we're happy about the fact that Voith was also able to save some weight and improve the ventilation concept in the process.

The 210 traction inverter units will be overhauled without making any changes to the existing mechanical systems, electrical connections and software. How will Voith achieve this?
Gmeiner-Ghali: In order to minimize the number of changes requiring regulatory approval, we are not replacing the entire unit, but only certain components within it. This includes leaving the mechanical interfaces to the vehicle unchanged. The electrical interfaces involve power transmission on the one hand and the controller required for this on the other. As such, power will be transmitted via identical interfaces but using new power electronics. The connection to the traction motors will remain the same. The existing train control system will transmit the commands via fiber-optic cables, which will be converted to the technology used by Voith via optocouplers. As a result, no changes need to be made to control system's software.

What adjustments will be made in order to retain the existing control system?
Gmeiner-Ghali: Since the existing control system uses fiber-optic cables, the power unit is galvanically isolated, which means the power unit does not provide any electrical feed-

back to the control system. Therefore, the existing control system can also control a new power unit without modifications. We “only” have to develop an interface board to convert the fiber-optic signals into electrical control signals for the new power unit.

Modernization in this segment isn’t possible without customized solutions developed to meet individual requirements. Which solutions did you come up with for the SSB project?
Jauß: This project is extremely unique in many respects. The call for bids was preceded by years of analysis to determine the underlying reasons for the increasing susceptibility to malfunctions. After all, this is one of the first traction inverter applications with IGBT technology in the light rail segment. The topic of obsolescence also plays a role in the selected refurbishment plan. And the existing control system needed to be left untouched. Overall, a compromise had to be found between selective replacement, refurbishment, cost-effectiveness and dealing with approval issues. Technical solutions developed specifically for this project include the new power module and its connection to the control system, the optimized ventilation concept and an improvement in contactor monitoring.
Gmeiner-Ghali: Based on past experience, SSB places particular emphasis on demand-based fan control in order to prevent large temperature changes, because it is exactly these kinds of temperature spikes that reduce the durability of power components. This is why we implemented an infinitely variable controller for the fan. In addition to improved ventilation, this also reduces noise because the fan operates much more quietly at low speeds.

How will Voith ensure that components for the inverters will be available in the future?
Gmeiner-Ghali: We’ve introduced an obsolescence management system in accordance with EN 62402. Proactively monitoring critical components, especially electronic assemblies and components, allows us to respond to changes in availability early on and initiate appropriate measures. These range from stocking and certifying alternative components to identifying or developing compatible next-generation components that can replace them in the future.

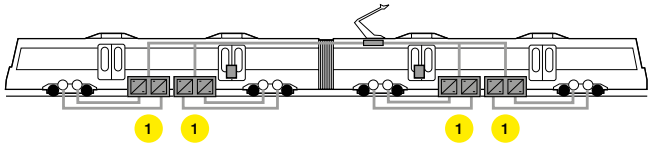
The modernization project is scheduled to be completed by the end of 2025. How will you then determine whether it was a success?
Jauß: Costs and deadlines are both common criteria. But we are also going to closely monitor whether the reliability and availability of the upgraded traction inverters meet our expectations. As a special feature of this project, we have scheduled a considerable amount of time for testing and trial runs prior to actually upgrading the vehicles. This is mutually beneficial and is intended to prevent the retrofitting process from coming to a standstill due to time-consuming corrective work. We will know whether this approach was effective in 2025.

Alfred Gmeiner-Ghali
holds a degree in engineering and is in charge of the sale of electric drive systems at Voith in St. Pölten, Austria.

We won’t know the condition of the units before inspecting them, and the entire modernization project, including the test runs, is on an extremely tight schedule.

SSB S-DT 8 Two-Car Set

In each of the S-DT 8.10 and 8.11 series of bidirectional two-car sets, four traction inverters including control electronics (1) are installed on the underside of the vehicle, which power all eight axles.

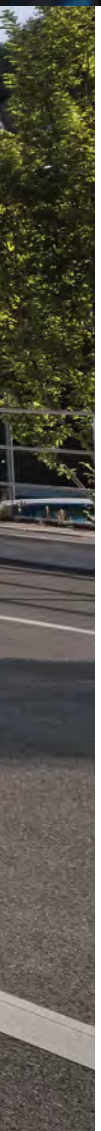


Detailed information about VEDS
is available on the Voith website via this QR code.

E volu

The first transit buses between Schwäbisch Hall and Heidenheim are now in regular service with the Voith Electrical Drive System (VEDS), the company's solution for the electrified drivetrain. The results so far have been just as positive as the prospects for the technology with its holistic, flexible system approach.

ution at the Bus Stop



Driving Farther, Charging Less Often
VEDS is extremely efficient, helping bus operators cover longer distances.

When the future rolls into the avant-garde bus station in Schwäbisch Hall, the passengers waiting there initially notice – nothing. No engine noise. No exhaust fumes. Only driver Armin Hinderer's satisfied smile provides a clue that something here is different. He sits at the wheel of one of three electric buses that have been in regular service for Stadtbus Schwäbisch Hall GmbH (a Transdev Group company) since the fall of 2019. "It was a completely new experience for me," says the experienced driver, "but I'm absolutely thrilled." In fact, he now prefers to drive electric rather than diesel-powered buses.

Hinderer's enthusiasm is based solely on the drive system. The electric buses from the Solaris Urbino 12 family are equipped with the Voith Electrical Drive System (VEDS), which combines a water-cooled, permanent-magnet motor with a particularly efficient inverter. As a result, the VEDS achieves an output of up to 340 kW and a maximum torque of 3,100 Nm – enough to power even heavy articulated buses or double-decker buses effortlessly. In the process, sophisticated control algorithms make

It was a completely new experience for me, but I'm absolutely thrilled.

Armin Hinderer
Bus driver for Stadtbus Schwäbisch Hall GmbH

100 percent of the torque available as soon as the driver pulls away – a particularly helpful feature when ferrying passengers on the hilly streets of Schwäbisch Hall. And it also makes sense in Heidenheim, some 80 kilometers away, where the Transdev subsidiary Heidenheimer Verkehrsgesellschaft mbH also brought three electric buses with VEDS drivetrains into service in February 2020.

When it comes to operators of local public transit systems, the most important aspect is range, emphasizes Alexander Denk, Vice President Product Management E-Mobility at Voith. "We can currently boast of having the most efficient system on the market today," says the executive. To achieve this, both the motor and the inverter were deliberately redesigned for the automotive sector – for one thing, standard industrial components would neither meet Voith's high standards of quality nor the safety standards applicable to passenger transport. On the other hand, this allowed the technology specialist to ensure that all of the components – from the electric motor, traction inverter, and high-voltage power distribution box to the drive control and energy management software – are perfectly compatible with each other. The success of the VEDS can be seen in the consumption data. "We distribute recovered power efficiently and can split it effectively between the components, because the most sensible solution isn't always to feed it back into the battery," offers Denk as an example. The fact that the VEDS doesn't require a separate transmission, which saves weight, further increases its range.

In Schwäbisch Hall and Heidenheim, buses equipped with the Voith Electrical Drive System are expected to clock up some 320,000 km by the end of the year. Compared to buses with conventional diesel engines, these buses have already cut CO_2 emissions by approximately 320 tons alone – and in the future, it will become even more important for operators and vehicle manufacturers to further reduce their carbon dioxide emissions. This is because the European Union has defined binding targets for the procurement of low-emission and zero-emission buses in its Clean Vehicles Directive, which countries will

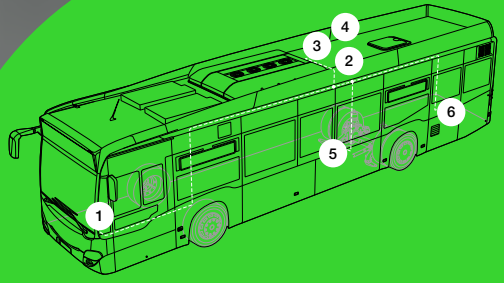
High-performance engine concept also suitable for single, articulated and double-decker buses. Optimized range due to low system weight.

Supports all common battery systems on the market and can be integrated into any vehicle.

No local NO_x and particulate matter emissions thanks to regenerative braking and energy management.

As an international mobility service provider, we also have a responsibility to combat climate change and ensure that the air in cities remains clean.

Michael Dalhof
General manager of Stadtbus Schwäbisch Hall GmbH



Voith Electrical Drive System

1 Drive management unit (DMU)
2 Electric auxiliary converter (EACU)
3 Power distribution box
4 Drive inverter system (DIS)
5 Water-cooled IPSM motor
6 Battery

need to implement in two stages by 2025 and 2030, respectively. The electric bus projects in Schwäbisch Hall and Heidenheim are leading the way. “As an international mobility service provider, we also have a responsibility to combat climate change and ensure that the air in cities remains clean,” explains Stadtbus general manager Michael Dalhof. “And we want to fulfill this responsibility through Transdev GmbH’s first pilot project of this kind in rural areas.”

The experience gained from the company’s collaboration with Transdev and Solaris is particularly valuable, emphasizes Alexander Denk. “Solaris explicitly highlights the power density and Transdev is excited about the range because our VEDS consumes very little energy.”

Irrespective of these benefits, the OEMs are primarily interested in the modularity and adaptability of the drive concept in addition to the extremely stringent hardware and software security requirements. This is precisely where the VEDS stands out, because its compact design means it can also be integrated into low-floor buses with improved accessibility for passengers with disabilities. And it doesn’t even make a difference whether the manufacturers equip their vehicles with a fuel cell or batteries for the power supply in the future in order to meet the EU requirements – Voith’s drive system supports both options. “Our modular inverter concept makes our system extremely flexible in this regard,” Denk makes clear. The e-volution is already underway.

Intelligent Fleet

Pilotfish® is digitizing public transportation

Models

Pilotfish offers its system to operators in various stages of expansion.

Communication platform with hardware / software, maintenance

Complete solution with applications, hosting and service

Broadband

Data is transferred between the vehicle and the cloud interface using the 3G, 4G or 5G mobile telecommunications standards.

5G

3G

4G

From the passengers' perspective, digitization in public transportation primarily means ticket apps and electronic displays at stops. But the real change is taking place behind the scenes. This is because the digital transformation is giving providers the ability to have their fleets operate much more efficiently and simultaneously eliminate their reliance on proprietary IT solutions.

Tapping this potential is the goal of Voith's majority stake in Pilotfish. The Swedish provider based in Gothenburg has developed a cloud-connected on-board platform for digitizing buses, trains and trams based on the open ITxPT architecture (Information Technology for Public Transport). As a result, the wide variety of Pilotfish applications – such as the fuel-saving app Fuel Economy, the tachograph and the automatic fault reporting system – can be supplemented by additional apps offered by specialized third-party providers. "The platform allows operators to make their IT system more open and future-proof," explains Robert Müller, Director Driver and Driveline Apps at Voith. In addition, the Fuel Economy application alone ensures that users rapidly achieve a return on their investment. "The system will pay for itself within the first year simply as a result of the fuel savings," stresses the Voith executive.

More than 10,000 vehicles in Sweden, Norway, Germany, England and France now have the Pilotfish solution on board. The collaboration with Voith is now opening up new markets for the company. "With its global reach, resources as a multinational company, and decades of experience in the public transportation and vehicle industry, Voith is the perfect partner for us," sums up Pilotfish founder Tomas Gabinus.

But the focus isn't only on international expansion. Together with Voith, Pilotfish wants to create an ecosystem of application suppliers whose apps add new functionality to the open platform and offer operators additional fleet management options.

"We make public transportation more attractive by helping our customers increase their efficiency," sums up Gabinus. "We want to encourage people to use public transportation instead of privately owned cars whenever possible."

Cloud

Data generated during vehicle operation is transferred to the operator's IT systems via a cloud connection.

Hardware

The hardware installed in the vehicle can be integrated into the Pilotfish system via the Vehicle Gateway.

Video surveillance

Breath alcohol ignition interlock device

Passenger counting

Fleet management system

Indicators / displays

Tickets

Base Package

All of the components listed on this line are included in the base package.

Pilotfish®

Econometer

Tachograph

Driver's console

Fuel Economy

Vehicle Gateway

The Vehicle Gateway is connected to the driver's console and transmits the data provided by the apps to the operator's IT systems.

ITxPT

The open standard for the mobility industry specifies how data is exchanged between systems on board buses, trams, subways and trucks as well as the operators' IT infrastructure.

ITxPT

Apps

In addition to Pilotfish's own applications, operators can use custom-designed apps from third-party providers.

10,000 installations

in Sweden, Germany, France, England and Norway

Navigation

Schedule

VoIP

Vehicle status report

Manual fault report

Automatic vehicle localization (AVL)

Messages

Automatic fault report

Robbery alarm

–10 %

Fuel Economy

Driver assistance system to reduce fuel consumption by approx. 10 percent

How much fuel would you save?

Scan the QR code to calculate your own savings potential

Please unfold and discover the future!

Service Operation Vessel

The Voith Schneider Propeller is particularly suitable for propelling and steering service vessels, including the electrified version eVSP (see page 08).

In the future, remote control and AI will take the helm in the shipping industry. Voith is collaborating with renowned research partners and bringing the technology needed to implement cutting-edge projects on board.

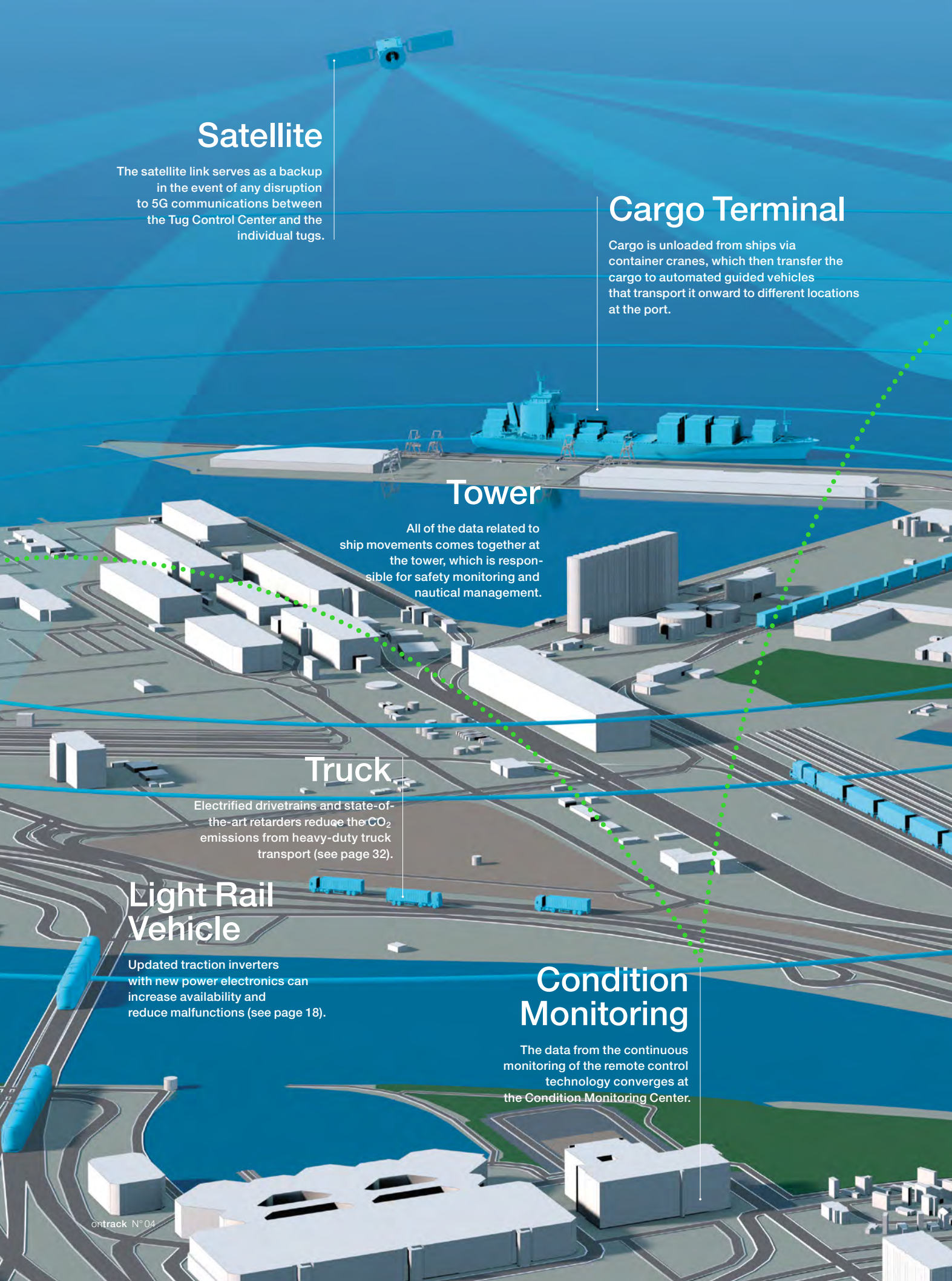
Driven by Autonomy

Electric Bus

Buses equipped with the Voith Electrical Drive System (see page 22) transport employees to the individual areas of the port.

Autonomous Ferry

Voith and its partners are conducting research on an autonomous ferry that navigates, docks, and departs automatically. It is scheduled to enter service in 2022.



Satellite

The satellite link serves as a backup in the event of any disruption to 5G communications between the Tug Control Center and the individual tugs.

Cargo Terminal

Cargo is unloaded from ships via container cranes, which then transfer the cargo to automated guided vehicles that transport it onward to different locations at the port.

Tower

All of the data related to ship movements comes together at the tower, which is responsible for safety monitoring and nautical management.

Truck

Electrified drivetrains and state-of-the-art retarders reduce the CO_2 emissions from heavy-duty truck transport (see page 32).

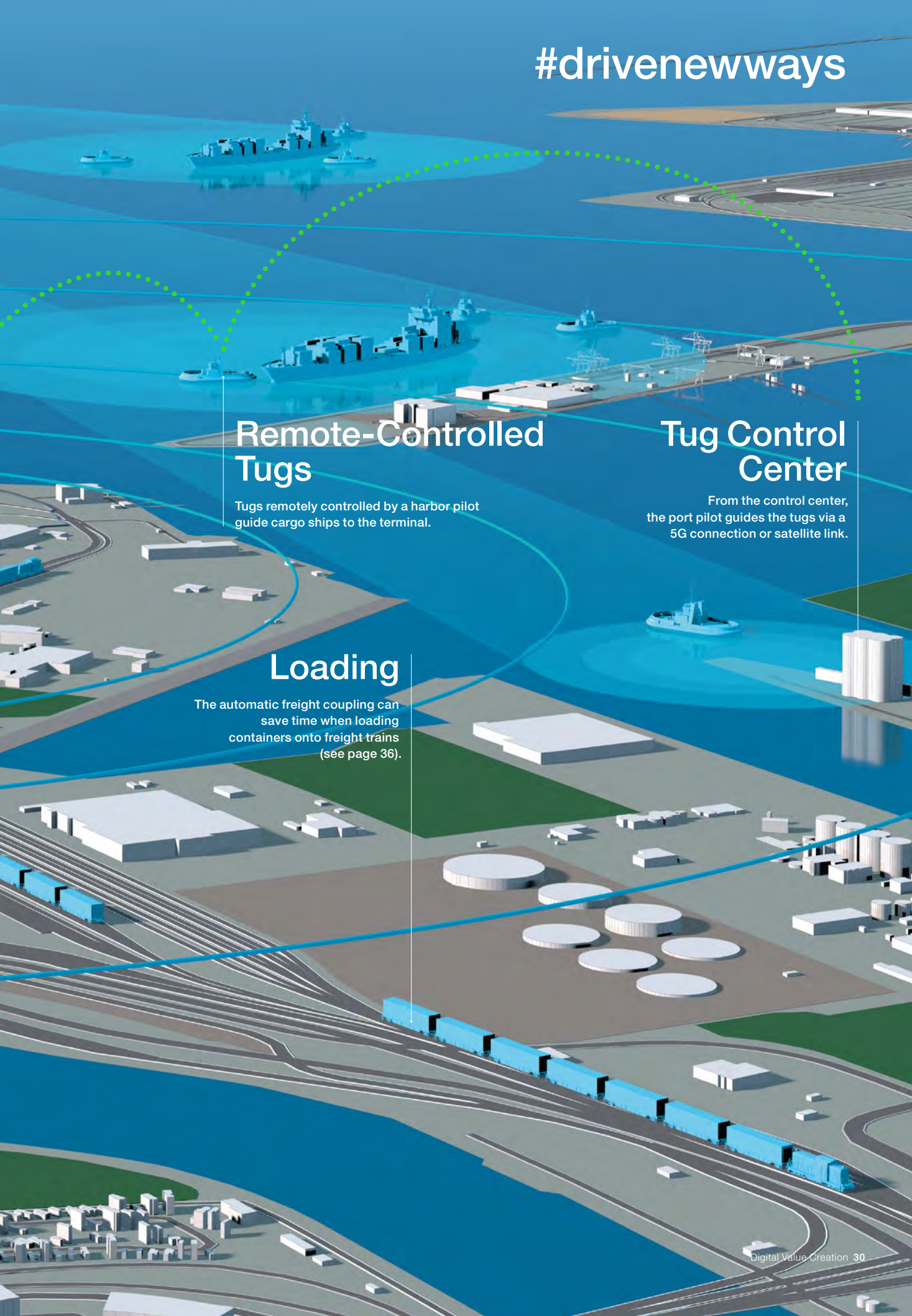
Light Rail Vehicle

Updated traction inverters with new power electronics can increase availability and reduce malfunctions (see page 18).

Condition Monitoring

The data from the continuous monitoring of the remote control technology converges at the Condition Monitoring Center.

#drivenewways



Remote-Controlled Tugs

Tugs remotely controlled by a harbor pilot guide cargo ships to the terminal.

Tug Control Center

From the control center, the port pilot guides the tugs via a 5G connection or satellite link.

Loading

The automatic freight coupling can save time when loading containers onto freight trains (see page 36).

Hamburg, 4:40 a.m. As both the sun and the tide gradually rise, a giant container ship enters the port. Six assistant tugboats swarm around the enormous ship like bees around a beehive and carefully guide it through the narrow waterways towards its mooring. And yet none of the tugs has to maneuver dangerously close to the bow of the 366-meter vessel. There won't be any towing lines passed over by hand – the tugboats don't even have a crew on board. Instead, they are all remote controlled. A harbor pilot coordinates and monitors their activities from a safe distance and maintains radio contact with the freighter, which he directs to the terminal. There, the container crane is ready and waiting to unload its cargo from 14,000 forty-foot containers.

While the scene is still fiction, the technology is not – the industry and research community have long been working on solutions to remotely control and automate shipping. "Apart from rail freight transport, shipping is the sector with the greatest autonomization potential," explains Dirk Jürgens, Vice President Research and Development, Marine at Voith. "Safety and efficiency are the key benefits." And also a win for the environment. On the one hand, by navigating the vessel in a particularly resource-friendly manner, which is something that humans can't do. On the other hand, by avoiding accidents in which leaking oil would cause severe consequential damage. "It's preventive environmental protection."

There's a reason why researchers aren't experimenting on the open sea, but instead using the much more heavily trafficked rivers and ports, with their numerous ship movements, for field tests. Although there is an increased risk of collision in these areas, communication is reliable, such as via fast 5G wireless networks, for example. "We need a secure data connection and redundant systems in case the enormous steel masses of the ship being assisted move between the transmitter and receiver," Jürgens explains. Sophisticated sensor technology and control logic are also required; they must replace the experience of a human crew. And a condition monitoring solution to permanently monitor the equipment is equally important.

The research project FernSAMS is studying how all of these systems interact with each other in real-world situations. Voith is leading the project in cooperation with the Fraunhofer Center for Maritime Logistics and Services, the Marine Training Center Hamburg (MTC), the Technical University of Hamburg, and Germany's Federal Waterways Engineering and Research Institute. In order to integrate the individual components into an overall plan, Voith is also working with the Bremen-based tugboat operator URAG and the Dutch towage and salvage company Mutraship. After trials with Hamburg harbor pilots in the MTC ship simulator and a pilot test, a large field test with Mutraship is planned for the end of 2020 that will be carried out at the Port of Rotterdam.

The results will have far-reaching consequences. Remote-controlled tugs not only hold the promise of lowering operating costs – they also allow open the door to completely new ship designs. "The cost of designing and building ships will fall because requirements such as noise insulation will no longer need to be met and there will be more space available due to the elimination of superstructures and bridges," explains the engineer with a doctorate in shipbuilding. The extremely fast-reacting propulsion solutions required are already available – the Voith Schneider Propeller (VSP), the world's most responsive propeller, has long been a tried-and-tested solution in tugboats and is now also available as the eVSP version powered by an electric motor. Nevertheless, the tugs won't be operating fully autonomously anytime soon. "Ship assistance is simply too complex for autonomous vessels," Jürgens clarifies. "The situation is different with inland ferries, however."

Autonomous operation is, in fact, easier to implement in their case, generally speaking. After all, when traveling back and forth between two defined points on the riverbank, the route essentially always remains the same – and the number of possible objects that could be involved in a collision is more manageable than in the harbor. The Rhine ferry "Horst" is going to demonstrate just how this might work in real-world operation. It is designed to operate fully automatically and, in addition to ferrying passengers between the towns of Oestrich-Winkel and Ingelheim, will also autonomously handle docking and undocking at the ferry pier. The ferry currently transports 300,000 vehicles and 600,000 passengers across each year, still navigated by ferry operators who make their way between sandbanks.

"Horst" serves as an experimental vessel in the research project AKOON, in which Voith is collaborating with RWTH Aachen University, the Kornwestheim-based technology consultancy "in – innovative navigation" and the Mainz-based Rhine ferry operator Rheinfähre Maul GmbH. The partners have divided up the work between them, with Voith responsible for creating a digital twin of the ferry in Heidenheim while RWTH Aachen University prepares the control system and "in – innovative navigation" develops the sensor technology. The partners hope that optimized control of the propulsion units (four VSPs) will reduce fuel consumption and intelligent route planning will increase safety during ferry operations. To achieve this, a variety of sensors will provide the control system with extensive information about the current traffic situation on the Rhine.

The team has high expectations – the research project aims to lay the foundations for fully automated inland navigation and act as a technology driver. Therefore Germany's Federal Ministry for Economic Affairs and Energy is supporting it within the framework of its "Next-Generation Maritime Technologies" subsidy program. "Horst" is scheduled to begin autonomous operation in June 2022. Future developments in the field of ship assistance systems will then be developed based on the results.

For Voith executive Jürgens, the trend towards autonomous or remote-controlled shipping is undeniable. "Shipping will become much more autonomous than the automotive sector. Maybe not in recreational boating, but certainly in the commercial sector," the expert predicts. "And we provide the technology for the maritime world of tomorrow."

Braking for

Greenhouse Gas Emissions in the EU

94%

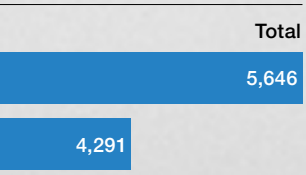
of greenhouse gas emissions from the transportation sector are caused by highway freight transport

Planned Reduction of

It will be impossible to achieve the EU's ambitious goal of rapidly reducing CO_2 emissions from heavy-duty truck transport without changes to the truck drivetrain. The water-based and disengageable Voith ECO Retarder continuous braking system helps reduce emissions and cut costs.

the Climate

CO_2



27 %
trucks and buses

73 %
cars and vans

CO_2 Emissions by New Trucks from **2025** **–15 %** and from **2030** **–30 %**

Greenhouse Gas Emissions from Road Transportation

Source: European Environment Agency

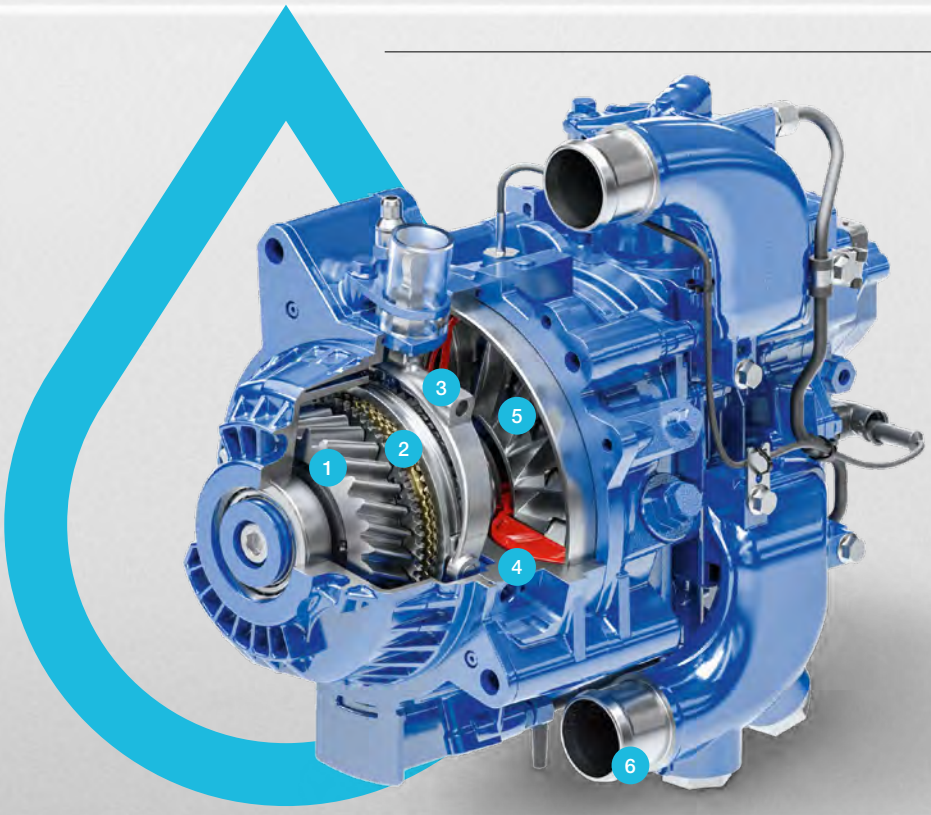
Voith
ECO Retarder

Main Components

1 Retarder pinion
2 Synchronization
3 Gear shift fork
4 Rotor
5 Stator
6 Water socket

Eliminating the conventional combustion engine also involves eliminating its engine brake – which means the customer will need a replacement braking element that ideally also dissipates energy as soon as it can no longer be stored.

Gunther Kraft
Vice President Truck OEMs at Voith



Increased Efficiency and Sustainability

35 kg
lower
system weight

50 %
less space required

80 %
less brake dust

When it comes to reducing greenhouse gases, the EU is putting the pedal to the metal – and threatening to run over the automotive industry. The first European CO_2 emissions standards for trucks and other heavy-duty commercial vehicles call for a reduction in CO_2 emissions from new trucks by an average of 15 % by 2025 and as much as 30 % by 2030. These ambitious targets come with draconian fines – the "excess emissions penalty" of 4,250 to 6,800 euros per gram of CO_2 per ton-kilometer could potentially jeopardize the viability of even large commercial vehicle manufacturers, as the German Association of the Automotive Industry has already warned.

The industry is caught in a dilemma. The EU emission targets can only be achieved through significant additional reductions in fuel consumption. Because fuel is one of the main cost factors in the logistics sector, it has long been included on the specs sheet anyway. This means that great leaps are highly unlikely. As such, manufacturers have no choice but to think beyond the diesel engine and include alternative drive systems in their planning, as well as components that play a role in increasing efficiency and therefore reducing CO_2 emissions.

Continuous Braking System for Alternative Drives

In the (partially) electrified trucks of the future, the drivetrain will play a key role. "Eliminating the conventional combustion engine also involves eliminating its engine brake – which means the customer will need a replacement braking element that ideally also dissipates energy as soon as it can no longer be stored," explains Gunther Kraft, Vice President Truck OEMs at Voith. The company's latest, particularly environmentally friendly, continuous braking system is a good example of what this could look like. The Voith ECO Retarder – an efficiency-optimized, next-generation version of the popular Voith Retarder – can be adapted to alternative drives and features a built-in, electronically controlled unit for speed synchronization between the retarder drive shaft and rotor shaft. With their help, the rotor can be mechanically decoupled from the drivetrain when the retarder is switched off, preventing power dissipation when the rotor shaft is stationary. "This reduces fuel consumption and, as a result, also CO_2 emissions," Kraft emphasizes.

Multiple Benefits with CO_2 Certification

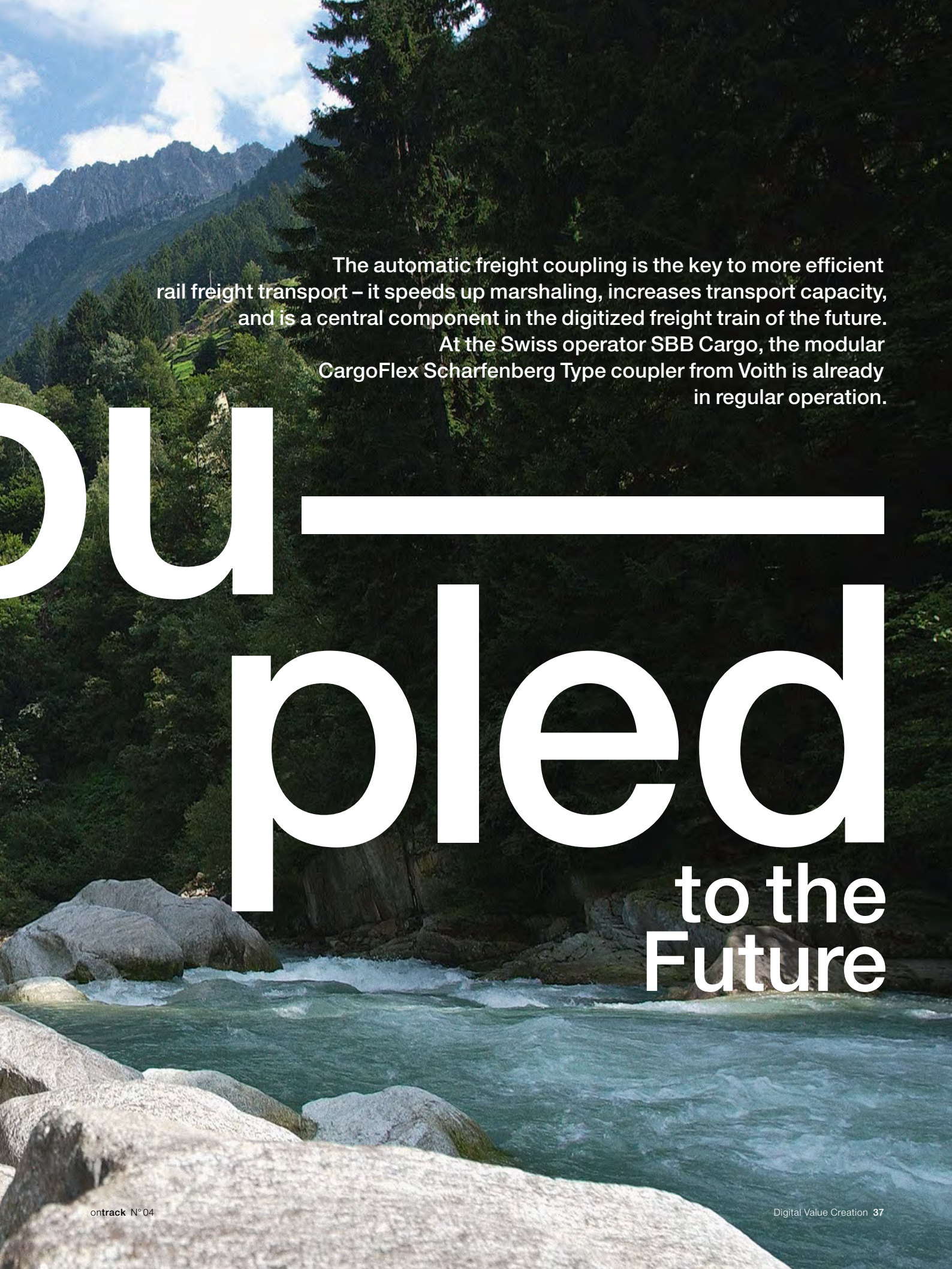
Despite these improvements, however, the executive primarily focuses on the fundamental benefits of using the Voith ECO Retarder in "green" trucks. "On the one hand, in order to continue to meet legal requirements, such as the Type IIa test, manufacturers will have to replace the engine brake that is not available on heavy electric trucks because of the potentially fully charged battery. On the other hand, the sale of electric trucks gives manufacturers a further advantage in terms of fleet consumption, which earns them bonus points with customers of conventionally powered trucks as well," argues Kernke. "This results in multiple benefits for them."

In order to help OEMs integrate the unit into the respective drivetrain, Voith has created a modular system that is precisely designed for use with electrified vehicles and, for example, controls the interaction between the Voith ECO Retarder and the energy management and recovery systems. "We have to meet both mechanical and electronic requirements and also ensure that the unit can be optimally integrated into the system, and adapt the solutions to each OEM," summarizes Kraft. The concept and its flexibility are impressive. Customers are already expressing interest in using the new ECO Retarder, particularly with water technology, in alternative drives, emphasizes the expert from Voith.

His colleague Joachim Kernke also believes the continuous braking system has a bright future. "We're currently conducting market research. Today, about four out of ten trucks in Western Europe are sold with retarders – we expect a significantly higher retarder penetration with electric-powered heavy trucks, especially those powered by fuel cells."

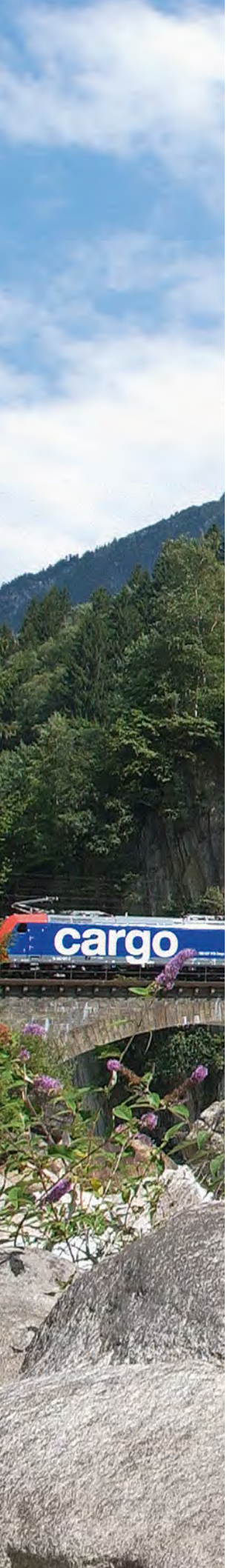
Co

Starting in June 2021, SBB Cargo plans to gradually switch all of its intermodal domestic freight trains to the automatic coupler.



The automatic freight coupling is the key to more efficient rail freight transport – it speeds up marshaling, increases transport capacity, and is a central component in the digitized freight train of the future. At the Swiss operator SBB Cargo, the modular CargoFlex Scharfenberg Type coupler from Voith is already in regular operation.

ou pled to the Future



837,000,000,000 ton-kilometers. Germany's Federal Transport Infrastructure Plan forecasts this gigantic transport volume – some 25 percent higher than today's – for freight transport in Germany alone in the year 2030. It won't be possible to move this huge amount on the road – and even with the help of rail freight transport, only if it operates much more efficiently in the future. This is why one of the German government's explicit goals is to expand the rail network and increase its share in the rail/road/shipping transport mix – both for economic reasons and under pressure to translate rail's significantly improved environmental footprint compared to trucks into concrete reductions in CO_2, nitrogen oxide and particulate matter emissions.

The rapid implementation of this plan has proven difficult because one thing is slowing down productivity: the screw coupling, which is now almost 160 years old. The high degree of manual effort required during marshaling with this component has long since become a major obstacle negatively impacting the competitiveness of European rail freight transport. It needs to be replaced with an automatic coupling that speeds up marshaling and makes it possible to form longer trains and thus increase transport capacity. This has been common practice in the passenger sector for decades, where the Scharfenberg coupler fulfills this role and makes it possible to couple and uncouple any type of train – from trams to bullet trains – quickly, easily, and safely. In the freight transport sector, it is also important to prepare for digital technology in order to simultaneously lay the foundation for the intelligent freight train of the future. And last but not least, automatic coupling increases occupational safety, since railroad workers no longer have to spend any time between the cars.

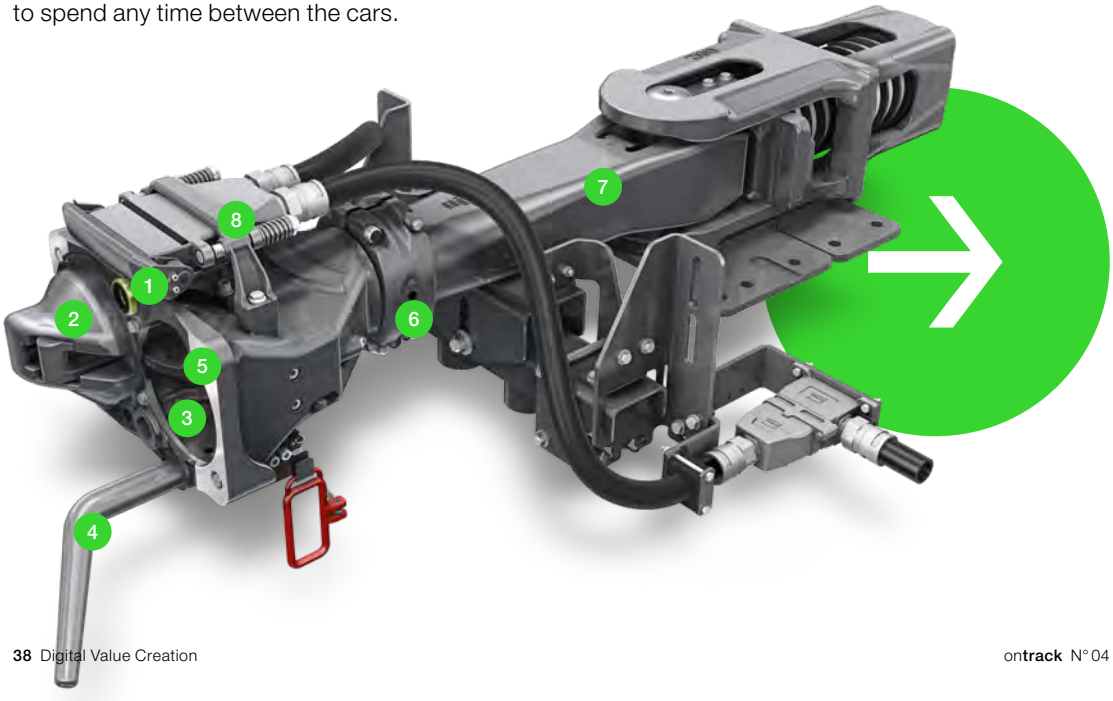
This is why railroad associations and industry associations – including the Technical Innovation Circle for Rail Freight Transport, the German Railway Industry Association, the Association of German Transport Companies, and the International Union of Wagon Keepers – are pushing for all of Europe to switch to using digital automatic couplers (DAC). "With the new coupling technology, we are combining the long overdue automation of railroad car coupling with the world of Rail 4.0 in a single step," argues Malte Lawrenz, Chairman of the Association of Freight Car Owners in Germany.

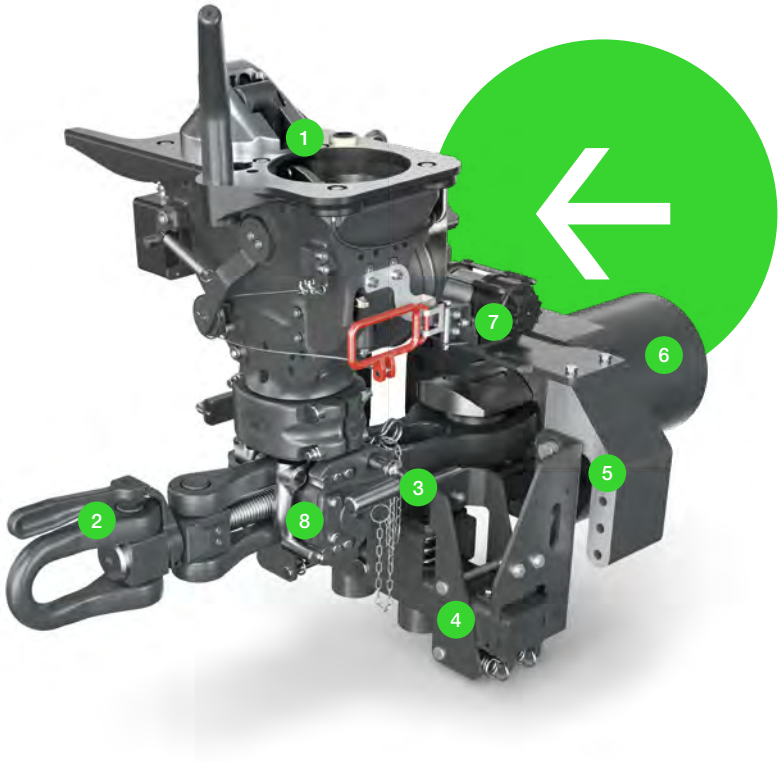
What still sounds like fiction has, in fact, long been the reality in Switzerland. There, SBB Cargo and Voith are proving that the automatic freight coupling works in day-to-day operations. Since May 2019 in the Alpine Republic, 25 locomotives and 100 railroad cars – connected by Voith's CargoFlex Scharfenberg type couplers – have been in regular intermodal service, in which containers are loaded from truck to rail. It is based on the tried-and-tested Scharfenberg Type 10 coupler used in passenger transport and, thanks to its zero-backlash design, is the first freight coupler that can be equipped with an automatic uncoupling system and signal or power trans-

Voith CargoFlex Scharfenberg Type

Function and Design

1 Air pipe connection for brake pipe (BP)
2 Male cone
3 Female cone
4 Gathering horn
5 Winter-optimized front plate
6 Muff coupling connection
7 Draw gear
8 Electric head





Voith CargoFlex Hybrid

Function and Design

1	Type 10 coupler head	**5**	Adapter frame
2	Screw coupling	**6**	Draw gear
3	Locking pin	**7**	Electric cable winch
4	Coupler support	**8**	Folding device

19
grams
CO_2 is emitted per ton-kilometer by rail – compared with 81.5 grams by truck.

740
meters
is the target train length in order to increase the utilization of the rail network. In Germany, most freight trains are currently shorter than 600 meters.

87
percent
growth in rail freight traffic could be achieved by 2050, forecasts the European Commission.

mission. This makes fully automated processes, as well as the ability to relay signals and provide power to electrical consumers, possible. “We are the only supplier in Europe that has an automatic freight coupler in regular operation based on the current migration strategy,” says Niklas Weidert, Key Account Manager Freight Couplers Rail EMEA at Voith.

The Swiss decided to invest in technology at an early stage in order to become more competitive and counter the shortage of shunting staff. In this context, the focus wasn’t only on automation, but also on reducing maintenance costs, for example by eliminating the side buffers and thanks to the maintenance-free buffer coupler on the CargoFlex Type Scharfenberg. “Voith uses proven design principles in its freight couplers and deliberately avoids bolted connections in the load path that require maintenance” explains Jessica Amberg, Project Manager 5L Train at SBB Cargo.

The efficiency gains made possible as a result of automatic coupling are distributed among all market participants. “With longer, heavier, faster trains, infrastructure companies benefit from increased capacities, while operators can cut their operating and shunting costs,” explains Voith Manager Weidert. “For wagon keepers, the amount of maintenance required is reduced due to the lack of buffers and less wear on the wheel sets, because the automatic coupling with a stabilizing joint reduces the forces applied between the wheel and rail during cornering. And shippers can acquire new customers thanks to the higher payloads per wagon and train.”

According to a study carried out on behalf of Germany’s Federal Ministry of Transport and Digital Infrastructure, however, preliminary calculations indicate that between 432,000 and 485,000 freight cars will have to be converted in Europe, including England, Norway, and Switzerland, when migrating to digital automatic couplers. In addition, around 17,000 locomotives will be equipped with an automatic coupler. During a transitional period, Voith will also offer the CargoFlex Type Scharfenberg for locomotives as a hybrid version that, thanks to its head that can be swiveled up, can also be used as a mixed towing coupler with a draw hook.

Because of the cost of retrofitting, SBB Cargo CEO Nicolas Perrin called for European standards to be created as soon as the pilot project for the automatic coupler was launched. “The joint approach will allow us to collectively drive the freight transport sector forward and reap the benefits equally,” says the executive. At the beginning of 2020, six rail freight transport associations signed a charter in which they called on policymakers and the industry to join forces and “place a focus on the digital automatic coupler as a key technology for efficient Rail 4.0.” The goal is to have freight cars throughout Europe automatically coupled and digitally connected, from the locomotive to the last car, by 2030 at the latest. Automated marshaling and brake testing would then become a reality, as would digital integrity testing and load monitoring.

Until then, the SBB freight subsidiary will expand its pioneering role with the help of the Voith CargoFlex Type Scharfenberg, based on its experience gained in day-to-day operations. “Everything has been running smoothly since the automatic coupler was introduced,” says Jasmin Bigdon, head of Asset Management at SBB Cargo. As a result, her company plans to gradually switch all of its intermodal domestic freight trains to the automatic coupler starting in June 2021.

India's economic growth hinges on a massive expansion of its transport infrastructure. Voith is doing its part with systems and services for the establishment and expansion of efficient metro rail networks in major cities.

Destinat Progress

1

2

tion

India's economic output is changing even faster than its image. This huge emerging market with over 1.3 billion people has achieved impressive growth in recent decades, making it the world's fifth-largest economy today. The International Monetary Fund forecasts that by 2024, India's gross domestic product will only be slightly lower than that of Germany. About three years after that, India will replace China as the most populous country in the world, the United Nations expects.

This dynamic change is not without its problems. Population growth and accelerated urbanization are causing greenhouse gas emissions to continue to rise. At the same time, the lack of public transportation cuts economically disadvantaged groups off from their jobs. This is why the rapid expansion of public transport is becoming increasingly important. "The number of people who use the metro has risen dramatically, so the demand for new metro systems is increasing all over India," confirms JE Atridev, manager of the Mukundpur depot of the state-owned operator Delhi Metro Rail Corporation (DRMC). "The Indian government has identified 33 cities in which it wants to build a metro system."

Voith has been supplying DRMC with couplers and transmissions for a long time and is responsible for their maintenance. "As a supplier of key components, we can provide safe, efficient, top-quality units and help drive the expansion of the metro in India forward," explains Gregor Wiche, Chief Marketing Officer Mobility APAC, Voith Turbo.

1
At the Faridabad service center, Voith employees maintain the metro rail cars owned by the Delhi Metro Rail Corporation.

2
The Lotus Temple in New Delhi is open to followers of all religions. Several metro stations are located in its vicinity.

The DMRC Serves

286

Stations

The metro rail network in all of India currently only covers about 650 kilometers, compared to 900 kilometers in the city of Shanghai alone. As such, the country has enormous theoretical potential.

Gregor Wiche
Chief Marketing Officer Mobility APAC, Voith Turbo

1

1
Intensive maintenance ensures that downtimes remain low while train availability remains high.

2
In India's capital region, the metro rail connects the Noida and Gurgoan metropolitan areas with Delhi, among others.

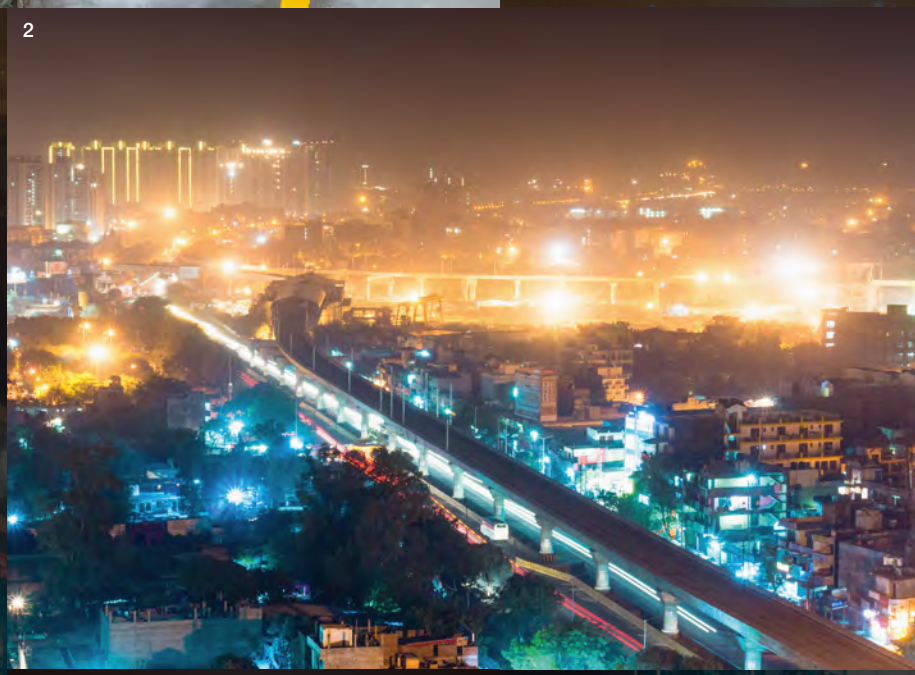
Delhi's Entire Metro Rail Network Covers

391

Kilometers

But the systematic expansion of the transport infrastructure will also mean increased service requirements. This is why in addition to the company's three locations in Hyderabad (production, service, sales), Pune (sales) and Kolkata (sales), Voith has opened another rail service location in Faridabad, only about 30 kilometers south of Delhi's city center. "By opening this new service center, we want to further expand the range of services we offer for the metro rail aftermarket in India and contribute to the country's urbanization and improve its transport system," says Kuntal Dasgupta, Vice President Mobility India, Voith Turbo.

The company will need to move fast. A total of 40 percent of India's population is expected to live in cities by 2030, generating 75 percent of the country's gross domestic product. This will only be possible with an efficient infrastructure on a metropolitan scale. Dasgupta's colleague Wiche breaks down the magnitude of this task: "The metro rail network in all of India currently covers about 650 kilometers, compared to 900 kilometers in the Chinese city of Shanghai alone. As such, the country has enormous theoretical potential.



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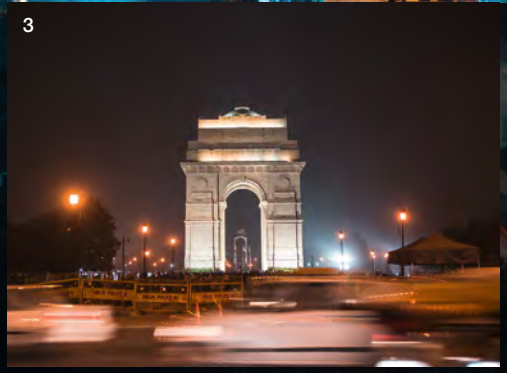
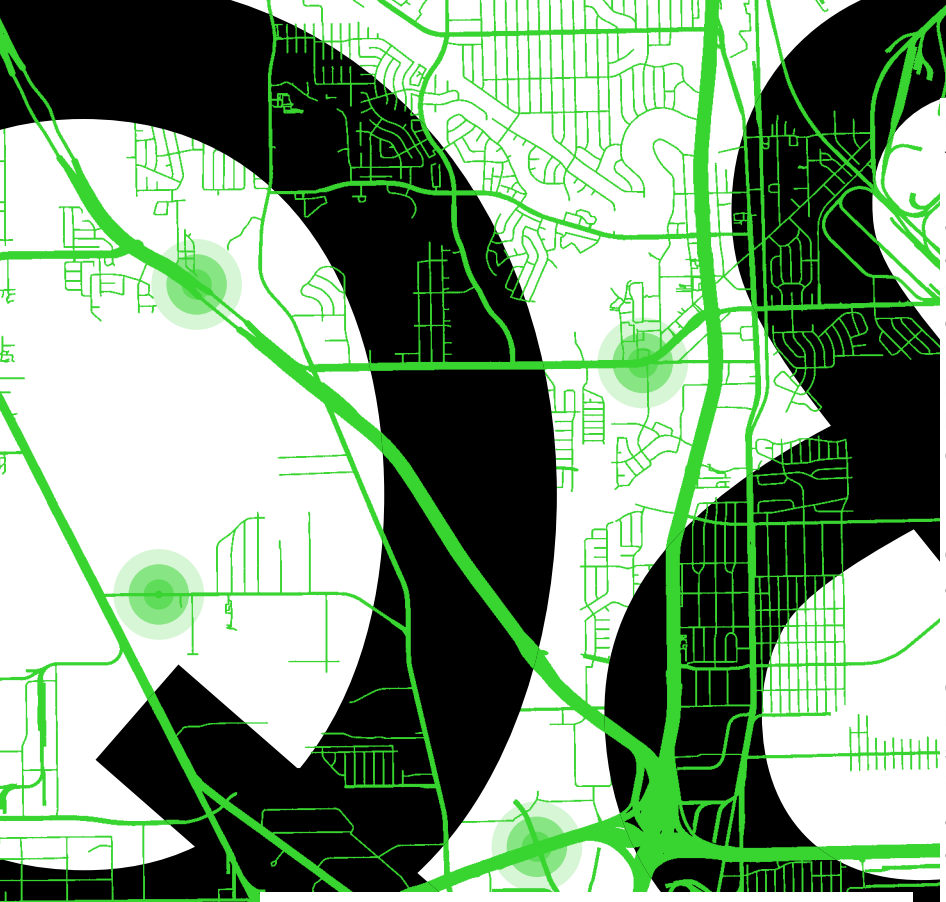


3

3
The India Gate, New Delhi's famous triumphal arch, is also accessible via the DMRC network.



The Digitized Road

Ilja Radusch heads up the Smart Mobility division of the Fraunhofer Institute for Open Communication Systems (FOKUS) in Berlin. In order to optimize the mixture of conventional and highly automated vehicles that will be on the road in the future, he is conducting research on a hybrid road infrastructure.

Mr. Radusch, what will happen when autonomous and manually operated trucks and cars share the road in the future?
We definitely expect both safety and efficiency to increase as automated systems become more widespread. This has already been proven historically, for example as a result of the introduction of more intelligent adaptive cruise control systems. In addition, humans are currently the primary cause of road accidents, and the general population has come to realize that driving at high speeds doesn't mean you'll arrive at your destination any sooner.

In order to handle mixed traffic, you contrast today's passive roads with the concept of the hybrid road. What can a hybrid road do specifically to increase the flow of traffic and reduce the number of accidents?
Just like in other areas, digitization is also having an impact on roadways. This begins with the digital twin of light signal systems such as traffic lights, which in addition to light, also communicate their current – and just as importantly, future – signal phase via data communication. In addition to ultra-precise positioning, especially near intersections, we are also working on a smartphone-based hazard warning system designed to prevent accidents involving both vehicles and vulnerable road users caused by inattentiveness. The next step would be a more dynamic division of the roadways. It would make sense, for example, to use LED markings in the ground to widen bicycle paths when the weather is nice, or to help bikers maintain a greater distance from vehicles in the rain.

Is it even possible to use the road as efficiently as possible as long as all of the vehicles aren't autonomous and connected?
It will be extremely difficult, to say the least. Particularly in the context of freight transport, for example, connecting trucks to each other is a helpful step, but their digital integration with upstream and downstream parties is even more important. One-third of the trucks on the road are empty, for example when returning from a delivery. In this respect, we need to become much better at making effective use of these transport capacities via interconnected logistics.

Would hybrid roads with a lane reserved for autonomous trucks, for example, be a good way of introducing us to the world of "coexisting" manually operated and autonomous vehicles?
A dedicated lane – similar to high-occupancy vehicle lanes in the United States – would, of course, help. Especially if we can ensure that the legal, structural, and, if necessary, technical conditions such as obstacle-free access are met. Then it would also be conceivable for transport operators to reserve certain times and sections in order to be able to guarantee arrival times.

If the hybrid road increases the capacity of this traffic area, won't the traffic density there continue to grow at the expense of the more sustainable rail?
Interconnected transportation doesn't only refer to the road. Rail traffic must also be included. Freight trains are running into bottlenecks on main lines. Mass freight such as coal is on the decline, and freight is becoming more fragmented. These challenges are best met by using a mix of transportation methods. For example, the goods can initially be transported by rail. An automated electric truck is then used for the last mile to bring the cargo to the factory gate. Digitization also improves the ability to forecast and plan – and therefore ensures that the different methods of transportation interact efficiently.

Road, Rail & Water

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