

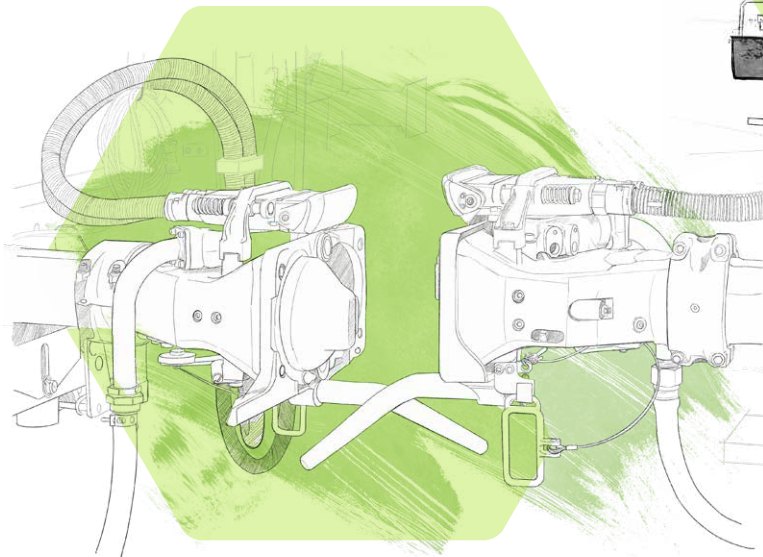
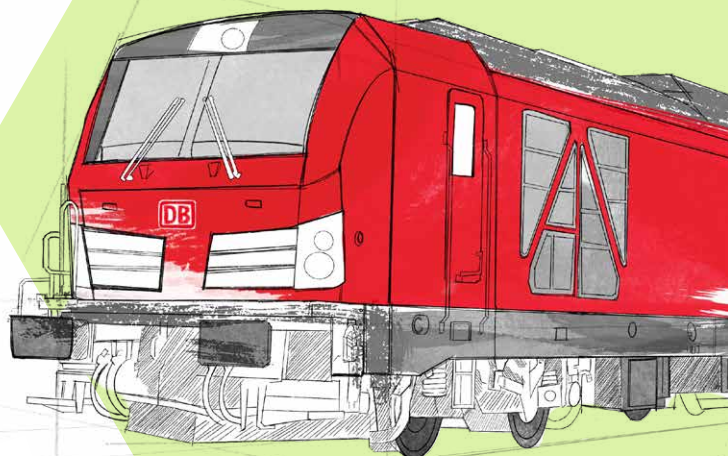
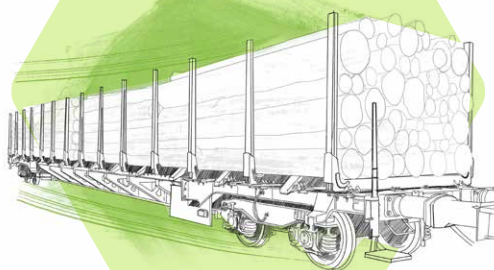


Cargo

White paper

Digital and modular

On track with innovations
for sustainable
rail freight transport



Foreword

Dear Reader,

“What we do today shapes the world of tomorrow.” This quote from the writer Boris Pasternak gets to the heart of the current situation. It’s also true for DB Cargo. After all, climate change is real and demands an active commitment here and now, especially from transport operators. The goals are clear enough: use less energy and reduce our carbon footprint.

This is exactly why DB Cargo is setting course to move step by step towards a specific goal: shifting ever more shipments away from the road to green rail in the future. To achieve this goal, we’re making many technical, operational and organisational adjustments. These adjustments include rethinking our transport strategies, digitalising and automating our processes, using sustainable drive systems, and constantly modernising our fleet; the latter involves developing and using technical innovations.

That’s why this white paper is dedicated exclusively to innovative solutions for sustainable rail freight transport. DB Cargo is involved in many research and development projects relating to innovative solutions for locomotives and wagons. Some of our innovations are almost ready for market and will soon be put to use to make rail freight transport even more sustainable and environmentally friendly; others are already in service. We present three of them in detail here.

I wish you an enjoyable read.

Yours sincerely,

Thorsten Meffert

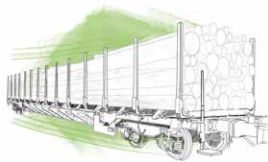
Vice President of Marketing
DB Cargo Group



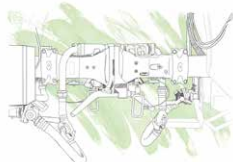
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More than eco-friendly: three innovative solutions to help shift more goods to rail in future



The freight wagon of the future adapts to customer requirements flexibly.



Digital automatic coupling boosts rail capacity.



The bi-mode locomotive is carbon-neutral on the last mile.

W

ith their impact on our way of life and our future, climate change and global warming are existential threats that may well pose the greatest challenge of the 21st century. Against this backdrop, a radical reduction in global CO₂ emissions is an absolute necessity, and the transport sector has an essential role to play. It has to take effective action and make rapid progress towards climate neutrality. Generating around 20% of CO₂ emissions, it is the third-largest source of greenhouse gas emissions in Germany after the energy and industrial sectors. Around a quarter of the sector's emissions are attributable to road freight.

This is exactly where DB Cargo comes into play: freight trains emit around 80% less CO₂ than lorries, and a single train can replace up to 52 trucks. DB Cargo already replaces some 22 million truck journeys in Europe every year for a reduction in CO₂ emissions of 7 million tonnes annually. But there's still plenty of room for improvement. After all, some two-thirds of goods are currently transported by lorry and only around 20% by rail.

It's also true that many companies want to make their logistics greener and are shifting the transport of their products from lorries to sustainable rail. But if we want to shift more and more traffic to rail, we need to make further improvements to rail freight transport and boost its appeal. This means making it faster, more efficient, more flexible, more automated, more modular and more multifunctional.

To make lasting improvements in the rail system as a whole, DB Cargo is currently working on multiple fronts. Through projects with a range of partners, we are developing innovative solutions, some of which involve vehicle hardware. We would like to present three of these innovations in more detail in this white paper. First is the m² freight wagon system, which separates carrier wagons from transport containers, opening up new possibilities in wagon design. Second, digital automatic coupling (DAC) is in its final stages of development. In future, DAC will enable freight wagons to be connected automatically, without any manual work at all. And third, bi-mode locomotives will pull future trains. Their hybrid drives, running on electricity and diesel or biofuel, will make it easy and efficient to cover even the last mile to customers' non-electrified sidings. ●



Multifunctional × modular = m²

Our next-generation freight wagon is ready for series production

One of our innovations is m², a multifunctional and modular freight wagon system. It's the result of a revolutionary idea for freight wagon design and operation, developed by DB Cargo in partnership with VTG and approved throughout Europe since 2021.

The market launch of our innovative multifunctional and modular freight wagon system m² is being funded by Germany's Federal Ministry for Digital and Transport. It follows a resolution by the Bundestag as part of a government programme to promote pioneering rail freight technology.

Status quo

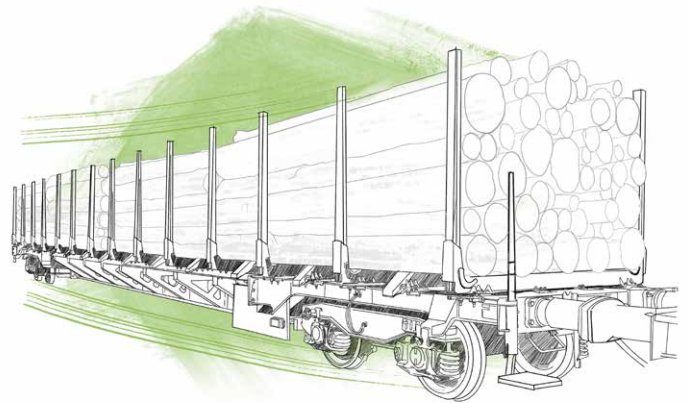
Because of the high level of diversification and specialisation resulting from different designs and cargoes, current freight wagon fleets are of limited flexibility. Freight wagons are durable capital goods, with a typical service life of 40 to 50 years. Conventional freight wagons are built for a specific purpose, usually to transport a certain type of goods, so their flexibility is limited. Modifications are often impossible during their service life. Where modifications are possible, they're very time-consuming and expensive because they usually require the wagon to be re-approved by the regulator.

For these reasons, innovative freight wagon designs allowing for flexibility and individualisation are called for because they make it possible to adapt wagons to changing market, transport and logistics requirements quickly, economically and flexibly.

The innovation

This is exactly where m² comes into play. These challenges can be managed much better with this newly developed freight wagon. The m² modular system separates the transport container from the carrier wagon, so the wagon can be perfectly adapted to different customer and industry requirements at short notice. This is made possible by a standardised, modular carrier wagon and multifunctional customer- and industry-specific containers and superstructures that enable the wagon to be customised in terms of length, loading capability and mounting points. This allows the freight wagon system to be flexibly and quickly adapted to specific transport requirements and purposes, making rail freight transport more attractive and more competitive against road transport.

Find out more about the freight wagon of the future and the engineering behind it:
dbcargo.com/m2



m²: the details

• The modular carrier wagon

The standardised, modular carrier wagon can be configured for loading lengths from around 10.80 to over 22.66 metres depending on the application, and it can be combined with various superstructures – without losing its regulatory approval. In other words, the m² carrier wagon combines two important aspects: first, standardisation in the procurement of components and spare parts and in the maintenance and improvement of components, and second, the customisation of crucial wagon characteristics, most importantly the wagon length during its life cycle. In addition, the m² system has another important benefit: unrestricted single-wagon capability in European single wagonload transport. And incidentally, regulatory approval for our customisable carrier wagon is unique in all of Europe. System approval of m² was granted in May 2021, making DB Cargo the first wagon keeper to have European type approval for an entire wagon system.

• The multifunctional containers and superstructures

The m² system can also be equipped with various industry-specific containers or load units that can be changed multiple times from season to season or over a wagon's service life. For example, the modular system enables a wagon for coarse tree trunks to also transport moisture-sensitive pulp and paper rolls when needed, and a wagon for steel coils straight from the steelworks can also transport scrap.

In the freight wagon system's intermodal configuration, the containers are also designed for transport by lorry (for example, for short onward carriage by road in combined transport) and for standard handling using container corner fittings and grapple pockets.

During 2022, we fulfilled our first customer orders in the timber, steel coil and scrap sectors. This is the basis for production of the new range of wagons. On its delivery at the end of 2022, the first scheduled service will begin and the system will gradually become available for further transports.

General benefits

- Improved fleet efficiency could increase availability of loading capacity
- Accounts for current industry requirements for loading/unloading
- Fast implementation of special customer requirements and shorter time-to-market for superstructure development
- Hump capability strengthens single wagonload system long-term and offers opportunities for new transport concepts

Benefits of intermodal configuration (compatibility with lorries and cranes)

- Intermodal capability offers new customers, especially those without sidings, easier access to rail freight transport
- Implementation of smaller batches and consignments
- Integration in production logistics with short-term buffer storage, including stackability of selected containers

Practical examples

Example 1

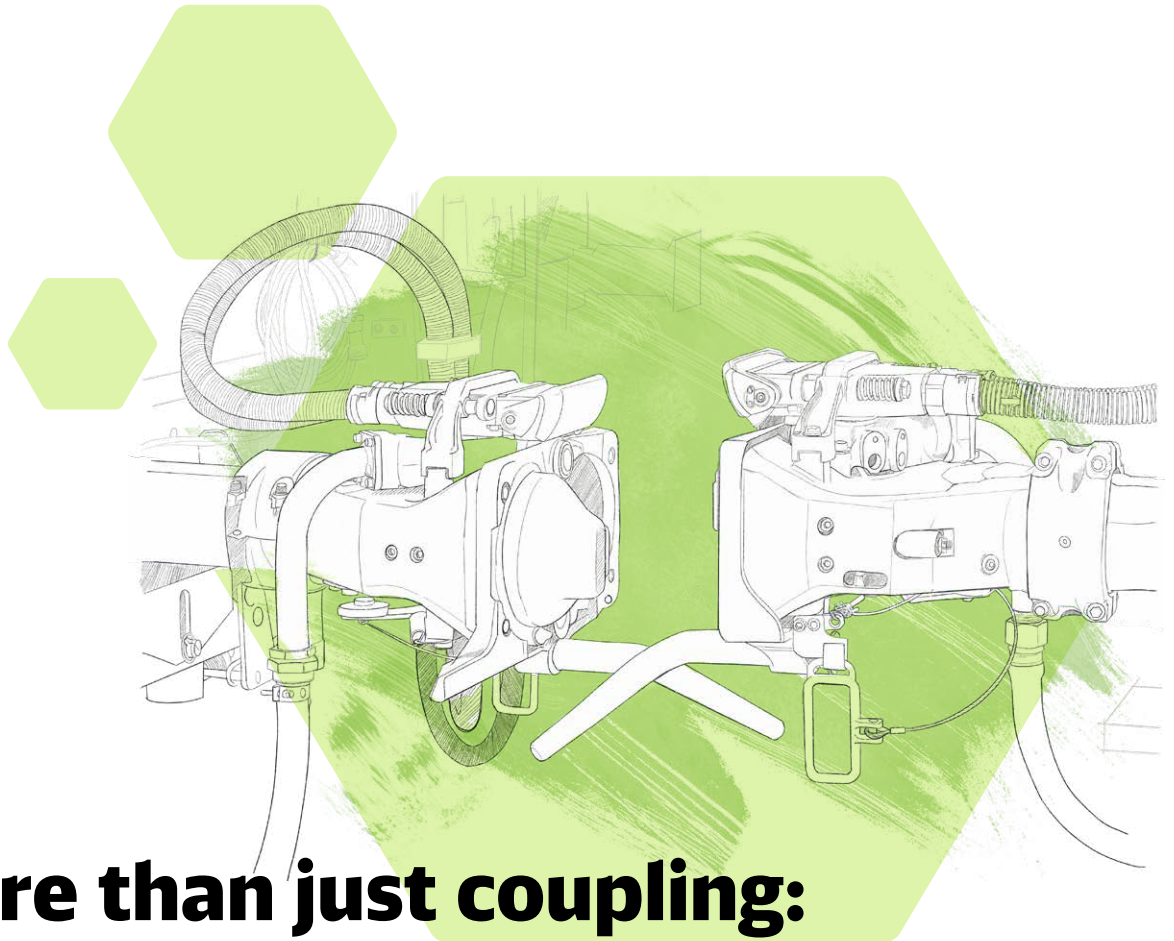
In the timber sector, the superstructures are used for optimised rail transport handling. In this configuration, the system provides new flexibility for the transport of logs and square-sawn timber: both raw and processed materials can be loaded onto a single freight wagon, in succession where possible. The stanchion system can also be designed to customer specifications for the specific cargo and the corresponding length (up to sevenfold stacking of 3-metre timber with high loading length).

Example 2

In the coil and scrap industry, our freight wagon system is completely intermodal. This means the containers can be handled with cranes in terminals and placed on lorries for pick-up and delivery. This opens up completely new possibilities for connecting new customers in the single wagonload system for a large-scale modal shift from lorry to rail and for innovative logistics concepts.

Example 3

The m² scrap containers are designed with features that make them ideal for use in the plant logistics of steelworks: they are craneable, stackable (three levels) and suitable for lorries. This enables valuable residual material or high-quality scrap, for example from the production of coils in the automotive industry, to be loaded and returned sorted by type for optimised recycling in the steel cycle – a perfect example of the circular economy. This shows how DB Cargo is creating real added value for the entire value chain of green steel production, and putting more goods on the railways in the future. ●



More than just coupling: digital automatic coupling

Whether they're m² wagons or other designs, all freight wagons have to be connected via couplers to form a train. To make that easier, faster and more economical in the future, a European sector initiative has been established to develop, test and ultimately launch digital automatic coupling (DAC) throughout Europe. DB Cargo is at the forefront of this initiative, working to make this groundbreaking innovation for rail freight transport a reality. The first tests have already been completed; the aim is to launch DAC in Europe by 2030. Space to install the new coupler has already been provided on the m² wagon.

Around 70,000 times a day, our shunting staff have to heave heavy looped coupling links to shoulder height to couple trains. But the new technology is not just about coupling. With its “D” for digital, DAC is bringing a continuous power and data line to freight trains. It’s an important stepping stone on the way to the new world of digitalisation and automation in rail freight transport – and to the smart freight train.

Status quo

For more than 150 years, European rail freight transport has almost exclusively used screw couplers, which shunting personnel couple and uncouple entirely by hand. To connect a wagon, a shackle weighing 20 kg is connected to the hook on the next wagon. The coupler is then tightened by adjusting a turnbuckle-style screw behind the shackle. The air line for the brakes is also connected by hand. This takes time, and it’s very hard work for the shunting staff.

The innovation

Coupling is automatic with DAC, as it has been for decades on almost all other continents. Only in Europe is the old screw coupler still used. But DAC is taking things a step further in Europe, because it also opens the door to further digitalisation in rail freight transport. The coupler, which does much more than “just” couple freight wagons, makes it far easier to assemble a freight train. It creates the mechanical connection between the wagons without the need for heavy physical labour by the shunting personnel. At the same



“This new coupling system fundamentally changes rail freight transport and will give us the speed we need to save the climate.”

DR SIGRID NIKUTTA
CEO of DB Cargo AG

time, DAC couples the air lines for the brakes and the power and data lines – also completely automatically. On top of that, DAC enables the automation of other time-consuming train formation tasks that are still done manually, such as brake testing, end-of-train detection, and recording the wagon sequence. That’s why the D for digital and the A for automatic are at the front of the name, before the C for coupling.

How can this innovation of the century succeed?

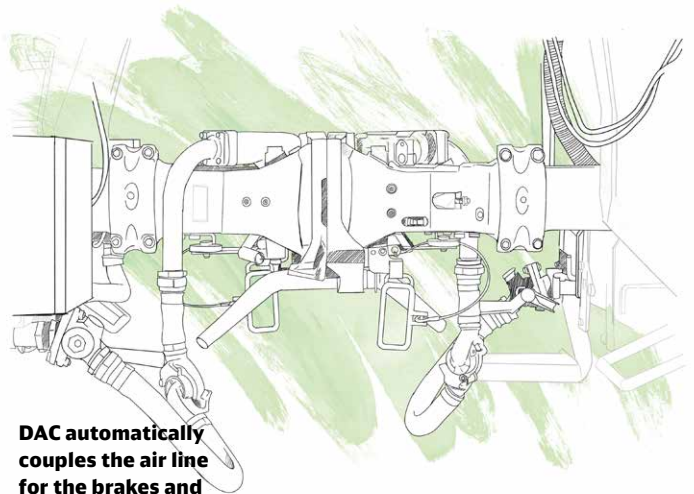
“To make this a success story, many elements will have to mesh. The equipment has to work very reliably, we need a clever and coordinated migration plan, and the funding has to be in place,” says Dr Armin Günter, project manager for digital automatic coupling at DB Cargo. “It’s a complex and ambitious challenge, but we’re making progress. It’s a great pleasure to see the whole sector getting involved and feel a strong political tailwind at the same time.” It’s clear that we’re facing a major effort for Europe. Large-scale projects have been set up to tackle the challenges mentioned.

- In European rail freight transport overall: around **400,000 coupling operations per day**
- Rolling stock to be upgraded in Europe: **approx. 500,000 freight wagons, 20,000 locomotives**
- **Target:** Upgrade completed by **2030**

The European Commission is working hard to award a major joint project under the umbrella of the “Europe’s Rail” funding programme. More than 20 partners, including operators, vehicle leasing companies and industrial firms aim to develop a product ready for series production by the end of 2025 so that the DAC launch can start immediately afterwards. In addition, the European DAC Delivery Programme was established to engage and involve the entire sector in Europe. This platform has already been involved in many trend-setting decisions on matters including technical aspects, migration plans, profitability, and financing models. More than 80 companies and organisations are involved in this initiative.

Pilot project

Germany’s Federal Ministry for Digital and Transport (BMDV) has commissioned a pilot project to demonstrate, test and approve the use of DAC on freight trains. The DAC4EU (Digital Automatic Coupling for Europe) consortium, led by Deutsche Bahn, is currently testing the use of DAC on freight wagons within this framework. In addition to DB and DB Cargo, five other companies are involved: the Swiss and Austrian freight operating companies SBB Cargo and Rail Cargo Austria and the wagon keepers Ermewa, GATX Rail Europe and VTG. The BMDV is funding the project from June 2020 to December 2022. Further funding until June 2024 is under discussion. ●



DAC automatically couples the air line for the brakes and the power and data bus line.

Benefits

- Faster, simpler and more efficient operations; thanks to DAC, more trains can be formed in less time while the capacity of sidings, marshalling yards, transshipment stations and ports increases considerably. This will allow freight trains to depart faster and more frequently.
- Longer and heavier trains can run with DAC, as its tensile and compressive forces are higher than those associated with screw coupling. And with modern braking systems, we can even travel faster. That allows more trains on the line, a smart capacity increase that, along with new infrastructure, boosts the attractiveness of rail.
- Improved sustainability, profitability and competitiveness for rail freight transport. For customers, this makes shifting their goods to rail more attractive, especially in single wagonload transport.



Two is better: the bi-mode locomotive

Last but not least, nothing works without a locomotive. After all, it is this that provides the power to move the wagons and cargo from A to B. For many years now, pure diesel locomotives have accounted for only a small part of transport capacity. DB Cargo already uses climate-friendly electric locomotives for 95% of its tractive power in the railway network. In order to also reach the last mile to the non-electrified sidings of many customers more easily and efficiently, it's now time for the next step in locomotive evolution: the bi-mode locomotive.

Status quo

Even though the main rail lines in Germany are already electrified, the so-called last mile to a customer's siding can usually only be travelled using a combustion engine, i.e. with diesel locomotives. That means one locomotive must be coupled to the other and shunted, which requires resources, time and personnel.

The innovation

The solution is hybrid propulsion. Our new eco-friendly bi-mode locomotive can operate on both kinds of line. On routes with overhead lines, it runs on electricity. On all other routes without overhead lines, as when driving on a customer's factory premises, it switches to diesel operation. So in future, our bi-mode locomotives will be used both as shunting locomotives and for heavy main-line runs. DB Cargo's goal is to equip some 70% of its diesel locomotives with innovative drive systems by 2030. The first bi-mode locomotives will be delivered in 2024.

Two drive systems for more climate protection

With the new locomotives, DB will reduce its fuel consumption by some 8 million litres and its CO₂ emissions by 17,000 tonnes annually. But that's not all: in future, we aim to reduce our use of fossil fuels such as diesel to a minimum, and even to zero by 2040. To get there, DB Cargo is testing alternative biofuels. One of those is hydrotreated vegetable oil (HVO), which is produced from plant remains and other biological waste. With HVO, CO₂ emissions can be reduced by around 90% compared with standard diesel fuel, and bi-mode locomotives will be able to provide carbon-neutral service on the last mile. ●

Benefits

- Use of locomotives with adequate power and low energy consumption
- Electric operation on electrified line sections cuts energy costs, reduces noise emissions, and significantly improves the carbon footprint.
- Increasing the performance of local services under the overhead lines enables both heavier trains and higher speeds, thus ensuring train path availability with increasing network capacity utilisation.
- More efficient operation on the last mile – more attractive for customers
- Climate-neutral supply chains from end to end thanks to biofuels



Using the new locomotives, DB will drop its fuel consumption by some eight million litres a year while also generating 17,000 fewer tonnes of CO₂

Take-aways from this white paper

Kee on thinking – that's our motto at DB Cargo now. Even things that are tried and tested have to be refined and adapted to current requirements. It's a huge task, with a lot of issues that need to be addressed. An essential item on our to-do list is manoeuvring our wagons and locomotives into a new era and developing new and innovative train and wagon solutions with the goal of bringing more and more goods onto rail in the long run.

To achieve this goal, DB Cargo is working with many other companies on lasting improvements to rail freight transport to make environmentally friendly rail the first choice for transporting freight. With the three assets described here – m², DAC and bi-mode locomotives – we'll soon be launching three innovations that will achieve just that. One thing is certain: these won't be our last innovations and improvements. To be continued...

m² wagon

- You can modify these wagons flexibly to meet your specific transport requirements and purposes, and you can do so quickly and easily.
- Even if you don't have a rail siding, or if we only receive small batches and consignments from you, we can still handle them on the main leg via rail and the single wagonload network.
- You have more flexibility in transport planning because the wagons can be craned and transhipped and are compatible with lorries.

Digital automatic coupling

- The stronger coupling enables the operation of heavier and longer freight trains, so you can transport more goods at a time.
- Since DAC completely automates the coupling process and the tests between wagons, train formation (especially in single wagonload transport) is much faster.
- The time saved means more wagons can be prepared and dispatched. In other words, they become available again more quickly so you can increase your transport volume on eco-friendly rail.
- Simpler and more efficient operations make rail a more attractive and economical means of transport for you, especially in single wagonload transport.

Bi-mode locomotives

- Goods in single wagonload transport can be transported directly to your premises, saving time on last-mile shunting movements.
- On routes with overhead lines, the bi-mode locomotive runs on electricity with zero local emissions, significantly reducing the energy costs and carbon emissions of your transports and bringing you closer to your climate targets.
- The use of biofuels makes bi-mode locomotives more efficient on the last mile, too, and reduces carbon emissions by up to 90%. ●

Imprint

Published by

DB Cargo – Marketing

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