

# ontrack

by Voith Turbo — N° 06

## Electricity for HD

The VEDS HD+ is the perfect drive system for electric-powered heavy-duty vehicles

04

28

## Clean Power from the Ocean

How the energy revolution is taking place on the high seas

## H<sub>2</sub> to Go!

Voith's hydrogen storage system is designed for vehicles with long ranges and heavy loads

12

→  
E-Mobility  
Pays Off!

## Digital Is Better

Increasing the efficiency of rail freight transport with DAC4EU

42

PLUG AND DRIVE

# Editorial ontrack N° 06



**We are part of the global transformation in both energy production and mobility solutions.**

“Plug and DRIVE – E-Mobility Pays Off” isn’t just the title of this latest issue of ontrack, it’s an attitude. The transformation toward electrified powertrains has been underway for years. Whether in city buses and, in the future, intercity buses, heavy-duty waste and construction vehicles, ferries, offshore supply ships, and countless rail vehicles – e-mobility is the mobility of the future. And this is true not only due to environmental and social reasons, but even more so for financial reasons. As a systems manufacturer, we’re just as aware of them as we are of national framework legislation being passed around the globe. In China, the United States, and in Europe, the end of fossil fuel-based combustion technology as a drive solution has been ushered in by law.

In light of this fact, I believe that Voith Turbo’s systematic realignment towards the growth markets of e-mobility puts us in a strong position. We are part of the global transformation in energy production (think wind turbines and their offshore installation, for example) as well as mobility solutions on the road, rails, and the water.

On the following pages, I invite you to learn more about our e-mobility solutions such as the VEDS HD+ or our electric Voith Schneider Propeller. I’m sure you’ll be impressed. In addition, witness how we’re leading hydrogen technology into an innovative, promising future with our 700 bar storage system. And recognize the special role we play in Europe with our automatic coupler solution for rail freight transport, because Voith has succeeded in setting a benchmark with our CargoFlex.

Hopefully we’ll see each other in person at one of the three leading trade shows for rail vehicles (InnoTrans), heavy-duty vehicles (IAA Transportation), and ships (SMM). I look forward to further in-depth discussions and send you my warmest regards!

**Martin Wawra**  
Executive Vice President & CEO Voith Turbo Mobility

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89522 Heidenheim, Germany  
ontrack@voith.com

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Sebastian Busch,  
J.M. Voith SE & Co. KG

**Editor-in-chief:**  
Philip Bäuerle,  
J.M. Voith SE & Co. KG

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# Contents

- |   |  |
|---|--|
| <p><b>04</b><br/><b>Electricity for HD</b><br/>The VEDS HD+ is the perfect drive system for electric-powered heavy-duty vehicles</p> <p><b>12</b><br/><b>H<sub>2</sub> to Go!</b><br/>Voith’s hydrogen storage system is designed for vehicles with long ranges and heavy loads</p> <p><b>16</b><br/><b>E-Mobility Pays Off</b><br/>The shift to electric vehicles also makes financial sense</p> <p><b>26</b><br/><b>Offshore Wind Farms Are Essential</b><br/>The importance of wind power for the global energy supply</p> | <p><b>28</b><br/><b>Clean Power from the Ocean</b><br/>How the energy revolution is taking place on the high seas</p> <p><b>34</b><br/><b>One For All</b><br/>One service partner for every manufacturers’ brand? Voith makes it possible</p> <p><b>38</b><br/><b>Second Life</b><br/>A fast and cost-effective way for bus operators to get started with e-mobility</p> <p><b>42</b><br/><b>Digital Is Better</b><br/>Increasing the efficiency of rail freight transport with DAC4EU</p> |
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**RE-  
THINKING  
E-MOBILITY  
FOR COM-  
MERCIAL  
VEHICLES!**



# Editor on track



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Martin Wawra  
Executive Vice President



# ELEC- TRICITY FOR HD

The electrification of commercial vehicles is picking up steam.

# THE POWER'S FLOWING

## TO HEAVY-DUTY VEHICLES

The Voith Electrical Drive System (VEDS) HD+ is the company's first drive concept tailored to the special requirements of electric-powered heavy-duty vehicles – such as long-haul trucks, concrete mixers, or other construction vehicles.

Even conservative forecasts predict that by the year 2030, the share of electric-powered HD trucks – i.e., all commercial vehicle types with a gross vehicle weight of more than 15 tons in which one or more axles are powered – will stand at between 35 and 40 percent in most regions of the world. This is primarily due to the fact that countries such as China, the United States, Canada, and EU member states have already introduced corresponding legislation. This political framework is also underpinned by economic considerations – since the passenger car industry will be investing around 25 billion euros in research into state-of-the-art battery technology in the coming years, it is safe to assume that the cost of batteries will fall rapidly. Similarly, their power density is likely to increase significantly. This will ultimately make it economically viable to use batteries in commercial vehicles. At the same time, hydrogen will soon play an increasingly important role in this segment. Many experts believe that by the end of this decade, it will likely be cheaper to operate a high-performance e-truck than a comparable vehicle with an internal combustion engine.

At the present time, numerous manufacturers are working on electric drive systems for this segment. Yet these concepts are more or less tailored to a specific use case and therefore cannot be applied across the board to all vehicle

applications. Alexander Denk, Vice President Product Management E-Mobility at Voith, explains the reason for this: "A truck traveling many miles on the highway with a load weighing several tons needs to leverage vastly different levels of drive power than, say, a garbage truck that repeatedly stops and starts while traveling over a short distance, but whose weight increases with each stop." In the world of internal combustion engines, the solution to this problem is already well established – a transmission sits between the engine and the drive axle that regulates the amount of power that gets put to the pavement. Electric trucks currently lack such innovative plug-and-play approaches. →

**"Customers can put together the ideal configuration from more than 40 variations."**

Alexander Denk  
Vice President Product Management E-Mobility

The automated manual transmission's patented coupling structure maximizes efficiency in all applications.

# #1

## CONCRETE MIXING TRUCKS



**The challenge:**  
Frequent changes between  
very high and low loads,  
high levels of torque required.

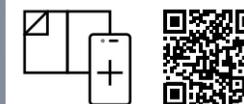
And this is exactly where Voith's new VEDS HD+ concept comes in. At its core is a new type of automated four-speed EV transmission. The technical term for this is automated manual transmission, or AMT for short. This transmission design combines maximum efficiency with the best possible tractive force. In order to reduce shifting times to less than the blink of an eye, Voith has implemented a new smart actuator concept. This changes gears in a fraction of a second, ensuring that torque is applied to the wheels again immediately after shifting. The result is a smoother ride and excellent handling characteristics.

According to Denk, however, other aspects proved more decisive in the choice of this specific transmission system: "The patented coupling structure of the completely newly developed AMT makes it possible to achieve the highest levels of efficiency and therefore directly increase the vehicles' range." This is an important advantage when starting up, for example: "The required

amount of traction is available in every gear, regardless of the load." Municipal garbage trucks are a prime example demonstrating how the transmission works. The distance the trucks travel between the individual garbage cans is short. Again and again, the vehicle accelerates and then has to brake again after a few feet. In the process, the weight of the vehicle steadily increases.

The transmission developed by Voith makes the right shifting profile available for every application – reducing wear and tear on the powertrain and minimizing energy consumption. It is designed to operate highly efficiently, both with high torque and at a high number of revolutions per minute. This means that the transmission is also designed for use over long distances and can deliver sufficient power to the axles, even on steep inclines. At the same time, this design ensures that the transmission will work flawlessly for years to come. This coupling structure is just one of many patents in the VEDS HD+.

Since Voith traditionally sees itself as a systems supplier, the development team developed a complete electric powertrain as part of the project that, in addition to the aforementioned transmission, also includes a new electric motor series in two power classes (with 330 kW and 390 kW of peak power) as well as an innovative inverter. The system can also be upgraded with an optional retarder. The advantage is that all of the components are perfectly compatible with each other. As a complete package, the VEDS HD+ thus holds the promise of ushering in a whole new level of efficiency in e-mobility for commercial vehicles. Customers receive a drive system perfectly adapted to their requirements. "Our system features a modular design that allows customers to select from a range of different components. They can put together the ideal configuration for them from more than 40 possible variations," explains Denk.



Scan the QR code to learn more about the VEDS HD+!

# #2

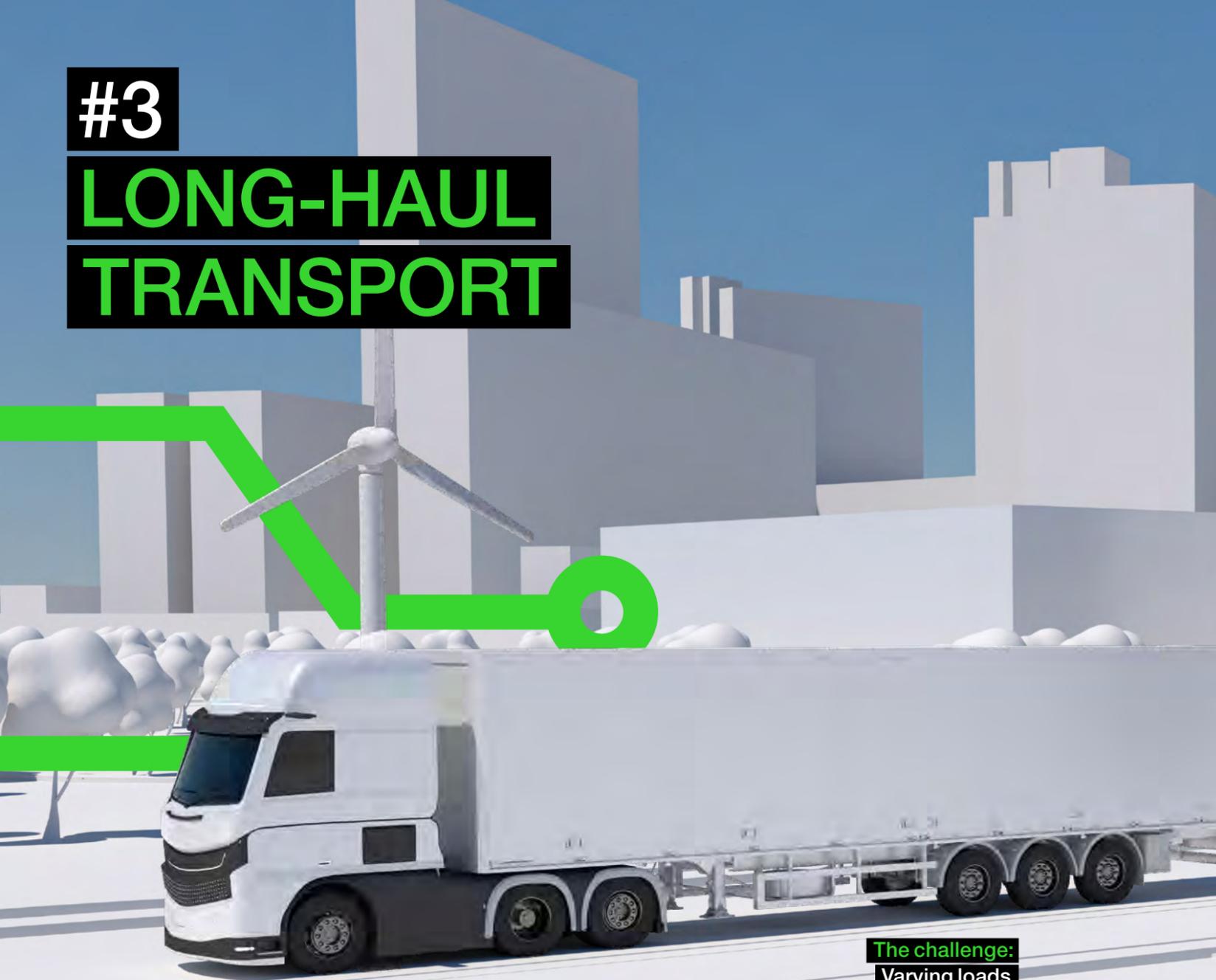
## CONSTRUCTION VEHICLES

**The challenge:**  
Significant differences between  
load conditions; changing  
road surfaces make traction difficult.



# #3

# LONG-HAUL TRANSPORT



**The challenge:  
Varying loads,  
high range, high speeds,  
consistent  
performance on inclines.**

**“All of our motors are built for maximum continuous performance.”**

Alexander Denk  
Vice President Product Management E-Mobility

This is enough to equip every single type of HD truck on the market. In fact, the VEDS HD+ proves to be a particularly clever solution for vehicles with more than one powered axle. These include the aforementioned garbage trucks and long-haul trucks, as well as off-road applications.

When selecting the power output of both motor options, the focus was also on efficiency aspects. “We see the Evo 390 being primarily used for traditional heavy-duty applications with significant intercity and highway use, as well as for electric-powered long-distance buses. In the case of the Evo 330, the focus is on conventional garbage trucks and comparable applications in urban areas with frequent stops and starts. When it comes to both motors, we opted for an ultra-stable thermal design with a high level of continuous

**“The inverter offers the possibility of additional power classes.”**

Alexander Denk  
Vice President Product Management E-Mobility

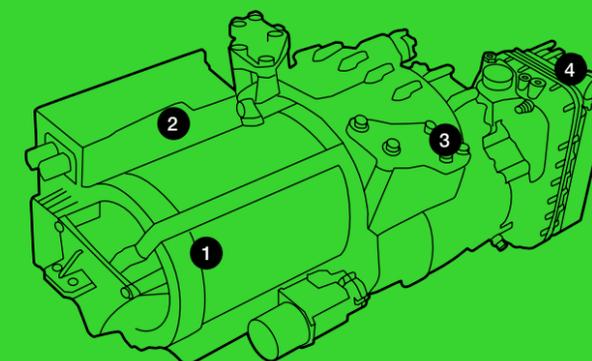
output,” says Denk. This improves the thermodynamic cycles. As a result, the motor doesn’t heat up as much, even during prolonged use under high load, which ultimately extends its service life and allows it to achieve higher average speeds.

When developing the motor, the Voith team also had one of e-mobility’s few problematic areas in mind: rare earths. They are a crucial component of numerous applications of our time, found in everything from smartphones to wind turbines – and are also used in electric motors. China is the main source of these metals. “The coronavirus pandemic showed us what happens when global supply chains grind to a halt. To reduce these dependencies, we’ve found a way to significantly reduce the amount of rare earths in the VEDS HD+,” Denk emphasizes.

The heart of the VEDS HD+ drive system – the newly developed inverter – is also designed for use in high-performance applications. Not only can the innovative power electronics handle the power of the two Evo motors, but also offer the possibility of additional power classes. Directly cooled power semiconductors maximize the power density. The inverter is also one of the first drive concepts ever that meets the requirements of ISO 21434 for automotive cybersecurity, which came into force this year. The first internationally applicable standard in this field is intended to protect vehicles from unauthorized modifications and safeguard their functionality in an increasingly connected world – by preventing external access to electronically controlled driving and braking systems, for example. It goes without saying that the VEDS HD+, like its HD and MD variants, meets the requirements of ISO 26262 with ASIL C (Automotive Functional Safety).

# VEDS HD+ CONCEPT

Perfectly Compatible Modules



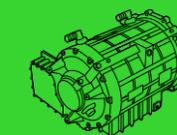
- 1 Motor
- 2 Inverter
- 3 Transmission
- 4 Optional retarder

## Transmission



- Automated four-speed manual transmission
- Fastest shifting times
- 99% efficiency in fourth gear

## Motor



- High-speed motor with two power classes to choose from:
  - Evo 330 (330 kW peak power, 210 kW continuous power)
  - Evo 390 (390 kW peak power, 270 kW continuous power)
- High efficiency and longer life
- Reduced use of rare earths
- Optimized efficiency of 97%
- Compact design

## Inverter



- Suitable for 390 kW, 320 kW, and 250 kW
- Directly cooled power stack (second power stack available)
- ISO 21434 compliance for automotive cybersecurity
- ISO 26262 compliance with regard to automotive functional safety
- IP6K9K rating
- Comprehensive sensor package for all relevant physical data

# H<sub>2</sub>



- 1 Main H<sub>2</sub> Module**
- Four 700 bar type IV pressure vessels made of CFRP (TowPreg technology) included
  - Complete H<sub>2</sub> periphery (valves, pressure regulators, filters, lines)
  - Tank Control Unit (TCU) with software and sensors (for pressure, temperature, H<sub>2</sub>), cables, state-of-health feature
  - Mechanical structure including the mount for the pressure tanks

**2**  
System service life up to 1.6 million km or 30,000 h

**3**  
Voith's patented tank force absorption

**4**  
Supply connections (e.g., air, power)

**5**  
Optional: small side tank (max. 5.7 kg H<sub>2</sub>), including on-tank valve (OTV), cap, and lines

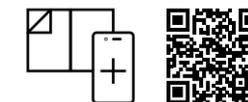
**6**  
Optional: large side tank (max. 13.7 kg H<sub>2</sub>), including on-tank valve (OTV), cap, and lines

“Soon, hydrogen powertrains will often be more cost-effective than traditional diesel drive systems.”

Patrick Seidel  
Product Owner H<sub>2</sub> Storage Systems

## On-Board Hydrogen Storage as a System Solution

In many cases, heavy-duty commercial vehicles can be operated better with hydrogen drives than with purely battery-electric systems. Because of this, Voith has optimized its newly developed hydrogen storage system for applications requiring long ranges and integrated systems.



Scan the QR code to learn more about the H<sub>2</sub> storage system!



Preimpregnated fibers known as TowPregs make the tanks lightweight and efficient

Possible applications in power generation, the heating market, the industrial sector, or the mobility sector highlight hydrogen's massive potential on the path to a carbon-neutral society. As a result, a recent study by the management consulting firm McKinsey predicts that global demand for hydrogen will grow from 115 megatons at present to nearly 600 megatons in 2050.

In the mobility sector, hydrogen in the form of the fuel cell or the H<sub>2</sub> combustion engine is competing against purely battery-electric concepts. In this context, it is becoming increasingly clear that zero-emission solutions in this segment are more likely to coexist than compete with each other. This is due to the fact that, depending on the application, the advantages sometimes fall to one side and sometimes to the other. Mobility experts have reduced this to a simple rule of thumb: the longer the distance and the heavier the load, the more advantages a hydrogen drive system offers. For example, ranges of up to 1,000 kilometers are already possible with hydrogen drives. When it comes to road applications, the obvious choice is commercial vehicles – such as long-distance trucks or buses. Rail vehicles are also an application where the use of hydrogen makes sense. Furthermore, hydrogen propulsion can, in all likelihood, play an important role in aircraft and ships. “Even in the entire off-road sector, i.e., in the case of construction vehicles, for example, the range of requirements often cannot be met with purely battery-electric solutions,” says Patrick Seidel, Product Owner H<sub>2</sub> Storage Systems at Voith. Last year, the technology company unveiled an innovative H<sub>2</sub> storage sys-

Whether Norway, Saudi Arabia, or Brunei – many of the traditional oil-producing countries have recognized that the era of fossil fuels is coming to its end. With increasing speed, these countries are working to maintain their position as the world's energy suppliers, and they are turning to hydrogen (H<sub>2</sub>) production to do so. Saudi Arabia, for example, is building an entire city, Neom, which it hopes will become the center of the hydrogen economy in the future, including a production facility for H<sub>2</sub>-powered trucks.

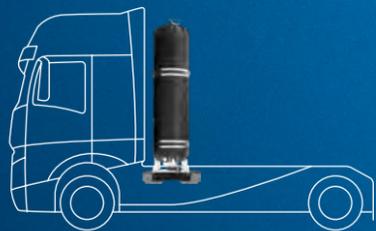
Thanks in part to the flexibility with which it can be used, in recent years this energy source has emerged as a favorite in the quest to create a zero-emission energy supply. This, of course, only applies to green hydrogen, which refers to H<sub>2</sub> produced using renewable energy, such as solar, hydroelectric, or wind power.

## Flexible Configuration Based on the Customer's Requirements



+ 1

**Version 2:** Basic H<sub>2</sub> base module + one side tank  
H<sub>2</sub> capacity: 68.5 kg  
Weight: 1,167 kg



**Version 1:** Basic H<sub>2</sub> base module  
H<sub>2</sub> capacity: 54.8 kg  
Weight: 982 kg

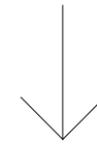


+ 2

**Version 3:** Basic H<sub>2</sub> base module + two side tanks<sup>1</sup>  
H<sub>2</sub> capacity: 74.2 kg  
Weight: 1,243 kg

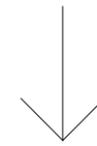
<sup>1</sup> One large + one small side tank

## Power Generation: Renewable Energy



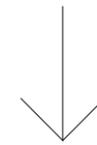
Hydroelectric, wind, or solar power make the production of hydrogen sustainable – in other words, green.

## Electrolysis



Splitting water into H<sub>2</sub> and O makes energy easy to store and therefore transport.

## Storage



Hydrogen can be stored for long periods without any issues or losses.

## Refueling



Hydrogen is as easy to refuel as fossil fuels, and hardly takes any longer – a clear advantage over batteries.

tem and is currently in the process of developing it to production readiness. In addition to the advantages in terms of range, there is also a financial aspect, Seidel notes: “Experts believe that in terms of cost-effectiveness, hydrogen will already outperform conventional diesel systems in some applications by between 2025 and 2030.” With the introduction of the VEDS HD+, Voith has also already launched an electric drive system that can draw its power from both batteries and fuel cells.

While the hydrogen storage system that Voith developed is already attracting a great deal of interest, there are still a few steps that need to be taken before the company can officially roll out the system. In the spring of 2022, for example, Voith began conducting the first road tests on a test track, which was the first time the tank systems had been mounted on a truck. In the meantime, the company is now busy preparing a 30-ton crawler excavator as a demonstration vehicle. “We’re right on schedule. We’ll begin prototype deliveries for the first vehicles in early 2023, and production will start at the end of 2024,” Seidel emphasizes.

For the storage tank, Voith is using preimpregnated fibers known as TowPregs. These offer significant functional as well as manufacturing advantages. In addition, Voith is producing the TowPregs itself. With a view to the volatile supply chains that can slow down or even prevent the industrial production of goods worldwide, this aspect represents an important advantage. “TowPreg technology allows us to build the best tank in terms of function per cost and make ideal use of the carbon fiber,” Seidel explains. The material is manufactured using a special winding process that optimizes the wound layers and thus makes higher H<sub>2</sub> storage volumes possible without compromising safety, even at high pressure levels in the tank. Seidel stresses, however, that the H<sub>2</sub> system shouldn't be reduced to the storage tank alone: “Our customers receive a complete plug-and-drive system from us. This means they can integrate the storage system into their vehicle with minimal effort.” As a result, the system is designed so that the refueling process runs smoothly under all conditions and the entire storage tank can be refilled in less than ten minutes. That's why Voith is focusing on the groundbreaking 700 bar technology in order to maximize operating ranges despite limited installation space – and therefore, in combination with short refueling times, cost-effectiveness for the operator.



**10**  
minutes

The refueling process only takes about ten minutes. A pressure of 700 bar makes long ranges possible, even with a smaller tank.



**700**  
bar

Total value of benefits of investing in climate change mitigation in the US

163

trillion dollars



-300 million lost workdays



-1.4 million hospitalizations



-4.5 million premature deaths

# EE MOBILITY PAYS OFF!

The shift toward electric mobility is taking place at an ever faster pace. By the year 2030, many buses and heavy trucks in Europe, Asia, and the United States will be powered by electricity. As a recent US study shows, investments made in the transformation of the transportation system in the interest of combating climate change quickly pay off. And hydrogen could become the key to decarbonization.

The figures published by a team of researchers from Duke University in the scientific journal *PNAS* in September 2021 are truly eye-opening. In particular, measures in the transportation sector such as replacing internal combustion engines with electric drive systems would generate positive effects for both human health and crop yields in the short term. The researchers calculated the economic benefits to the United States in the event that the 2 °C climate target was achieved by 2050. According to the study, all of the investments could pay for themselves five to twenty-five times over by 2030 due to the health benefits of both clean air and reduced climate change.

In particular, the researchers call for consequential damage caused by global warming, such as flooding, droughts, forest fires, and the resulting additional cost burden on the health care system, as well as, above all, crop failures, to be included in the economic valuation. The bottom line of the study is that the value of US public health benefits as a result of investing in climate change mitigation amount to \$163 trillion by the year 2050. Keeping to the 2 °C pathway would prevent roughly 4.5 million premature deaths, about 1.4 million hospitalizations and emergency room visits, approximately 300 million lost work-days, and about 440 million tons of crop losses in the United States.

Investments in transportation and vehicle infrastructure will pay off in ten to fifteen years at the latest

This means that the funds invested in transportation and vehicle infrastructure for the mobility revolution from now on would generate a positive return in ten to 15 years at the latest. This trend has long been recognized not only by politicians around the globe, but also by decision-makers in the automotive industry. In the EU, the first cities are already planning to implement zero-emission zones. Once in effect, buses and garbage trucks with internal combustion engines will no longer be allowed to operate there. By 2030, truck operators will also be required to have reduced their carbon emissions across the entire fleet by 30 percent compared to 2019 levels. This will not be possible without electric vehicles.

In the NAFTA countries, the situation is similar. Like the EU, buses and trucks there will have to reduce their carbon emissions dramatically by 2030; in the US state of California, the target for trucks is a 50 percent reduction by 2030, and for buses it is as much as 100 percent. China is also taking climate change seriously and has recognized that the transportation sector is a major factor. Through its China 7 emissions standard, the large country aims to reduce its carbon emissions by 80 percent for buses and 30 percent for trucks by the end of 2030. →

The costs of consequential damage due to flooding, droughts, and forest fires are also factored in.

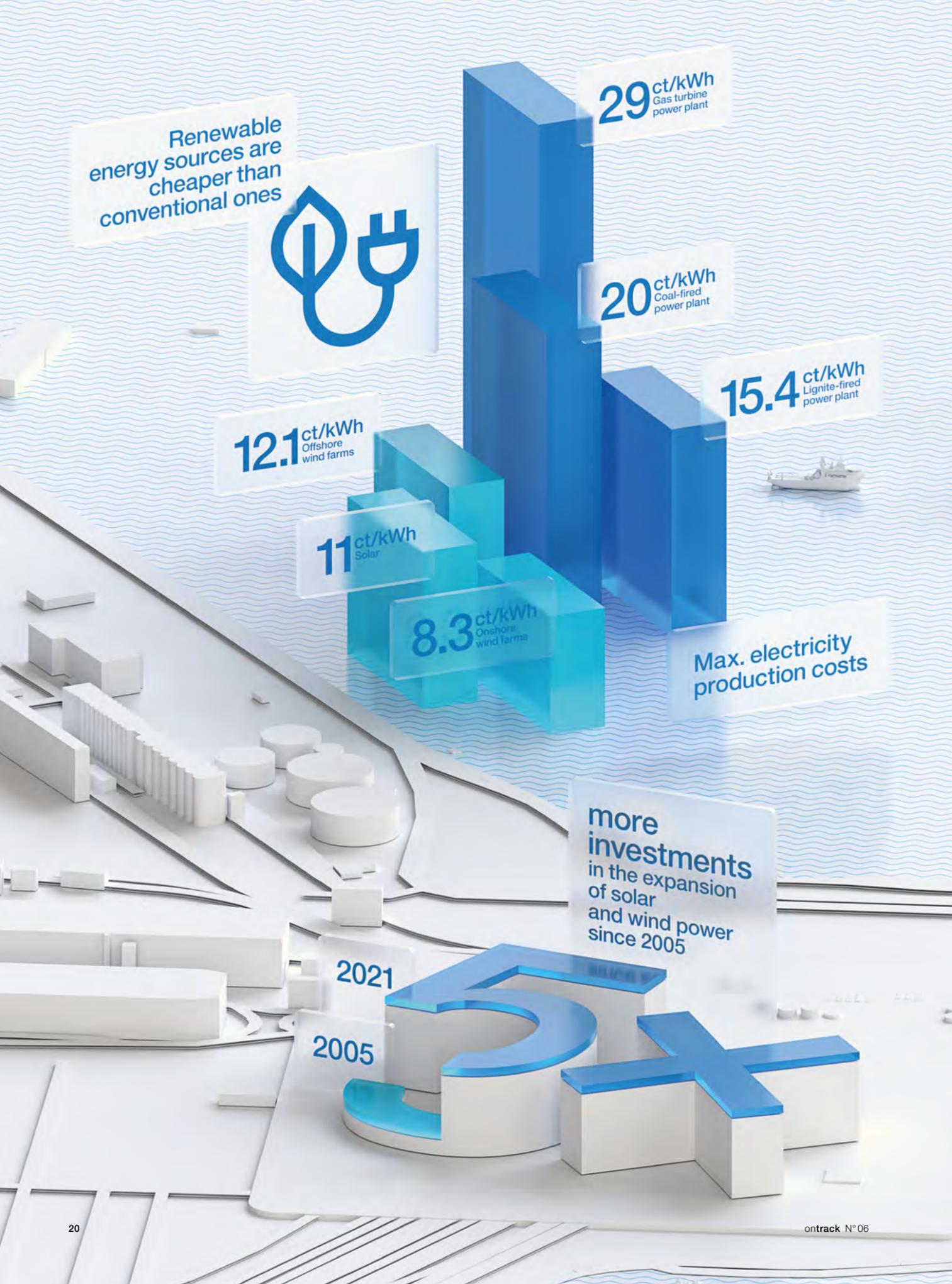
By 2030, all of the investments could pay for themselves

5-25 times over



440 million tons of crop losses could be prevented





Of the 743 GW of installed wind power capacity worldwide (2020), offshore accounted for just 35 GW. “In the onshore market, the typical mainstream turbine currently has a capacity of 4 to 5 MW in Europe and the Americas, or in the range of about 3 MW in Asia. Offshore, turbine output currently lies between 10 and 15 MW per turbine,” noted Stefan Schafferhofer, Director Wind Energy at ELIN Motors, in an interview with *ontrack* (see p. 26). The Austrian company is part of the Voith Group and supplies generators for wind turbines worldwide.

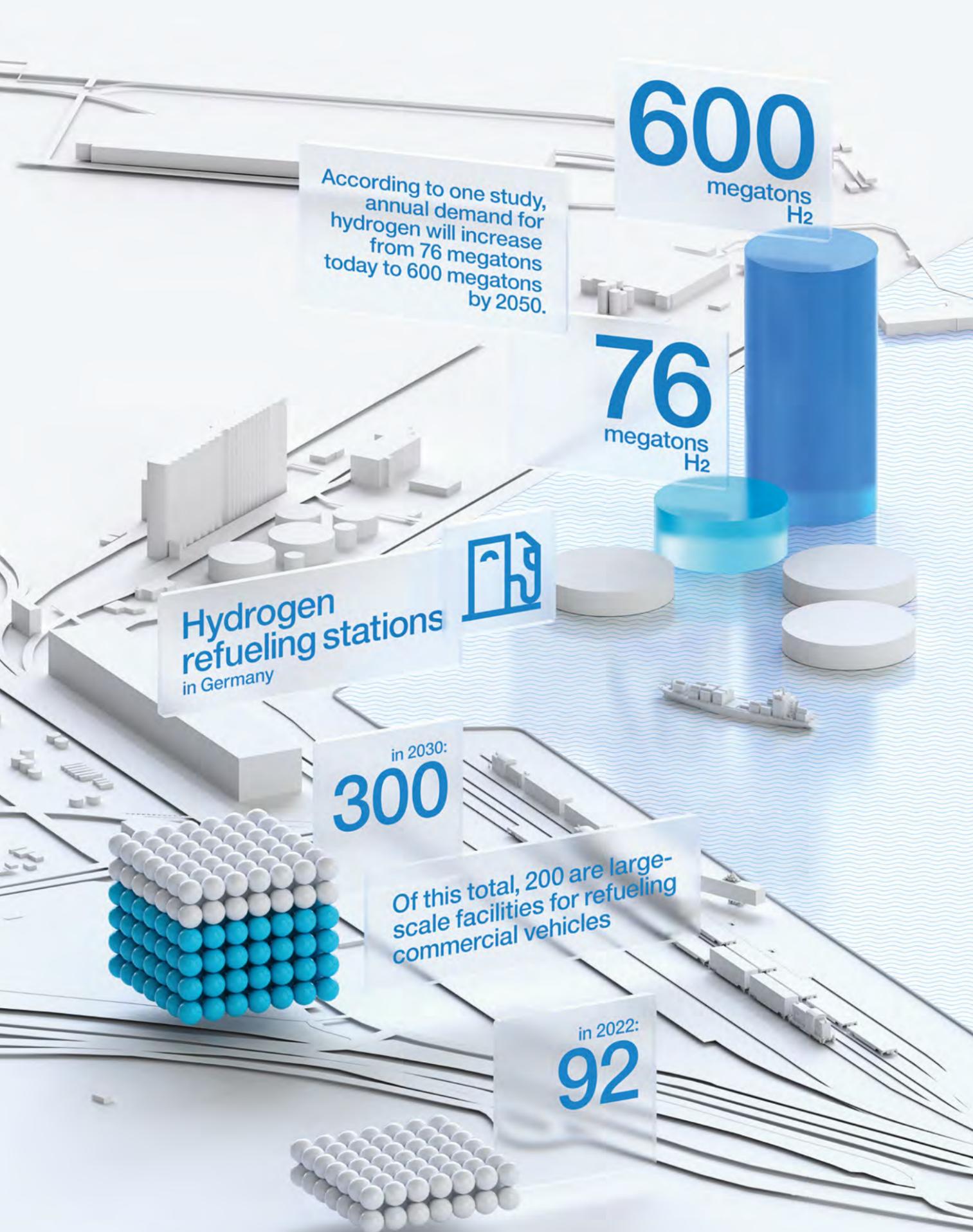
Schafferhofer predicts that offshore wind farms will play an “essential role in the future global energy supply” not only because of their high turbine capacities in combination with favorable and constant wind conditions. In fact, these systems are far from reaching their full capacity. This is because they are currently still firmly anchored to the sea floor as monopiles or tripods. Just recently, 15 GW of floating capacity off the coast of Scotland was awarded to a consortium of bidders in the world’s largest-ever floating wind project. Floating offshore – the technical term for the floating turbines – is expected to replace the XXL monopiles, which currently weigh up to 1,600 tons and are anchored to the seabed. Floating technology has been tested in Scottish waters for ten years. Five turbines are “installed” there, 140 kilometers from the coast. The ocean has a depth of about 300 meters at this point. The number of these floating projects is increasing worldwide – Japan, South Korea, China, and even Norway have projects planned. The US plans to install a total of 10,000 MW off the California coast by 2040.

#### Hydrogen could become the key to the decarbonization strategy

Another aspect speaks in favor of the expansion of wind power – green hydrogen. It could become key to many countries’ decarbonization strategy. The study *Hydrogen on the Horizon: Ready, Almost Set, Go* by PwC Germany in collaboration with the World Energy Council (WEC) and the Electric Power Research Institute (EPRI) estimates that global demand for hydrogen could reach 600 megatons per year by 2050 (from the current level of about 76 megatons). Numerous countries, including Australia, Canada, Chile, France, Germany, Hungary, Japan, the Netherlands, Norway, Portugal, Spain, and South Korea, have already adopted a national hydrogen strategy. The EU also has such a strategy, and at the end of March 2022, China also presented a hydrogen strategy for the period through 2035.

“Offshore wind farms will play an essential role in the future global energy supply.”





More than 6,000 vehicles in the country are already equipped with hydrogen fuel cells, representing “12 percent of the global total,” according to Liu Yafang of China’s National Energy Administration (NEA). His country particularly wants to use hydrogen energy to power buses and heavy-duty trucks, and to that end, China announced the construction of more than 250 hydrogen refueling stations in April 2022, according to the country’s Xinhua News Agency. In addition, he said, China is currently developing projects to produce hydrogen from renewable energy sources and to cut the cost of water electrolysis.

**Germany still leads the world in the number of hydrogen refueling stations**

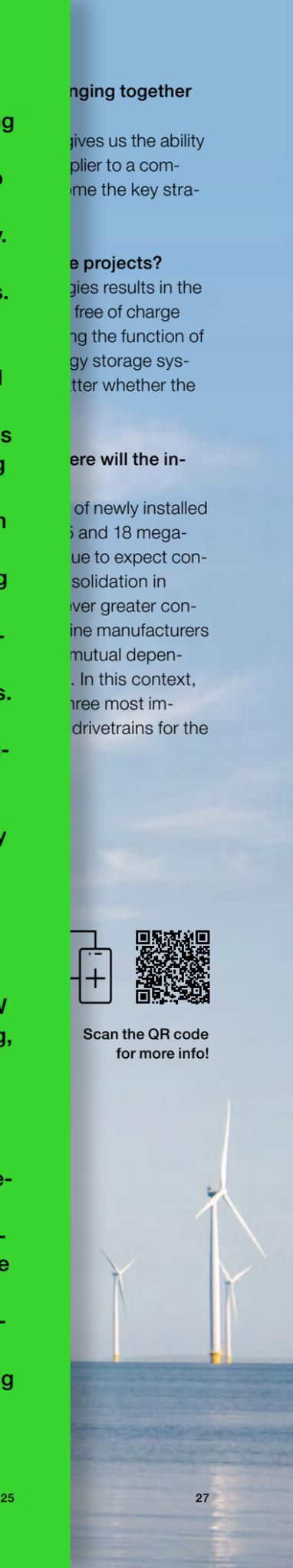
With an existing network of 92 hydrogen refueling stations, Germany is still the world leader. By 2030, the operating company H<sub>2</sub> MOBILITY wants to expand this network to 300, more than 200 of which will be large-scale facilities for refueling trucks and buses. But this will only be possible with a functioning hydrogen pipeline network. To this end, an alliance of 22 European gas network operators from the EU, the UK, and Switzerland is drawing on ideas from the EU hydrogen strategy with its “European Hydrogen Backbone” (EHB) initiative. According to the initiative, a network of hydrogen pipelines covering some 40,000 kilometers across Europe could be in place by 2040.

In any case, competition for the production and delivery of low-cost hydrogen is already in full swing. According to the Reliance Group, India intends to generate \$500 billion from green hydrogen exports over the next two decades. In pursuit of this goal, Indian Prime Minister Narendra Modi’s cabinet has passed a resolution that aims to make the subcontinent one of the world’s largest green hydrogen producers. In the future, India will be competing with Australia, whose company Fortescue Future Industries, together with E.ON, wants to supply up to five million tons of green hydrogen to Europe annually by 2030 (according to research by *Handelsblatt* published on March 30, 2022).

**Saudi Arabia aims to make Neom the center of the hydrogen economy**

In Saudi Arabia, Crown Prince Mohammed bin Salman has presented his “Vision 2030,” a similarly ambitious plan to transform his country’s economy that aims to install 40 GW of solar power, 16 GW of wind power, and 2.7 GW of solar thermal power by 2030. The megacity the country is currently building, Neom, is also set to become the center of the hydrogen economy. In collaboration with US and German companies, the Saudis are currently building the world’s largest electrolyzer there.

Norway, a country whose economy is heavily dependent on petroleum and natural gas exports, already generates 98 percent of its electricity from renewable energy sources. By 2030, the country not only wants to reduce its carbon emissions by 55 percent compared to 1990 levels, but will also only allow zero-emission cruise ships to sail the fjords of the UNESCO World Heritage site. Large-scale green hydrogen production facilities are already under construction. The “Aurora” project, which is also backed by the EU, is expected to produce six metric tons of green hydrogen per day starting in 2024. And between Hjelmeland and Nesvik, the shipping company Norled is planning to commission the “Hydra”, Norway’s first hydrogen-powered ferry, this year.



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Scan the QR code  
for more info!

# “Offshore wind farms are essential to the global energy supply”

**Stefan Schafferhofer is Director Wind Energy at Voith subsidiary ELIN Motors. In this interview, he explains the importance of offshore wind power in the global energy supply, what role ELIN currently plays in this regard, and which synergies are being created by bringing together ELIN’s and Voith’s expertise.**



**Stefan Schafferhofer**  
Director Wind Energy  
Voith subsidiary ELIN Motors

## **What differentiates the construction of an offshore wind farm from an onshore wind farm?**

In essence, there are three main differences. On the one hand, offshore wind turbines are much more powerful than onshore turbines. In an onshore market, the typical turbine currently has a capacity of 4 to 5 megawatts in Europe and America, and around 3 megawatts in Asia. Offshore, turbine output currently lies between 10 and 15 MW per turbine. In addition, a large percentage of offshore turbines currently in operation are gearless. Instead, they have a slow-turning, very large, and very heavy generator. Onshore, on the other hand, the majority of turbines are still equipped with a high-speed drive train with a three-stage gearbox and high-speed generator. And lastly, it goes without saying that the corrosion protection requirements for offshore installations are generally higher than for those on land.

## **What role will offshore wind farms play in the future global energy supply?**

Due to their high turbine output combined with the mostly favorable and more constant wind conditions at sea, offshore wind farms will already play an essential role in the global energy supply in the medium term. Apart from this, major technological advancements are already being achieved, especially with respect to large offshore turbines, which will make offshore wind power even more competitive in the future. One example would be floating foundations, which make it possible to erect offshore wind turbines at even greater ocean depths. Currently, offshore turbines are still firmly anchored to the seabed. This places severe constraints on the maximum ocean depth at which turbines can be installed and still be cost effective.

## **What is ELIN’s role in all of this?**

ELIN supplied the first generators for offshore wind turbines back in 2010. Currently, two of the three largest offshore wind turbine manufacturers rely on main generator components from ELIN. In some cases, we’re even a single-source supplier! From today’s perspective, the percentage of ELIN’s total revenue generated by the offshore wind market will continue to increase massively in the coming years.

## **What synergies are being created by bringing together ELIN’s and Voith’s expertise?**

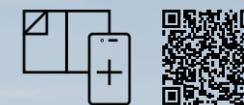
The collaboration between Voith and ELIN gives us the ability to grow from being purely a component supplier to a complete drivetrain supplier – and thus to become the key strategic partner for turbine OEMs.

## **What role does hydrogen play in offshore projects?**

In principle, combining these two technologies results in the ability to make surplus wind power available free of charge for hydrogen production, ultimately achieving the function of an efficient and largely carbon-neutral energy storage system. In this context, however, it doesn’t matter whether the wind turbine is located at sea or on land.

## **Let’s take a look into the near future: where will the industry be in 2030?**

It’s likely that in 2030, the average capacity of newly installed offshore turbines will already lie between 15 and 18 megawatts. In light of the climate targets, I continue to expect continuous and attractive market growth. Consolidation in the wind market sector will continue. This ever greater concentration on a few large, multinational turbine manufacturers and component suppliers will increase the mutual dependencies between customers and suppliers. In this context, I expect that Voith/ELIN will be one of the three most important suppliers of main components and drivetrains for the global wind market worldwide.



Scan the QR code for more info!



Around the world, the demand for electricity is growing – the greener, the better. In this context, offshore wind farms occupy a key position. At the end of 2021, the more than 10,300 wind turbines installed on the oceans across the globe had a combined total capacity of around 50 gigawatts – and this figure is growing rapidly.

The turbines are built by special wind turbine installation vessels like the Bold Tern operated by the Norwegian shipping company Fred. Olsen Windcarrier. To achieve the maximum precision required for this work during positioning, the vessel is equipped with three Voith Schneider Propellers – the most powerful the company has ever supplied.

# #1

# CLEAN POWER FROM THE OCEAN

1

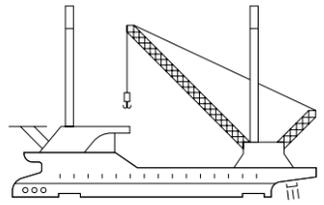
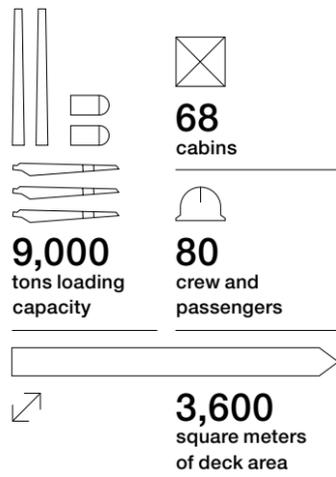
Even the maximum deck width of 45 meters isn't enough to stow the massive rotor blades on the Bold Tern without them protruding over the side. The blades, which can be up to 100 meters long, are one of the main components of modern wind turbines. They're made of fiber-reinforced plastics. In most cases, glass or carbon fibers are used. These materials offer excellent mechanical properties at a relatively low weight. Yet at 25 tons and more per blade, they're nevertheless anything but lightweight.

2

The Bold Tern and its identical sister ship, the Brave Tern, are optimized for transporting massive offshore wind turbines. The ship has more than 3,200 square meters of open deck space, providing sufficient room to transport components such as masts, rotors, or nacelles from several turbines to the wind farm at the same time. Each of the ships can carry more than 9,000 tons of cargo and has room for up to 80 people (crew and passengers) in the 60 cabins. If necessary, additional personnel or equipment can easily and safely come on board thanks to the helideck at the bow.

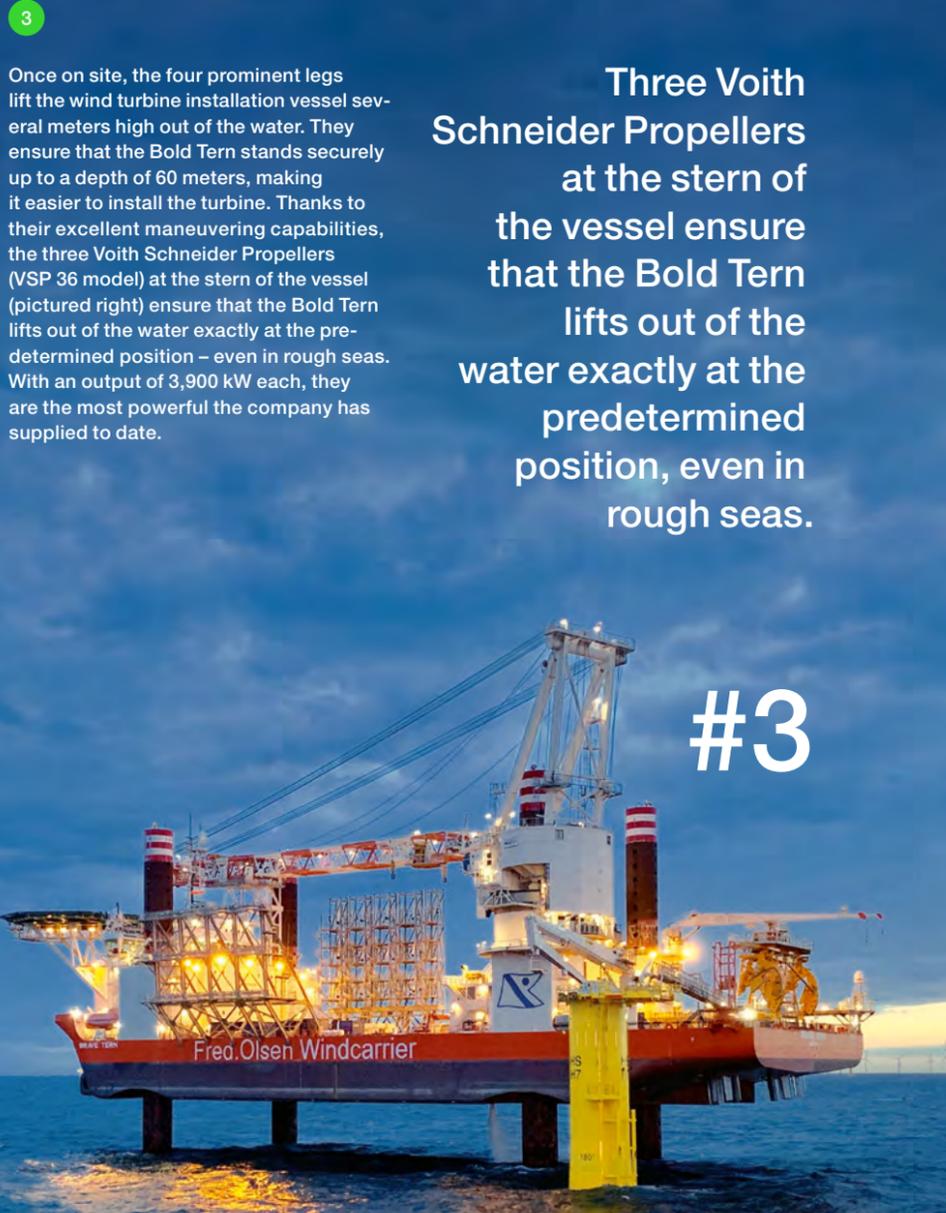
# #2





The Bold Tern can securely stand in water up to 60 meters deep

4 The world's first offshore wind farm, Vindeby, was built off the Danish coast in 1991 and had a capacity of 450 kW. With a hub height of 35 meters and a diameter of also 35 meters, the turbine was tiny compared to today's turbines. Today, turbines are taller than the Cologne Cathedral, whose towers measure over 157 meters. With a nameplate capacity of six megawatts, they can theoretically supply 3,500 households with electricity all year round.



3

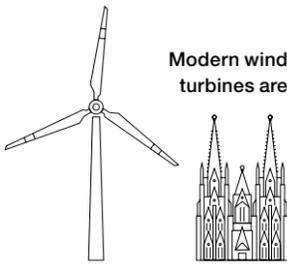
Once on site, the four prominent legs lift the wind turbine installation vessel several meters high out of the water. They ensure that the Bold Tern stands securely up to a depth of 60 meters, making it easier to install the turbine. Thanks to their excellent maneuvering capabilities, the three Voith Schneider Propellers (VSP 36 model) at the stern of the vessel (pictured right) ensure that the Bold Tern lifts out of the water exactly at the pre-determined position – even in rough seas. With an output of 3,900 kW each, they are the most powerful the company has supplied to date.

Three Voith Schneider Propellers at the stern of the vessel ensure that the Bold Tern lifts out of the water exactly at the predetermined position, even in rough seas.

#3



#4



157 meters and higher. Higher than the towers of the Cologne Cathedral.



#5

The teams on board consist of highly experienced specialists – XXL components come face to face with extreme weather conditions. Nevertheless, maximum precision is required at all times. After all, the equipment has to withstand corrosion, fatigue, erosion, lightning strikes, and biofouling.

5



#6

6

The precise installation of an offshore wind turbine, from the foundation to the tip of the rotor blade, forms the basis for ideally transforming any type of wind into power – even in harsh climates. Even for the specialists on the Bold Tern, building these engineering marvels is a new challenge every time. The process of installing the foundation of the structures makes use of the inherent weight of the bases as well as ocean currents (such as the change of high and low tides). Above water, the Bold Tern's crane allows it to work at a height of over 157.5 meters above the deck.

7

The rotors of modern offshore wind turbines have a diameter of more than 150 meters. The Bold Tern's towering crane lifts them directly to the nacelle at a dizzying height. Even though this can only be carried out in a light breeze, precisely maneuvering the individual rotor blades to within a few centimeters requires extreme sensitivity and a great deal of experience. Otherwise, both the turbine and the workers could be in serious danger. Soon, the new turbine will be generating clean electricity from the power of the wind, thereby making an important contribution to the energy revolution. For the Bold Tern, it's off to the next construction site on the high seas.

#7



3x

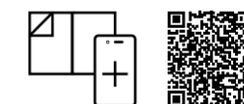
With an output of 3,900 kW each, the Bold Tern's three VSPs are the most powerful Voith has supplied to date.



## eVSP

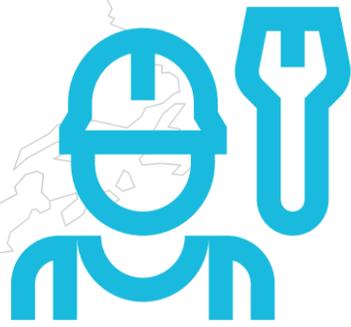
### More Climate-Friendly Turbine Site Operations

To ensure that the installation, operation, and maintenance of offshore wind farms will be more climate-friendly in the future, Voith is equipping the next generation of vessels for wind turbine deployment (construction support operation vessels, abbreviated CSOV) and maintenance (service operation vessels, abbreviated SOV) with the new electric Voith Schneider Propeller (eVSP). The propulsion system combines the technology of the VSP with the electrical expertise of the Voith Inline Thruster (VIT). Plans exist to build more than a dozen of these service operation vessels. The first of these ships, the Edda Breeze operated by the Norwegian shipping company Østensjø, has already left the shipyard. It is part of a fleet of (C)SOVs currently under construction, each powered by two eVSPs with 1,850 kW each.



Scan the QR code to learn more about the eVSP!

# ONE FOR ALL



The name alone is already a good explanation – a service for all manufacturer brands offers maintenance and overhaul work completely independent of a product’s manufacturer. Voith is systematically expanding this offering, and in doing so, benefits from its comprehensive expertise in the field of drive technology as well as its extensive global service network.

→→

BRA	MetrôRio
<ul style="list-style-type: none"> <li>Metro trains</li> </ul>	<ul style="list-style-type: none"> <li>Service: Coupler overhaul</li> </ul>

MetrôRio trains are essential to the city's infrastructure. The vehicles originally came from a Chinese manufacturer.

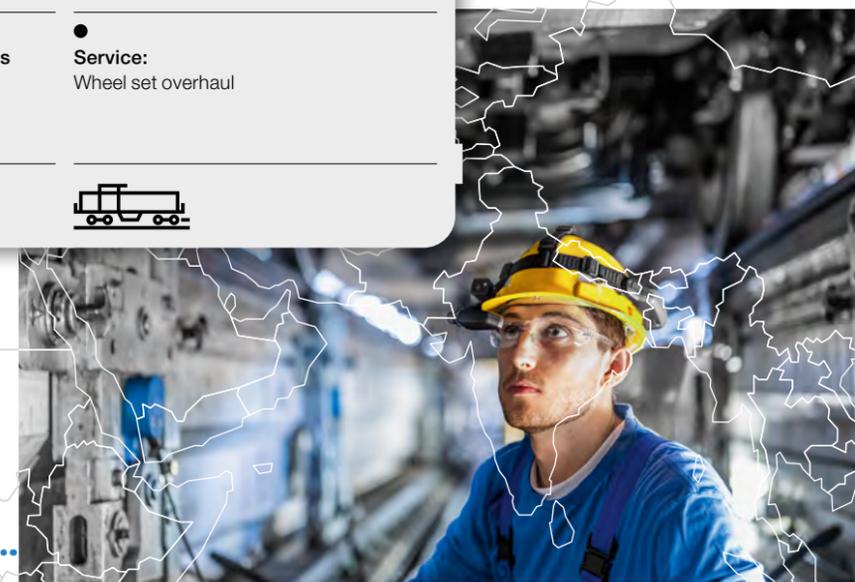


It's every vehicle's turn at some point! Whether it's been damaged, wear parts need to be replaced, or it's just time for a routine inspection, a visit to a service workshop is unavoidable. When it is finally time, the customer's expectations are really quite simple: the vehicle needs to be back in service as quickly as possible and not cause any more problems for a long period of time. For an operator of a rail vehicle fleet, this is critical to the company's survival. After all, stationary vehicles always generate costs and a loss of revenue.

"Our customers usually have a variety of products from different manufacturers in use in their vehicles," says Andreas Kelterer, Director Global All Brands Products at Voith. "Nevertheless," Kelterer continues, "operators always prefer to have a single service provider that takes care of the entire vehicle – regardless of who originally manufactured the individual components." Voith's service for all manufacturer brands stems from this customer need. For a little over three years now, the technology company has been systematically expanding this offering in its portfolio. After all, the greater the number of different service providers that have to take care of a vehicle, the longer the costly downtimes.

→→

FRA	Colas Rail
<ul style="list-style-type: none"> <li>Locomotives</li> </ul>	<ul style="list-style-type: none"> <li>Service: Wheel set overhaul</li> </ul>



Voith is systematically expanding its manufacturer-agnostic service concept.

**"From the very beginning, we were convinced of Voith's ability to meet our requirements. After all, Voith not only has a highly skilled service team in Brazil, but is also a global company with an excellent reputation in the rail coupler segment."**

**Glauco Bernardo**  
Manager for rail vehicles, MetrôRio

Customers have long been aware of Voith's excellent service quality and comprehensive technical expertise. "Voith has been working with many customers for years. So it's understandable that they don't want to look for a new partner just because there isn't any Voith technology installed in their vehicles," says Mario Gies, Vice President Service for All Brands at Voith. The concept also benefits from Voith's global service network, which facilitates work at customer sites and helps cut costs, as the service team only needs to travel a short distance, for example – and is often much closer than some of its competitors.

All these aspects played a role in Voith being awarded the contract to overhaul the couplers for the metro in the Brazilian metropolis of Rio de Janeiro. Operator MetrôRio's fleet consists largely of trains made by Chinese manufacturer CRRC. Rafael Mana, workshop coordinator at MetrôRio, recounts how this partnership with Voith began: "When we were preparing for a general overhaul of our fleet in 2018, it became

apparent that servicing the couplers would be extremely difficult and costly," he explains. The manufacturer's specialists would have had to be brought in from another country, which would have led to increased costs and servicing times. So Mana's team began exploring alternatives. Among other people, Mana ended up speaking with coworkers from São Paulo, who reported on their positive experience with Voith. Voith Turbo Brazil and MetrôRio quickly entered into a productive dialogue regarding the overhaul of these couplers. "From the very beginning, we were convinced of Voith's ability to meet our requirements. After all, Voith not only has a highly skilled service team in Brazil, but is also a global company with an excellent reputation in the rail coupler segment," adds Glauco Bernardo, manager for rail vehicles at MetrôRio. Voith's first step was to put together a kit with all the necessary spare parts. The Voith team overhauled the couplers for a total of 64 trains and MetrôRio was able to focus on its other activities. As part of the project, Voith also provided theoretical and practical training to MetrôRio's technical team, thus paving the way for long-term partnership.

"Our extensive service network is an important foundation that gives us the ability to offer our service for all manufacturer's brands worldwide," emphasizes Gies. This network also makes it easier to protect supply chains, which is an aspect that has become much more important in recent years. Currently, for example, contracts are in place with companies in France, Germany, and China, where Voith Service is overhauling third-party couplers from all manufacturer brands for Line 9 of the Shanghai Metro. An important side effect of this manufacturer-agnostic service concept is that it means Voith can also upgrade components to meet the latest requirements, for example with exhaust-optimized RailPacks.

As part of this service concept, Voith also upgrades components to meet the latest legal requirements.

And Voith has long since expanded its range of services beyond rail vehicles alone – for some time now, the team has been working on service products for the commercial vehicle sector, for example. "We plan to further expand our capabilities in this area," says Gies, with new ideas and approaches already in mind.

"Our experience as an established systems and component supplier for rail vehicles makes Voith an ideal service partner – regardless of which manufacturer the vehicle is originally from."

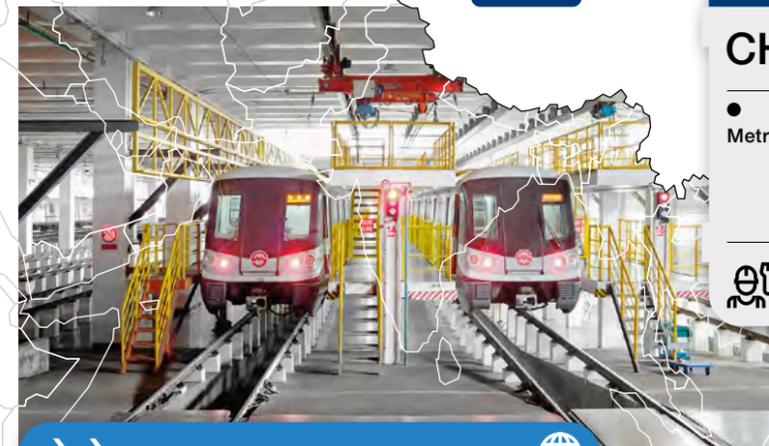
Mario Gies  
Vice President Service for All Brands, Voith



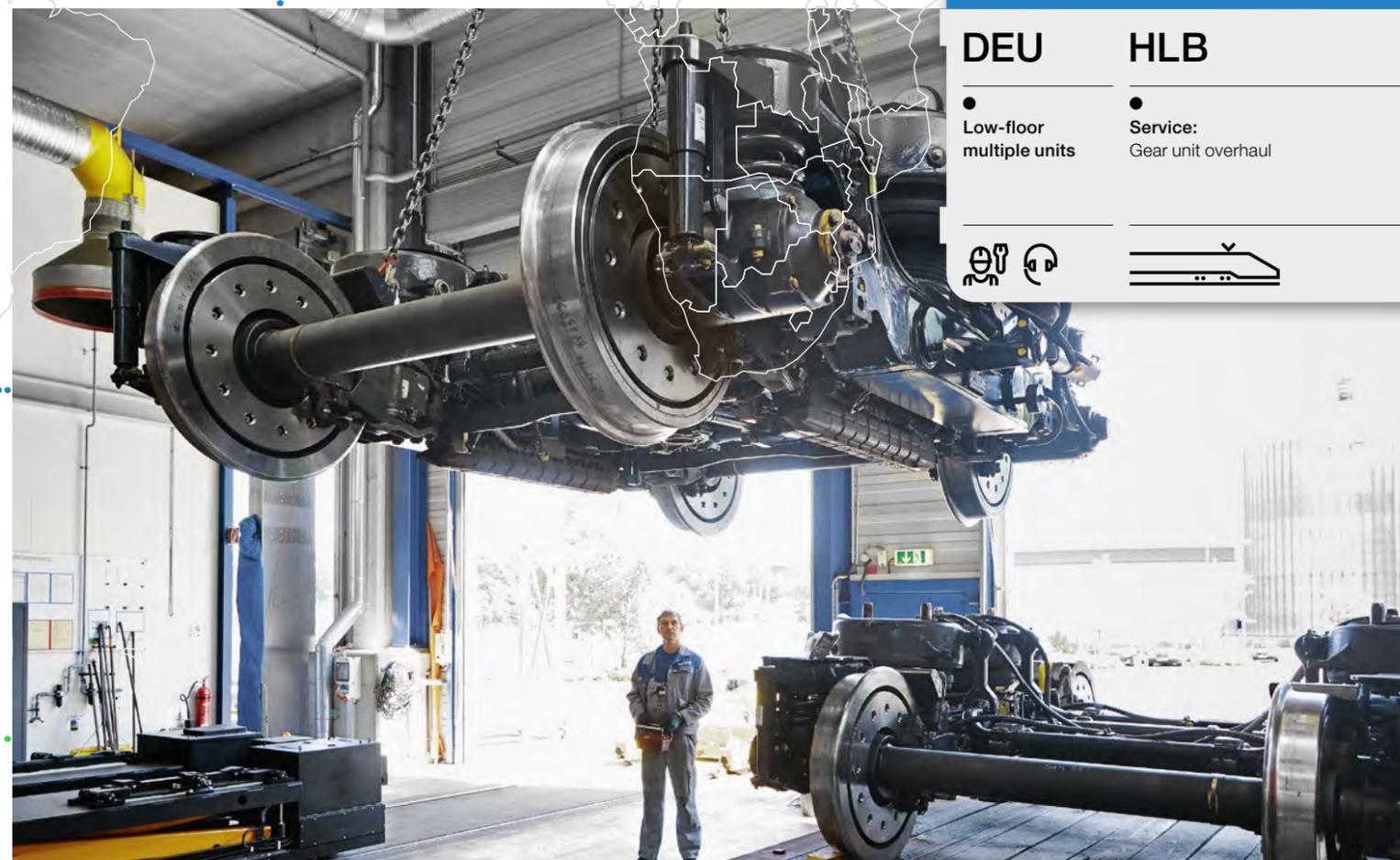
Germany

China

DEU	ODEG
<ul style="list-style-type: none"> <li>Four-part commuter train</li> </ul>	<ul style="list-style-type: none"> <li>Service: Truck overhaul</li> </ul>



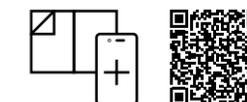
CHN	Shanghai Metro
<ul style="list-style-type: none"> <li>Metro trains</li> </ul>	<ul style="list-style-type: none"> <li>Service: Coupler overhaul</li> </ul>



DEU	HLB
<ul style="list-style-type: none"> <li>Low-floor multiple units</li> </ul>	<ul style="list-style-type: none"> <li>Service: Gear unit overhaul</li> </ul>



Ostdeutsche Eisenbahn GmbH (ODEG) currently operates 50 trains on a total of 13 lines with a total route length of approximately 1,294 km.



Scan the QR code to learn more about Voith's service for your fleet!

# 2ND

The cost to invest in a new e-bus is high, and delivery times are long. As an alternative, Voith, in collaboration with Orten Electric Trucks, recently started offering its customers the ability to equip their existing conventionally powered vehicles with the Voith Electric Drive System. Converting buses in this way is a cost-effective option for operators looking to quickly transition to e-mobility.

# LIFE



Unfold and learn more!



Anyone investing in a new electric-powered city bus should make sure they have plenty of funds available – 500,000 euros for a new vehicle is a common price, and this figure is actually increasing. But the costs rarely stop there. Even in cities with populations of only 100,000 to 200,000 people, transit companies often have more than 100 buses in operation. As a result, transitioning public transport to e-mobility means digging deep into the municipal coffers. To make matters worse, purchasing a vehicle today, in 2022, is no easy feat. Long delivery times are common. Popular models are sometimes only available after 18 months. In light of all this, the environment in which public transportation's mobility transformation is currently taking place can only be described as challenging.

New vehicles, however, are not the only way to accelerate the shift to more sustainable transportation concepts. Retrofit options, in which a bus with an internal combustion engine is equipped with an electric drive system, are beginning to emerge as a viable alternative. This solution is already worth it from a financial perspective alone. This is because the operator can use buses from its existing fleet and only has to pay for the conversion. A vehicle that is six to eight years old has typically only reached just under half of its total service life. By retrofitting, the operator can postpone the costly new purchase by a few years, meets the legal requirements of the future Euro 7 emission standards today, and in many cases can still take advantage of attractive government subsidies.

From a technical perspective, the retrofit solution doesn't present any major obstacles. "Modern diesel buses almost always have sufficient installation space available for the drive and storage system," says Jürgen Berger, Senior Project Manager R&D E-Mobility at Voith. About three years ago, Voith unveiled the Voith Electric Drive System (VEDS), a groundbreaking solution for public transportation vehicles. Today, numerous manufacturers are already equipping their new electric vehicles with the VEDS.

Thanks to its compact design, the VEDS makes it easy to convert conventional diesel, hybrid, and gas-powered buses. "The motor takes up about the space of a conventional transmission. Most of the other components can be installed in the engine compartment. Batteries, for example, can be installed where the combustion engine once was," Berger describes. Modifications to the chassis aren't normally necessary – only low-floor buses might need to have the seats raised slightly. However, as Thomas Sautter, Senior Vice President Sales DACH at Voith, emphasizes: "After the retrofit, the bus has room for just as many passengers as before." In this context, the powerful motor ensures that passengers are transported quickly and reliably. The high-performance unit has a peak output of 410 kW and provides 310 kW on a continuous basis. "That's enough to power even double-decker and heavy articulated buses without any issues," notes Sautter.

The now widely used CCS Combo 2 plug is used to charge the batteries with direct current. "Stations with a high charging capacity manage to recharge the battery in a little more than an hour," Berger says. At today's standard charging stations, however, the vehicle tends to take four to five hours to fully charge. But this is sufficient for typical use in regular service without any issues; faster charging isn't necessary for regular operations. Operators everywhere are working at full speed on planning and construction measures to install the necessary infrastructure.

Voith offers its retrofit service in collaboration with Orten Electric Trucks, and is the exclusive supplier of the drive system. In recent years, Orten has developed a high level of expertise in the field of e-mobility for commercial vehicles and also offers conversions. Initial orders have already been secured – the mobility provider Transdev is having several existing vehicles converted for regular service in the cities of Schwäbisch Hall and Heidenheim, for example.

## D2E – Another E-Alternative



**Michael Dalhof**  
General manager of Stadtbusschwäbisch Hall GmbH

**Transdev operates the largest electric bus fleet in Europe. What experience do you have with the vehicles in regular service?**

Until 2025, more than 5,000 e-buses will be operated by Transdev in Europe, currently there are around 2,000 e-buses at more than 100 locations. We now operate an industrial e-bus service. This term illustrates our claim to offer regular transport that is no longer inferior in any way to transport with fossil fuel drives.

**Why is Transdev now focusing on retrofitting existing vehicles?**

Only in Germany, Transdev operates more than 3,000 buses. Some of these will certainly be retired over the maximum possible technical service life, and alternatives will have to be found for the others. In the case of converted existing vehicles (D2E), we are still in the advanced trial phase. We will have to wait and see how the market accepts these D2E buses.

**How will the converted vehicles be deployed?**

In addition to the new vehicles, the vehicles will also be used in industrial e-bus traffic, i.e., both in regular service and as a supplement during peak periods.

**At Transdev, does e-mobility mean battery-electric drive systems or does the fuel cell also play a role in the plans?**

Both technologies have different applications. We see the e-bus in urban traffic, but in the intercity and coach sector, the FCEV bus is certainly the better alternative. That's why we are already following developments and implementing pilot projects today.

**"Modern diesel buses almost always have sufficient installation space available for the drive and storage system."**

Jürgen Berger  
Senior Project Manager R&D E-Mobility, Voith

# 5h



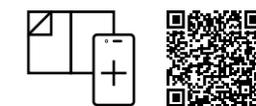
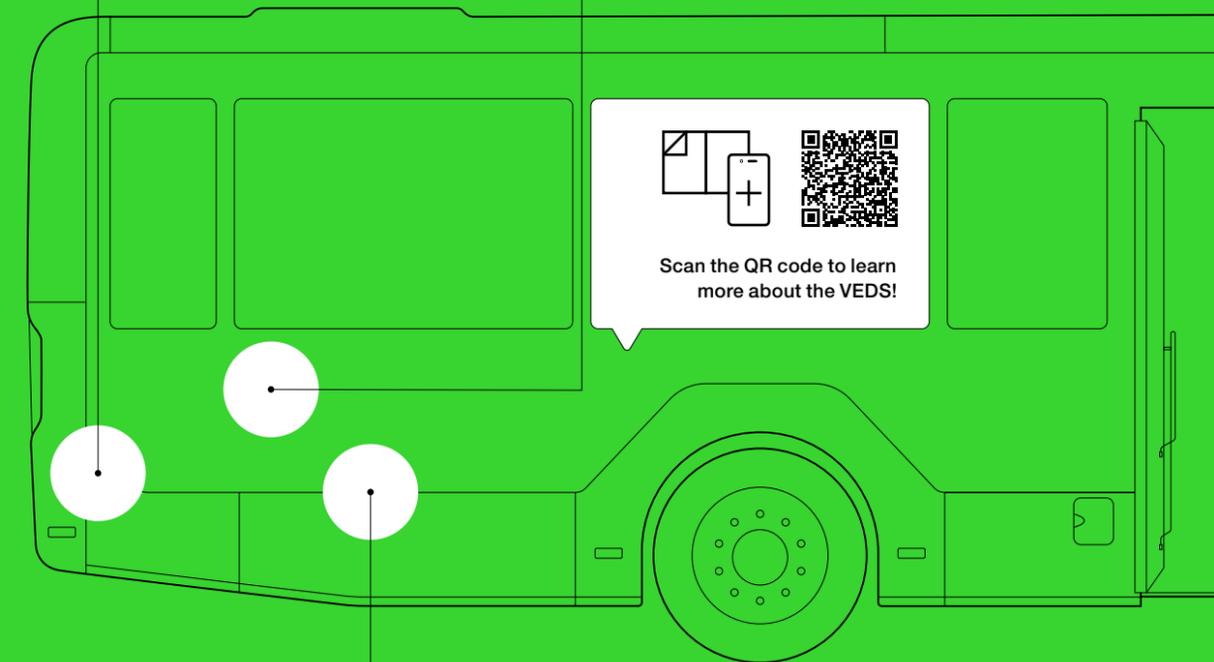
### Battery

The maximum charging duration of five hours can be conveniently scheduled during planned downtimes.



### CCS Combo 2 Plug

The system is charged with direct current.



Scan the QR code to learn more about the VEDS!

# 410 kwh



### E-Motor

Thanks to its modular design, the VEDS can be installed in almost any bus.

# DAC

# 4EU



# DIGITAL IS BETTER!



Climate change, traffic congestion, carbon emissions – these issues require solutions that can't be put on the back burner. European policymakers have recognized the need for this and, by passing the European Green Deal, have adopted the roadmap to a more sustainable EU economy. In this context, the increased shift of freight transport to rail presents a major opportunity. With the existing technology, however, this project will never get off the ground. This is why Germany's Federal Ministry for Digital and Transport has initiated the EU's DAC4EU program. Its aim is to get European rail freight transport fit for the 21<sup>st</sup> century by introducing an innovative standardized coupling system. After extensive trials, the CargoFlex coupler from Voith proved to be the most efficient solution.

# MASCHEN

# SHIFT



- 1 Coupling
- 2 Switching
- 3 Brake test
- 4 Car test

Total area	280	ha
Handling volume	3,500	wagons

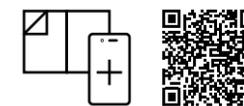
2019–2050

CO<sub>2</sub>=0%

FIT-FOR-55

# GREEN DEAL

The largest railroad yard in Europe is located in Hamburg-Maschen. The operator aims to make it more efficient through digitalization.



Scan the QR code to learn more about CargoFlex!

If you want to understand what's wrong with rail freight services in Europe, all you need to do is spend an afternoon at Europe's largest railroad yard in Maschen, Germany. On an area equivalent to almost 400 soccer fields located just outside of Hamburg, up to 3,500 freight cars are handled here a day during peak times. Coupling and uncoupling the individual cars is still mainly done by hand. This means that there are two screw couplings on each car, which a yard worker has to separate or connect manually. Together with switching, brake testing, and inspecting the cars, preparing a single train alone can take an entire shift.

"These processes have changed very little in the past 100 years," emphasizes Niklas Weidert, Key Account Manager Freight Couplers at Voith. In railroad circles, there's a saying that a truck has already reached its destination before a freight train has even left the station.

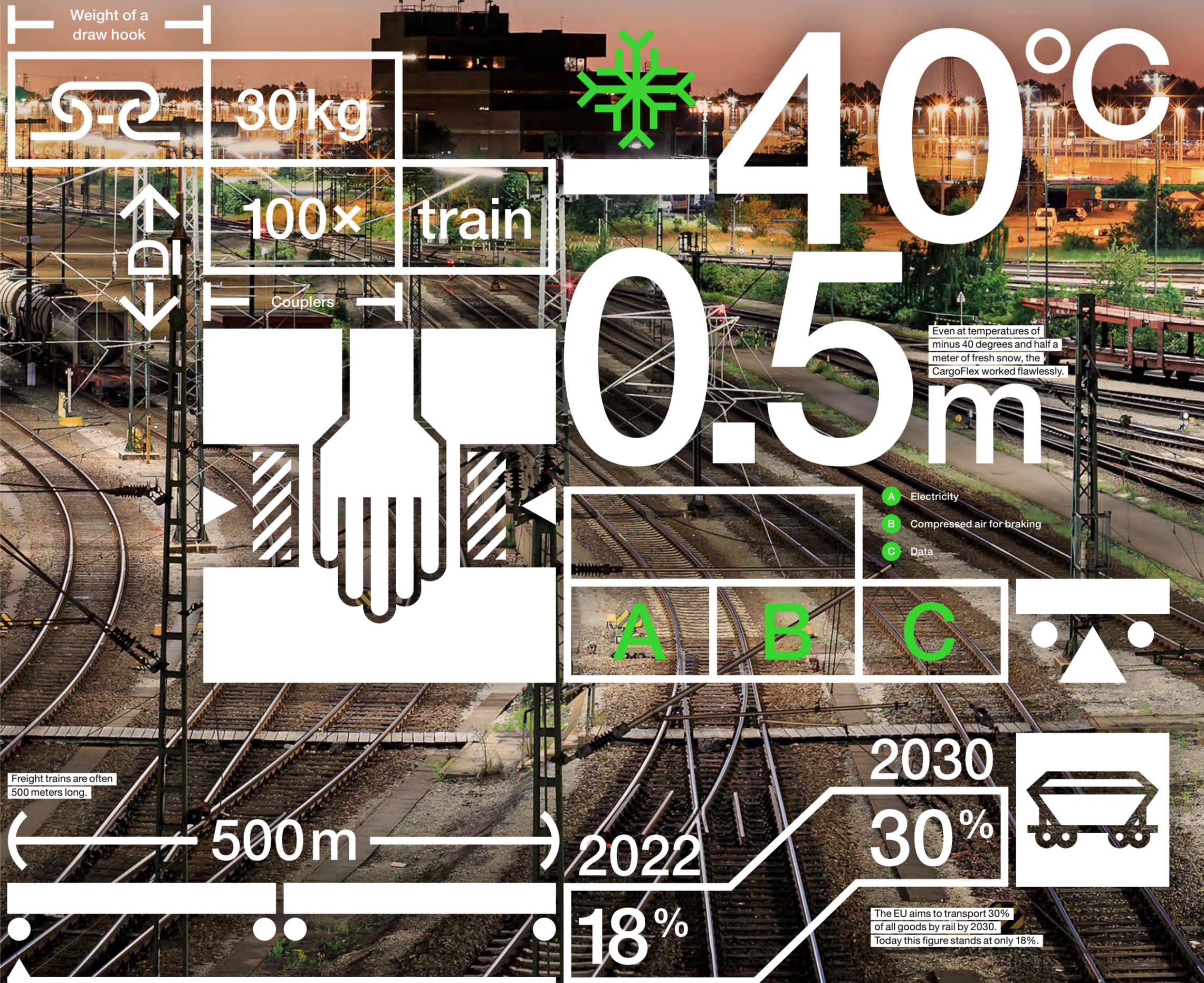
The DAC4EU project has made it its mission to bring this antiquated and dangerous process for railroad yard workers into the 21<sup>st</sup> century. The abbreviation stands for Digital Automatic Coupling for Europe. In addition to the standardized automatic coupling system for around 450,000 freight cars and some 20,000 locomotives, the new standard will also digitize rail freight transport.

With a digital automatic coupler (DAC), when two cars are being coupled, not only each of the car's brake air lines, but also their power and data lines are automatically connected to each other. This is a radical improvement over the current state of affairs. Today, a railroad yard worker has to climb into the dangerous space between the cars and connect the draw hooks, which can weigh up to 30 kilograms. And they have to do this up to 100 times – per train. In windy and cold weather, during the day and at night.

**"DACs open up completely new ways for operators to increase safety for employees."**

↳ Niklas Weidert,  
Key Account Manager Freight Couplers

"DACs open up completely new ways for operators to increase safety for employees and significantly improve the efficiency of transport operations," Weidert emphasizes. He cites automatic brake testing as an example: "In the future, before a train departs, the system will show the engineer whether each brake is functioning properly within a few minutes on their control panel. Today, the yard worker sometimes has to walk the entire length of the train, to one end and back, which takes a lot of time for a train 500 meters long."



## “This offers tremendous potential for rail operators and logistics companies.”

↳ Niklas Weidert,  
Key Account Manager Freight Couplers

But the benefits of the DAC are really revealed when it comes to maneuvering over the hump. Due to the considerable amount of energy absorbed by the DAC and the resulting reduction in acceleration when the cars collide, more sensitive goods can be transported safely by rail – goods that up to now have mostly only been transported by road. “This offers tremendous potential for rail operators and logistics companies,” Weidert notes.

This undertaking is also supported by the EU. As part of the European Green Deal, the EU has set itself the goal of transporting at least 30 percent of all goods by rail from 2030 onward. Today, this figure stands at 18 percent.

Since the summer of 2021, the consortium of leading rail operating companies and railroad car owners from Germany, Austria, France, and Switzerland behind DAC4EU has conducted numerous tests and studies. A wide variety of systems were available, such as the Scharfenberg coupler, Schwab coupler, or the SA3 coupler, which is particularly common in Eastern Europe. The testing program was identical for each type of coupler.

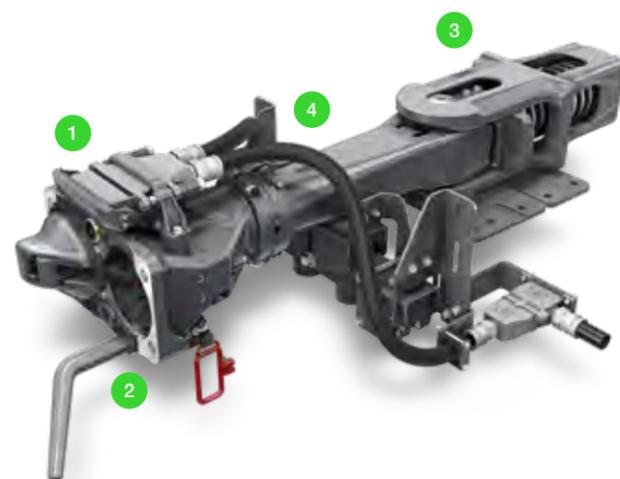
These tests revealed that Voith's CargoFlex, which is based on the Scharfenberg system, significantly increases the derailment safety of freight cars compared to previous solutions. Coupling the power and data lines was carried out reliably, without complex control and actuation. The CargoFlex also performed exceptionally well in winter tests under extreme weather conditions in Sweden, the Swiss mountains, and in DB Cargo's climate chamber in Minden, Germany. Even at temperatures of minus 40 degrees Celsius and half a meter of fresh snow, it worked perfectly thanks to technical modifications to the front of the coupler. In the end, the CargoFlex was the only one to fulfill all of the “knockout criteria,” and as such, the Scharfenberg system was selected as the Europe-wide standard for rail freight transport.

Since the end of 2021, a demo train equipped with Scharfenberg couplers from various manufacturers has been traveling throughout Europe to test regional requirements in real operation.

Unlike all the other automatic couplers being trialed, the CargoFlex has already been tried and tested in the real world – the Swiss company SBB Cargo has been using Voith couplers in regular commercial operation on a daily basis since May 2019.

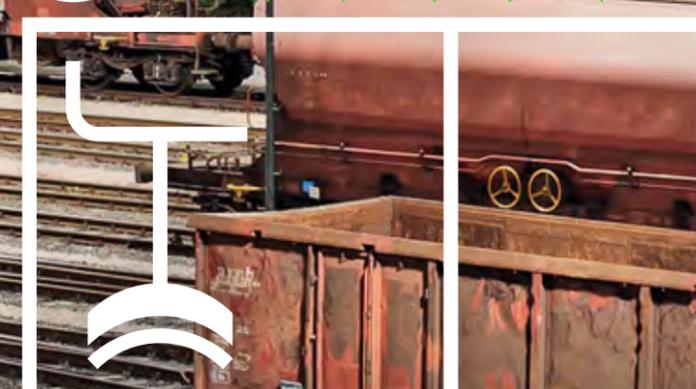


Up to now, working between railcars has been very dangerous. The digital automatic coupler will therefore also make railroad yard workers' everyday lives safer.



The CargoFlex coupler has been used by SBB in regular commercial operation since 2019.

- 1 Data communication systems
- 2 One4 coupler head
- 3 Energy absorption elements
- 4 Compressed air for braking



20,000	loco-motives
450,000	freight cars

In the coming years, many thousands of locomotives and freight cars will have to be converted.



Incidentally, Voith already offers railcar operators a simple and risk-free way to enter the world of automatic coupling. By modifying the cars to be “DAC-ready,” the company is equipping existing freight cars with the CargoFlex's energy absorption system. Known as the draw gear, this unit is located in the freight car's standardized UIC 530 installation space, while the draw hook and buffers remain on the vehicle. Later, these will be dismantled simultaneously throughout Europe and the front part of the CargoFlex coupler will be installed. This is the current plan outlined in the European DAC Delivery Program (EDDP).

## “Intelligent trains are being created that supply data on a continuous basis.”

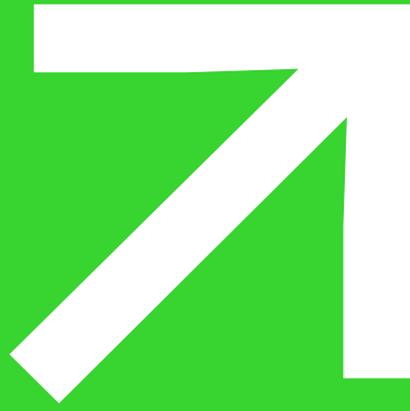
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In the future, the couplers will transmit power as well as data throughout the train. “As a result, a simple freight car will not only become a smart car, but also part of a smart train that continuously supplies data, controls and monitors itself, and interacts with its environment,” says Weidert.

In addition to around 450,000 cars, 20,000 locomotives also have to be prepared for automatic operation. Voith has developed a hybrid solution for these that allows the use of both conventional draw hooks as well as Scharfenberg couplers. The hook will then be eliminated once and for all in the year 2030, when all European freight trains will be equipped with a Scharfenberg type digital automatic coupler.

# EDDP

The European DAC Delivery Program (EDDP) is a Europe-wide, open collaboration platform to bring together rail companies from all sectors. The aim is to make European rail freight transport sustainable and attractive through technological advances and to drive the smooth as well as technically and commercially viable Europe-wide conversion of rail freight services.



**“E-mobility  
is the  
mobility of the  
future.”**

**And this is true not  
only due to environmental  
and social reasons,  
but even more so  
for financial reasons.”**

Martin Wawra,  
Executive Vice President & CEO Voith Turbo Mobility

**VOITH**

