

Rail

PARTNER IN  
POWERFUL SOLUTIONS.



A Rolls-Royce  
solution



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**1 UK | 700 kW / 939 bhp**  
Hitachi Rail  
Dependability for over 27 years – Intercity Express Programme trains with **mtu** PowerPack Series 1600 backed by **mtu** ValueCare agreements

**2 New Zealand | 2700 kW / 3620 bhp**  
CRRC  
63 locomotives equipped with **mtu** engines operate reliably, cost-effectively while keeping emissions to a minimum

**3 UK | 390 kW / 523 bhp**  
CAF  
Some 250 compact, lightweight and efficient **mtu** PowerPack Series 1800 keep Civity regional passenger trains operating on schedule

**4 USA | 900-2400 kW / 1207-3218 bhp**  
KLW  
30 locomotives with **mtu** diesel engines and OEM aftertreatment systems achieve Tier 4 benchmark as the cleanest in the US

# PIONEERING THE POWER THAT MATTERS.

Rolls-Royce provides world-class power solutions and complete life-cycle support under our product and solution brand **mtu**. Through digitalization and electrification, we strive to develop drive and power generation solutions that are even cleaner and smarter and thus provide answers to the challenges posed by the rapidly growing societal demands for energy and mobility. We deliver and service comprehensive, powerful and reliable systems, based on both gas and diesel engines, as well as electrified hybrid systems. These clean and technologically advanced solutions serve our customers in the marine and infrastructure sectors worldwide.

#### A solution provider

**mtu** systems power the largest yachts, the strongest tugboats and the biggest land vehicles and provide energy for the world's most important mission-critical applications. Through advanced solutions such as microgrids, we integrate renewable energies and manage the power needs of our customers.

Our customized service offerings help you maximize uptime and performance and are supported by our digital solutions, which enable remote monitoring, predictive maintenance and a range of other benefits that keep your systems running at their best.

For over 110 years, we have provided innovative power solutions for our customers – meeting even the most demanding drive requirements. Our products and services span a wide range of applications and power needs, with both standard and customized options.

#### An expert in technology

As part of Rolls-Royce, we have long been known for cutting-edge innovation and technological leadership in product development. That same spirit of innovation inspires our sustainability efforts. Our focus is on developing and implementing system solutions that both maximize efficiency and reduce emissions – which in turn work to reduce our impact on the environment.

#### A passionate and reliable partner

We at Rolls-Royce spend every day working together with our customers, to deliver engines, systems and complete life-cycle solutions that best fit your needs. We understand that each application is different and has its own specific demands. Our engineers embrace the challenge of finding the perfect solution for your unique power requirements. Every step of the way – from project planning, through design, delivery and commissioning; to the lifetime care of your equipment – we are dedicated to helping you get the most from your **mtu** investment.

#### 1 Resourceful

We are highly skilled at devising quick, intelligent ways to fulfil customers' needs.

#### 2 Responsible

We develop innovative technologies that also meet the highest emissions standards.

#### 3 Reliable

We can be counted on to find the perfect solution for any requirement at every step.



OVER  
**20,000**  
DRIVE SOLUTIONS  
FOR RAIL VEHICLES SINCE 1950

Lifecycle solutions provider

A TRADITION  
OF SOLUTIONS.

Designing and developing customized solutions has a long tradition for us. Karl Maybach introduced the first diesel engine for railcars back in 1924 already, bringing forth such milestone achievements as the “Hamburg Flyer,” the fastest passenger train of its time.

## 02

Agility, flexibility and the ability to come up with customized solutions that precisely fit the individual needs of rail clients have always been signature hallmarks of our company. In close cooperation with

customers, totally immersed in their daily operations, we push ourselves to design and develop the absolute best technological, economical and ecological answers for addressing their challenges.



Lifecycle solutions provider

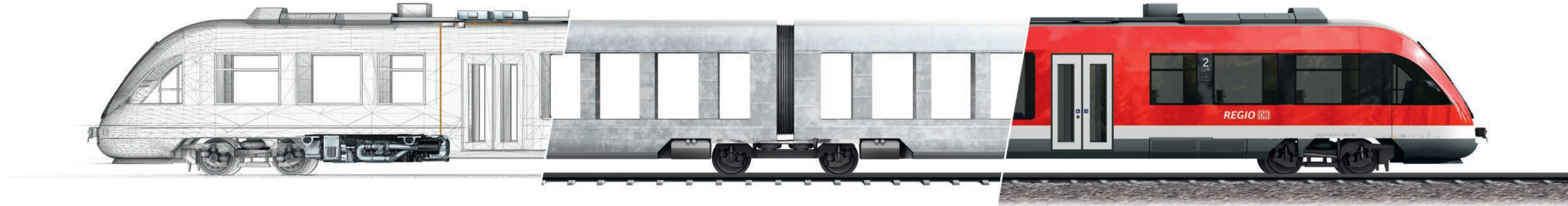
## BACKING YOUR POWER ALL THE WAY.

Although transport today comprises many different modes, rail continues to be the backbone of mobility. Staying power also defines our solutions and commitment to clients. We are specialized in complete drive solutions that offer optimal performance over the entire course of their lifetime. We ensure that they do by optimally supporting clients with first-rate solutions for optimizing their applications – continually, from day one, at every phase. From consulting and planning to development and commissioning, uptime maximization, digital field support, tailored services and more, we have the perfect solution.



What makes **mtu**  
your ideal Lifecycle Solution partner?

Learn more by scanning the code.



### PLANNING AND DESIGN

- Expert consultation on available technology options
- Track profile simulations to determine most efficient drive solution (conventional or hybrid)
- Various calculations, e.g. tractive effort calculations
- Feasibility and installation studies
- Technical specifications documentation
- 3D models and drawings

### DEVELOPMENT AND COMMISSIONING

- Tailored and modular drive solutions – diesel, electric or hybrid
- Alignment throughout design and prototyping
- Extensive prototype testing (e.g. full-load test, noise and vibration measurements)
- Installation support
- Static and dynamic commissioning

### PRODUCT AND SECOND LIFE

- Tailored ValueCare Agreements (e.g. for parts availability, guaranteed uptime)
- Global support through our comprehensive service network
- Repower solutions to improve fuel savings, emissions reductions, availability and more
- Engine overhaul for increased performance
- Reman services for parts and entire drive solutions
- Connectivity and digital solutions free of charge during warranty time

## Applications overview

## SPECIFIC IS OUR SPECIALTY.

Every rail drive application is different, has its own very specific requirements. Specific is our specialty. Our engineers welcome the challenge of finding the perfect drive solution for your needs.

**Multiple-unit and high-speed trains**

Extremely powerful and proven in continuous service – our drive solutions feature an excellent power-to-weight ratio and outstanding operational availability, enabling them to deliver the reliability, punctuality and safety that passengers expect of multiple-unit and high-speed trains.

**Railcars**

Designed specifically for quick and easy underfloor and roof installation, our complete, compact drive systems incorporate all components in one highly reliable operational unit. They combine decades of experience with one-of-a-kind technologies as the perfect railcar drive solution.

**Shunting and industrial locomotives**

The drive system requirements of shunting and industrial locomotives are very special. Our engines are well designed for the task, thanks in part to their excellent part-load performance and acceleration characteristics.

**Mainline and multi-purpose locomotives**

Whether for heavy goods transport, high-speed transit or long-haul passenger routes, our drive systems deliver reliable performance – along with extended service intervals, maintenance-friendly design and reduced fuel consumption that keep life-cycle costs low.

**Special purpose rail vehicles**

From diesel-electric to diesel-mechanical, diesel-hydraulic, even diesel-hydrostatic – we have the perfect drive solution for all types of special purpose vehicles operating at extremely low speeds.

Drive solutions for railcars, push-pull trains and locomotives

EFFICIENT. EFFECTIVE.  
ECO-FRIENDLY.

Collaborating closely with customers, we work to develop solutions that deliver superb performance over the complete lifecycle of the drive systems. Our solutions are extremely efficient, effective and eco-friendly. They are also highly compact and easy to integrate.

03

Drive solutions for railcars, push-pull trains and locomotives

# POWERPACKS FOR ROOF AND UNDERFLOOR INSTALLATION.

Increasing demand for local public transportation has created a need for modern railcars that support eco-friendly transportation with latest drive technologies. As complete drive solutions, our innovative and highly compact PowerPacks® are well up to the task and are quickly and easily integrated into wide-ranging vehicles.

mtu PowerPacks are highly reliable drive systems that help to ensure smooth, on-time train operations. Combining fuel efficiency with extended service intervals and a maintenance-friendly design, they keep operating costs low.

All drive components are contained in a single operational unit and can be individually configured.

We also offer railcar equipment for diesel-electric and diesel-mechanical power transmissions. If needed, we can adapt our systems, including the automation, to optimally fit your specific railcar needs.

Our Series 1800 and 1600 PowerPacks feature a particularly flat and compact design for easy underfloor or roof installation.



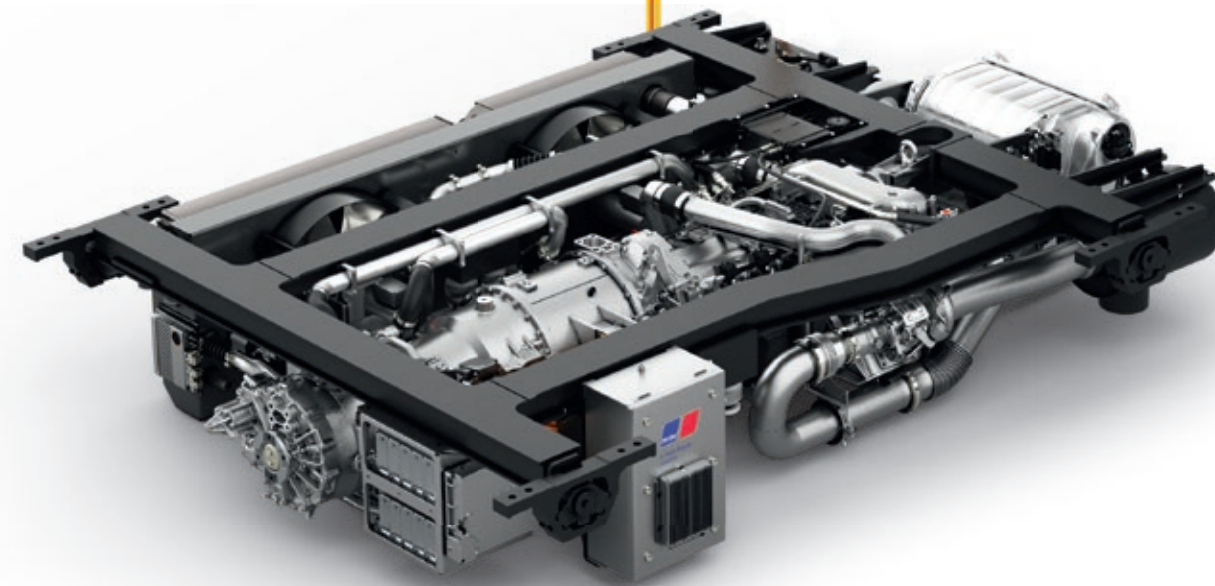
- Benefits:**
- Continuous design improvements with the same footprint (modular strategy)
  - Zero emissions operation on chosen stretches (with Hybrid PowerPack)
  - Extensive roof and underfloor installation experience
  - Repower capability to extend the life of your investment

Hybrid PowerPack with Series 1800  
Optimal integration of all drive components in a slim and trim design to enable easy underfloor installation.  
315 - 470 kW (422 - 523 bhp)



PowerPack with Series 1600  
Highly compact, integrated and powerful.  
565-736 kW (758-987 bhp)

PowerPack with Series 1800  
Over 20 years of reliable and efficient performance.  
315-390 kW (422-523 bhp)



# SYSTEM SOLUTIONS AND ENGINES FOR ENGINE ROOM INSTALLATION.

Our diesel push-pull, all-purpose and mainline drive solutions are specifically designed for heavy freight and high-speed passenger trains. Our locomotive diesel drives, on the other hand, have been optimized for shunting and industrial units involving frequent load changes in all partial load areas and high time slices with low loads. All of our

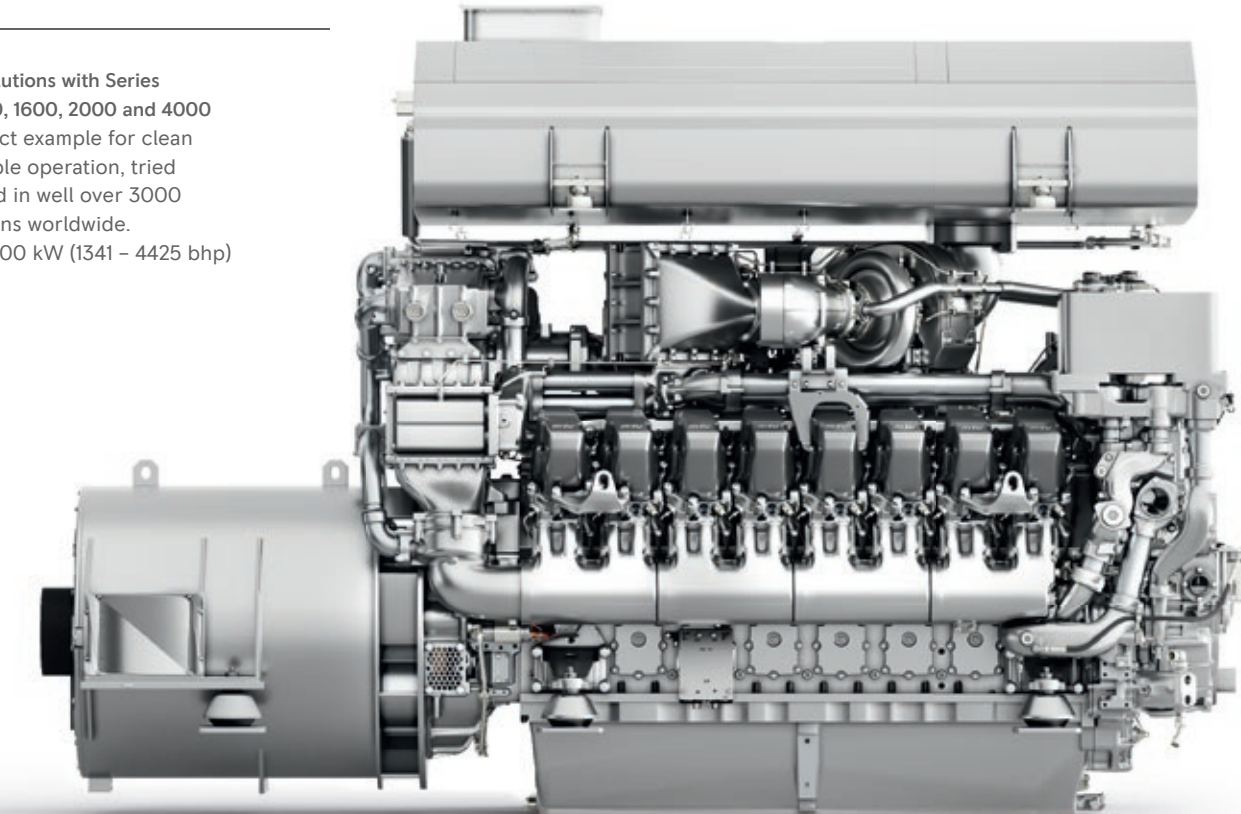
locomotive drive solutions are engineered for maximum uptime, high reliability, easy maintenance, long times between overhaul (TBO) and low life-cycle costs. They combine low emissions and fuel efficiency with a lightweight design for good overall value.

- Benefits:**
- Reliable performance under all conditions
  - Clean, low emissions power
  - Drive solution of choice for locomotives and push-pull trains
  - Repower capability to extend the life of your investment



System solutions with Series 1300\* and 1500\* also available as twin-engine package

System solutions with Series 1300, 1500, 1600, 2000 and 4000  
The perfect example for clean and durable operation, tried and tested in well over 3000 applications worldwide.  
1000 - 3300 kW (1341 - 4425 bhp)

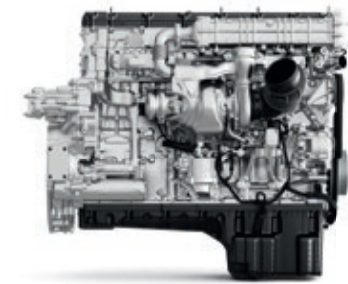


\* Engines for industrial applications with EU Stage V/Tier 4 certification

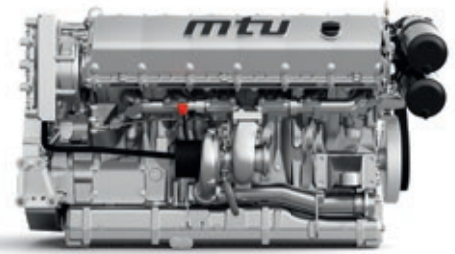
\*\* For rail specific usage please contact your local partner.



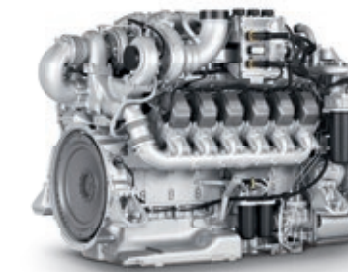
Series 1500\*  
Tireless performance and optimized fuel efficiency all in one.  
380-480 kW (510-644 bhp)



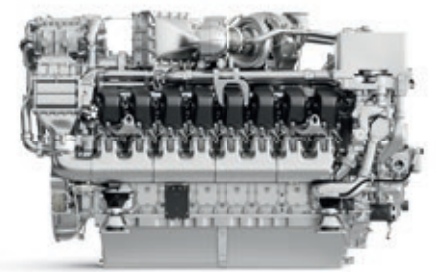
Series 1300\*  
Highly efficient design, ideal for shunting and multi-engine locomotives, railcars.  
320-390 kW (429-523 bhp)



Series 1600  
Extremely compact rail engine for smooth operation and extremely low emission values.  
565-736 kW (758-987 bhp)



Series 2000\*\*  
Durable components, dependable performance, day in and day out.  
783-1163 kW (1050-1560 bhp)



Series 4000  
Proven operations reliability in all conditions paired with cutting-edge emissions technology.  
1000-3300 kW (1341-4425 bhp)



Drive solutions for railcars and locomotives - references

# RAILCARS

Increasing demand for local public transportation brings with it an ongoing need for modern railcars with the latest drive system technology. We – as the experienced specialist – provide the drive systems to support eco-friendly traffic designs. The innovative rail **mtu** PowerPacks meet all the requirements of this high-performance sector, which demands far more than simply a “powerful engine”. Our extremely compact, complete systems are configured to suit individual customer needs and can then be integrated into the vehicle in a quick and easy process, using plug&play.



- 1 Europe | 390 kW / 523 bhp  
Alstom Lint  
Long-term experience and proven designs – over 2,000 **mtu** PowerPacks Series 1800 have been successfully deployed for the railcar platform
- 2 Europe | 565-736 kW / 758-987 bhp  
Pesa Link  
Tailored drive systems and solutions keep 2-car and 3-car train configurations on track and out of the repair shop
- 3 UK | 315 kW / 422 bhp (mechanical)  
150 kW / 201 bhp (electrical)  
Porterbrook  
Development of prototype HybridFLEX railcars fitted with **mtu** Hybrid PowerPack Series 1800 drive systems for clean, quiet hybrid-electric operation
- 4 Russia, Serbia | 360kW / 483 bhp  
RZD and Serbian Railway  
Metrovagonmash trains are equipped with highly reliable and robust **mtu** PowerPacks Series 1800

# LOCOMOTIVES

They are in continuous use, day after day, and prove their reliability on every continent and over thousands of kilometers. They prove their worth in heavy goods operations just as much as at high speeds on long-haul passenger routes. Long maintenance intervals, maintenance-friendly design and low specific consumption figures all contribute to keeping overall life-cycle-costs low and are thus important factors in the economically efficient running of rail vehicles.



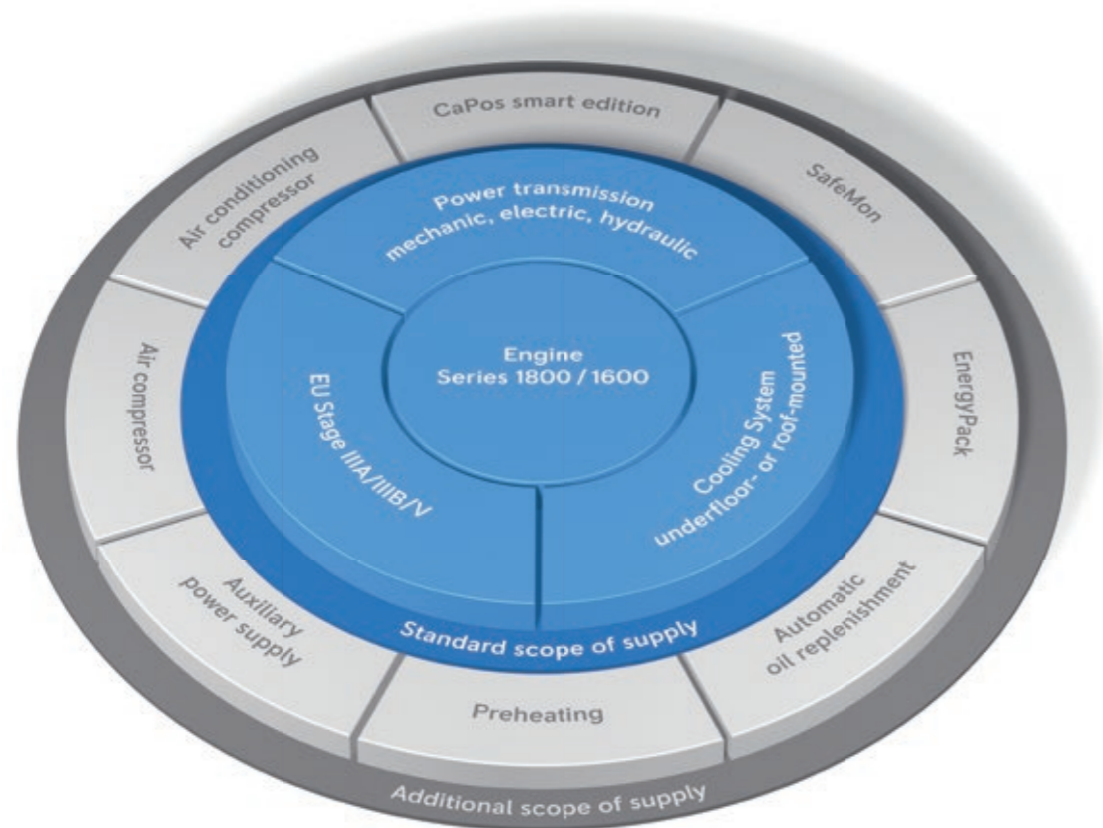
- 1 Europe, Middle East, Asia | 1500-2400kW / 2012-3218 bhp  
Siemens Mobility  
Our lightweight modular drives power more than 400 EuroRunner, Vectron DE and Dual Mode locomotives around the world
- 2 Europe | 1200-1800 kW / 1609-2413 bhp  
Vossloh DE12 and DE18  
204 industrial locomotives with modular drive and **mtu** Series 4000 diesel engine designs
- 3 Czech Republic | 2200 kW / 2950 bhp  
CZ LOKO  
Much more fuel efficient and reliable – 28 locomotives repowered for 2M62UM freight trains
- 4 Argentina | 2200 kW / 2950 bhp  
CRRC  
Designed for the long haul – 107 freight locomotives equipped with **mtu** 16V 4000 R43 diesel engines



Drive solutions for railcars

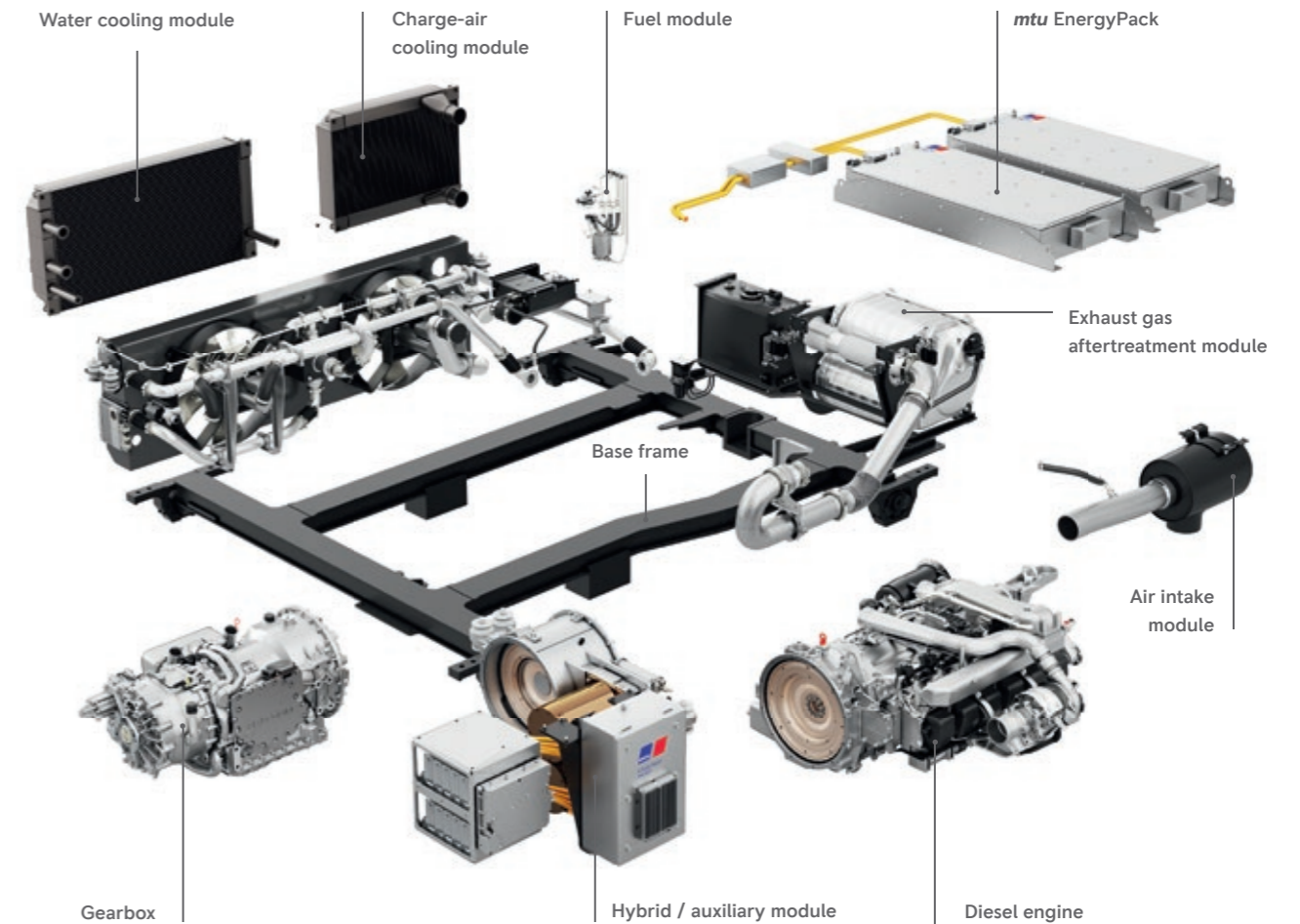
# POWERPACKS – COMPACT, COMPLETE AND COST-EFFICIENT.

What do you call an innovative drive system that combines all of the elements in one compact and efficient unit? We call it a PowerPack. Specially developed for underfloor or roof installation and available for diesel-electric, diesel-mechanical, diesel-hydraulic as well as hybrid drives, the system features an extremely flat design.



**The power of one**  
With over 1,000 successful rail installations, the **mtu** PowerPack Series 1600 and 1800 is the best example of proven performance reliability – and clean performance at that. As complete, ready-to-use drive system, the engine with integrated exhaust gas aftertreatment

fulfills the current EU railcar emission legislation standards. All rolled into one together with a power transmission and cooling system, the low weight unit is a perfect fit for railcars and special-purpose vehicles.



**Plug & play ready**

Quick, easy installation and removal for maintenance

**Cost savings**

Return on investment already begins with the installation

**Compact design & low weight**

Decades of experience in optimizing weight and design

**Engine monitoring**

All functions are monitored by an electronic engine-management and automation system

**System flexibility**

Optimum solution for every requirement - for both hardware and automation

**Eco-friendly**

Internal combustion technologies as well as aftertreatment solutions for lower emissions

**Standards compliant**

Meets US EPA Tier 3, 4i, EU Stage IIIA, IIIB and V standards

**All from one source**

From project kick-off over the entire lifecycle, we are your reliable partner

Drive solutions for push-pull trains and locomotives

# SYSTEM SOLUTIONS WITH SERIES 1300 AND 1500: RUGGED, RELIABLE AND READY TO ROLL

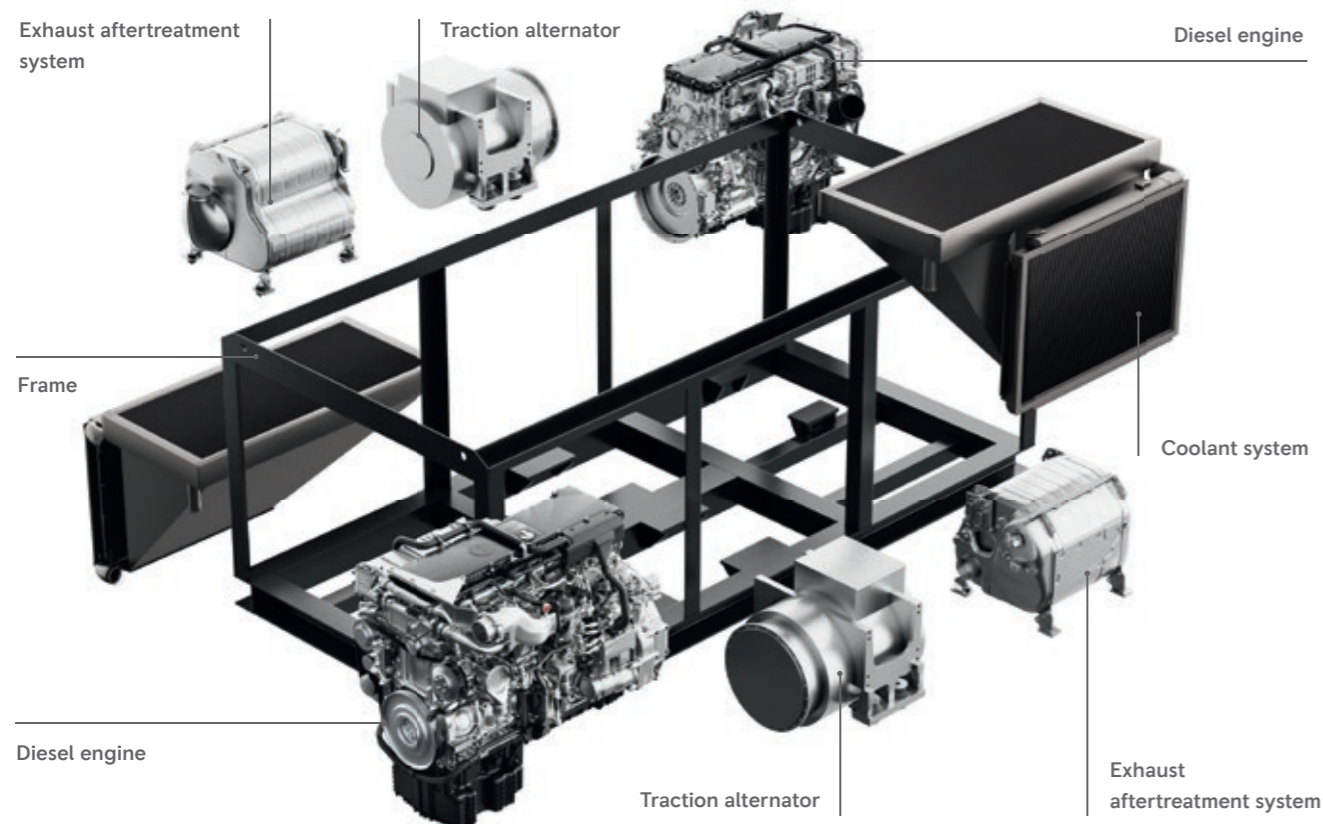
Whether for use in locomotives, railcars or special-purpose vehicles, **mtu** system solutions with Series 1300 and 1500 smartly integrate all drive components in a compact solution to deliver rugged, reliable performance that's ready to roll.

**mtu system solutions with Series 1300 and 1500 benefits**

- Depending on power needs available with single- or dual-engine
- Compact, lightweight engine and EGA system design
- Installation-ready solution for locomotives, railcars and special-purpose vehicles
- Proven in various applications of rugged and reliable performance
- EU Stage V NRE\* certified

- Suitable for EPA Tier 4 NRMM\*\* locomotives
- Condensed cooling system with low cooling load
- Can be operated with synthetic fuels\*\*\*

\* Engines for mobile nonroad machinery  
 \*\* Nonroad Mobile Machinery  
 \*\*\* Applies to EU Stage IIIB (Series 1300 and 1500) as well as EU Stage V (Series 1300 only)



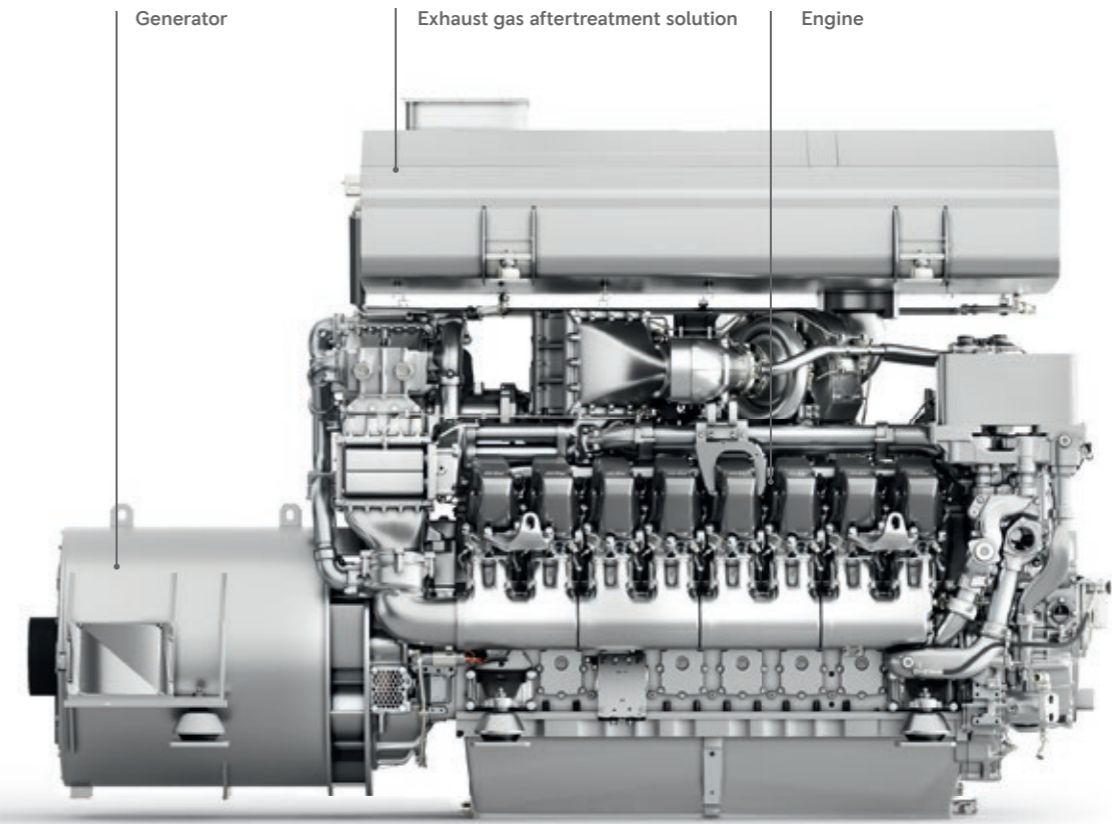
# SYSTEM SOLUTIONS WITH SERIES 1600, 2000 AND 4000: ALL-ROUND OVERACHIEVERS

To characterize the **mtu** system solutions with Series 1600, 2000 and 4000 as overachievers is almost an understatement. Talk about durability, dependability and clean operational efficiency. Since 1996, these diesel engines have been installed in well over 3,000 railway applications worldwide.

**mtu system solutions with Series 1600, 2000 and 4000 benefits**

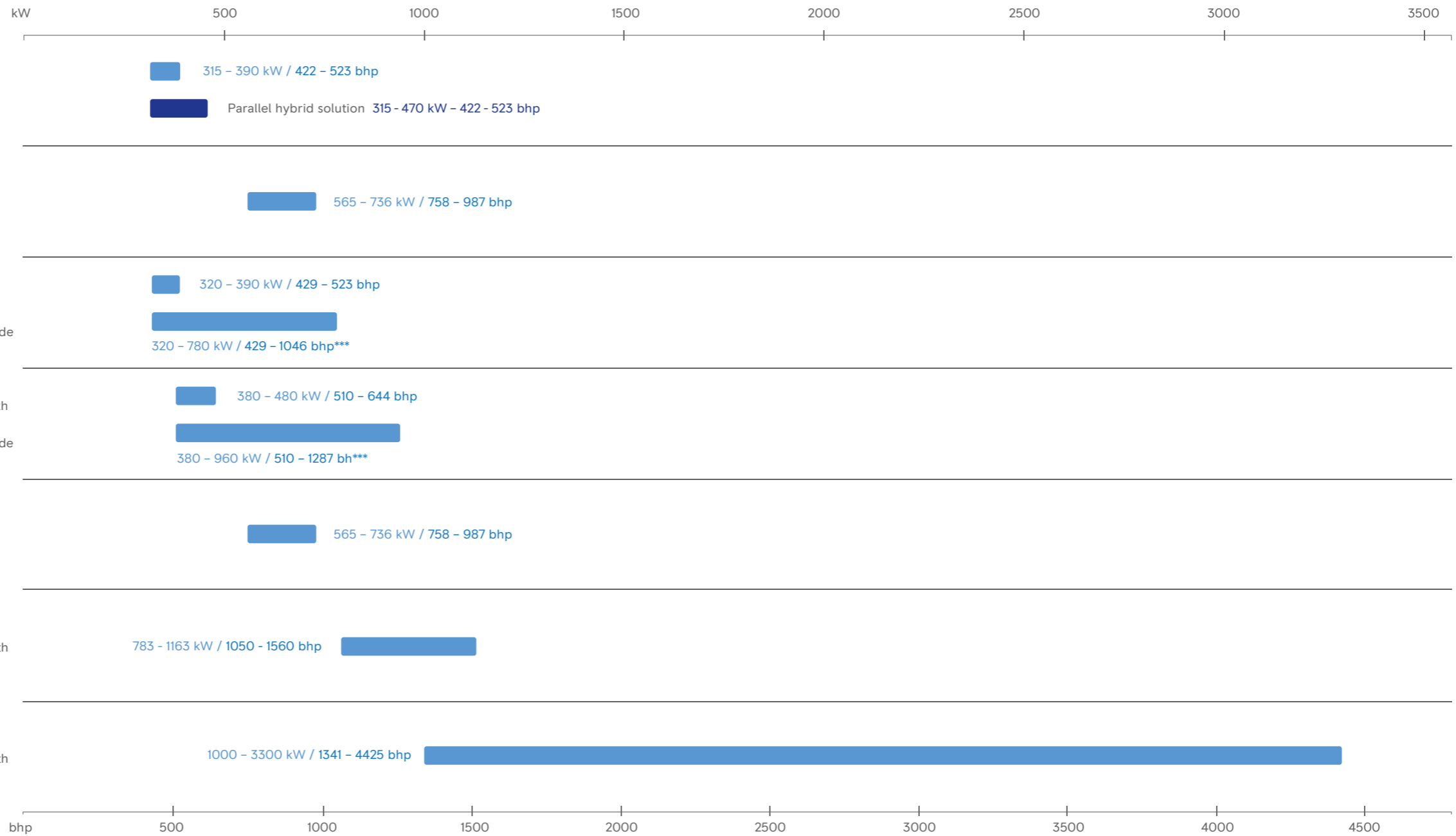
- Simple, single-frame engine and generator installation
- Perfect system component integration based on:
  - Complete torsional vibration analysis for the entire system
  - Calculation of vibration impact on locomotive performance
  - Optimized engine and generator alignment

- Excellent efficiency through common rail fuel injection and advanced engine control
- Superb emissions values: eliminates over 90% of particulates
- Development, commissioning and service warranty all handled by one source



Performance overview

# ENGINES AND POWERPACKS



\* Engines for industrial applications with EU Stage V/Tier 4 certification  
 \*\* For rail specific usage please contact your local partner.  
 \*\*\* Available as single- and dual-engine PowerPack

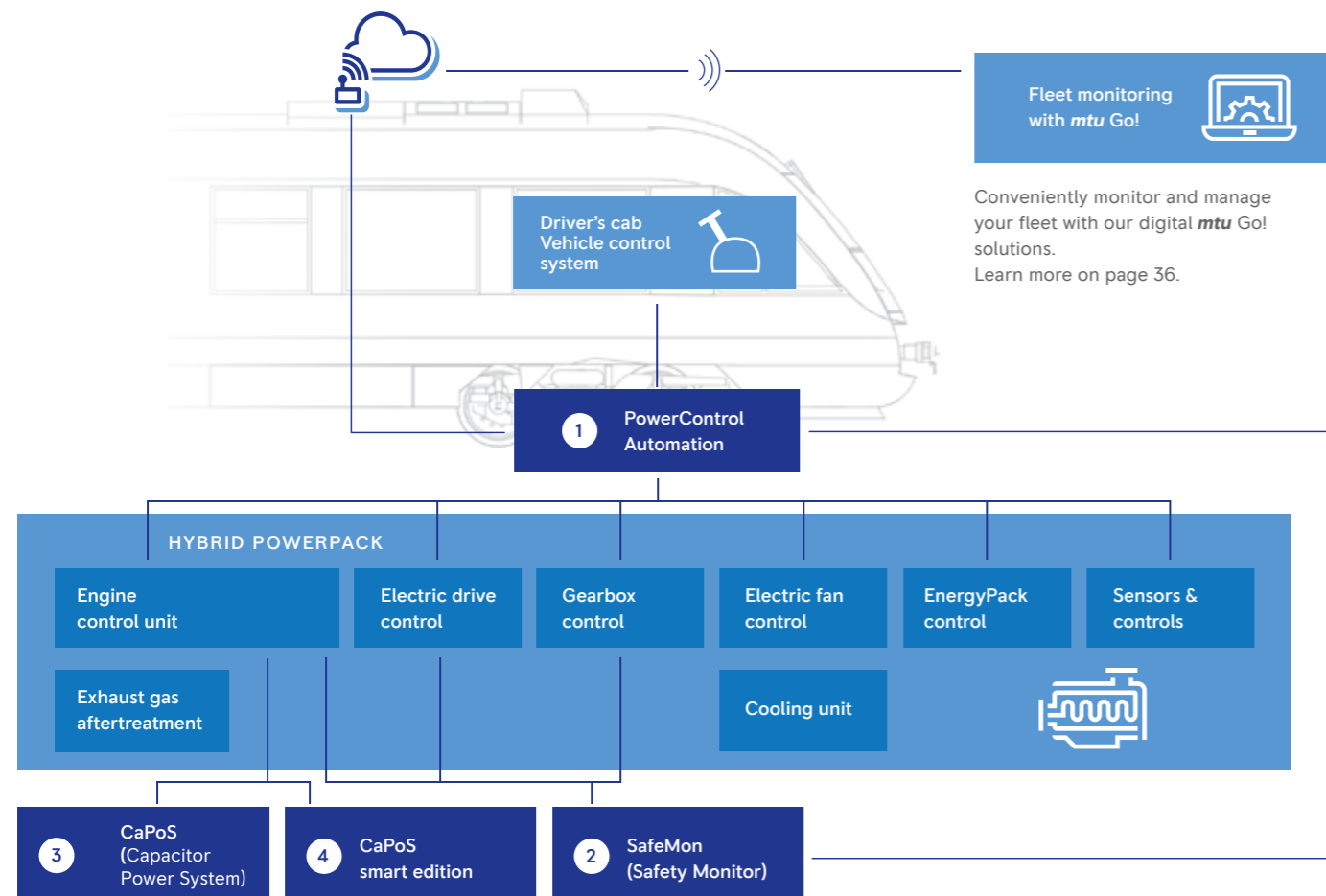
Automation solutions

# OPTIMAL DRIVE SYSTEM CONTROL.

# 04

Serving as the operational brain, the PowerControl Automation system monitors and controls the drive system, its components. The main function is to control the power distribution within the drive system and provide the demanded power to the rail vehicle.

PowerControl Automation continually monitors the entire drive system, ensuring maximum drive power availability while optimizing performance efficiency, fuel consumption and emissions reduction – for all types of railcars and in all types of climatic environments.



Fleet monitoring with *mtu Go!*

Conveniently monitor and manage your fleet with our digital *mtu Go!* solutions. Learn more on page 36.

# ENHANCED AUTOMATION FUNCTIONS.

Designed as a modular platform that easily integrates with wide-ranging rail drive control systems, PowerControl Automation functions can be further enhanced with the optional systems SafeMon, CaPoS and CaPoS smart edition.

**SafeMon**

The SIL-certified safety monitoring unit SafeMon reliably screens all safety-relevant engine, electric drive and gearbox control functions, immediately activating a shutdown, if necessary.

**CaPoS**

Innovatively optimizing cold start-up behaviour, the capacitor power system CaPoS marks a great improvement over conventional starter batteries.

**CaPoS smart edition**

Featuring an integrated starter with 24V onboard, the CaPoS smart edition is ideal for the heavy duty start-up tasks of Series 1600, 1800 and 4000 engines.

Implemented safety functions

- |                                  |   |  |   |                                      |
|----------------------------------|---|--|---|--------------------------------------|
| SIL 1                            | ➤ | SIL 2  | ➤ | SIL 3                                |
| – Avoidance of unwanted traction |   | – Safe shutdown of the PowerPack, if required (Emergency stop) |   | – Safe disconnection of the traction |
| – Protection against overspeeds  |   | – Safe uncoupling  |   |                                      |

Automation system	1 PowerControl Automation	2 SafeMon (Safety Monitor)	3 CaPoS (capacitor power system)	4 CaPoS smart edition
Descriptions	Lets you digitally monitor and maximize the performance and safety of your entire fleet.	Optimizes operational safety by reliably monitoring and controlling all safety-related functions.	Innovatively optimizes cold start-up behaviour, replacing conventional starter batteries.	Capacitor power system designed specifically for heavy duty tasks such as 24V DC starting sequences.
Advantages at a glance	<ul style="list-style-type: none"> <li>– Complete, high-connectivity automation control solution</li> <li>– Easy to integrate and scalable for wide-ranging applications</li> <li>– For new rolling stock and repowering</li> <li>– Monitors all critical operational functions of the entire PowerPack</li> </ul>	<ul style="list-style-type: none"> <li>– SIL-certified safety unit</li> <li>– Documents all safety-relevant operational procedures</li> <li>– Simplifies safety approval process</li> </ul>	<ul style="list-style-type: none"> <li>– Optimized cold-starting properties</li> <li>– Autonomous, modular and maintenance-free design</li> <li>– Low lifecycle costs</li> <li>– Electrical system voltage: 16V DC – 154V DC</li> <li>– CAN interface</li> </ul>	<ul style="list-style-type: none"> <li>– Stand-alone component with integral charger</li> <li>– Optimized cold-starting capabilities</li> <li>– Autonomous, modular and maintenance-free design</li> <li>– Low lifecycle costs</li> <li>– 24V DC onboard voltage</li> <li>– Integrated DC-/DC converter for automatic recharging</li> <li>– IP66 protection</li> </ul>

Available for rail engines and PowerPacks: Series 1600, 1800 & 4000

Green technologies

ENGINEERING TODAY  
WHAT YOU'LL NEED  
TOMORROW.

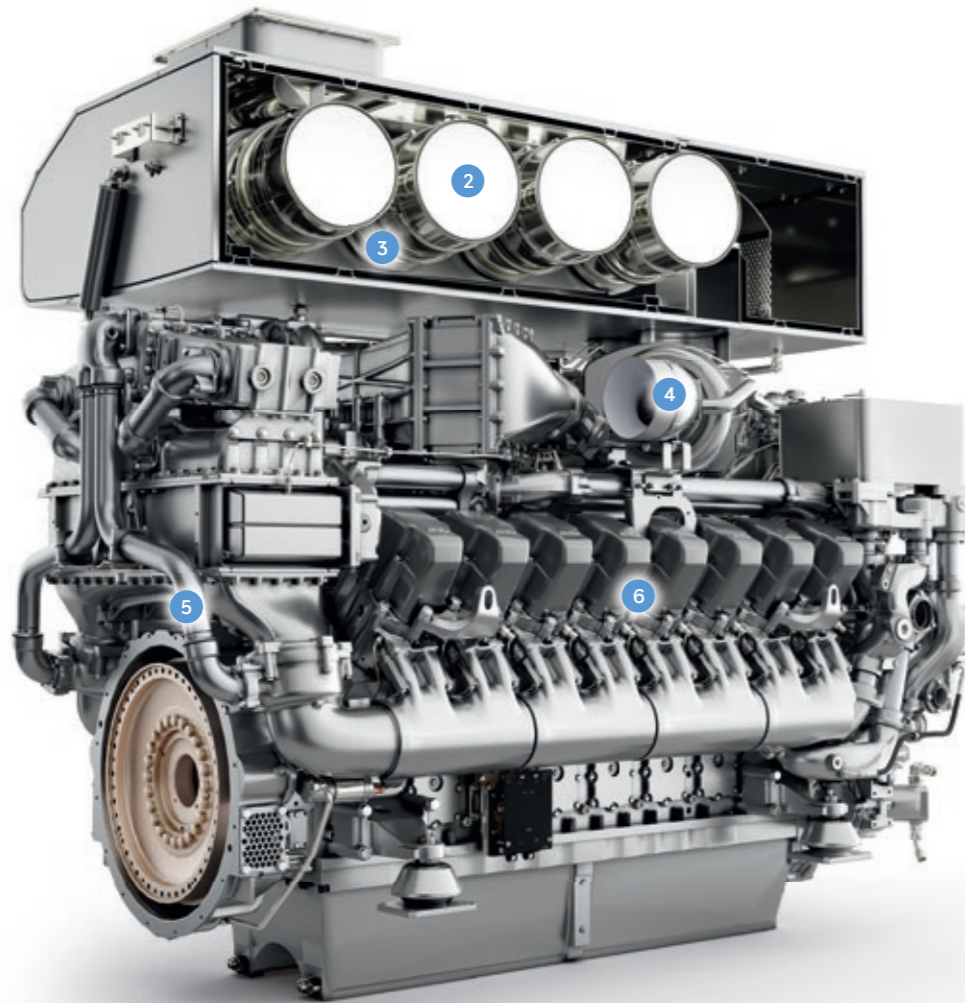
05



## Emission reduction solutions

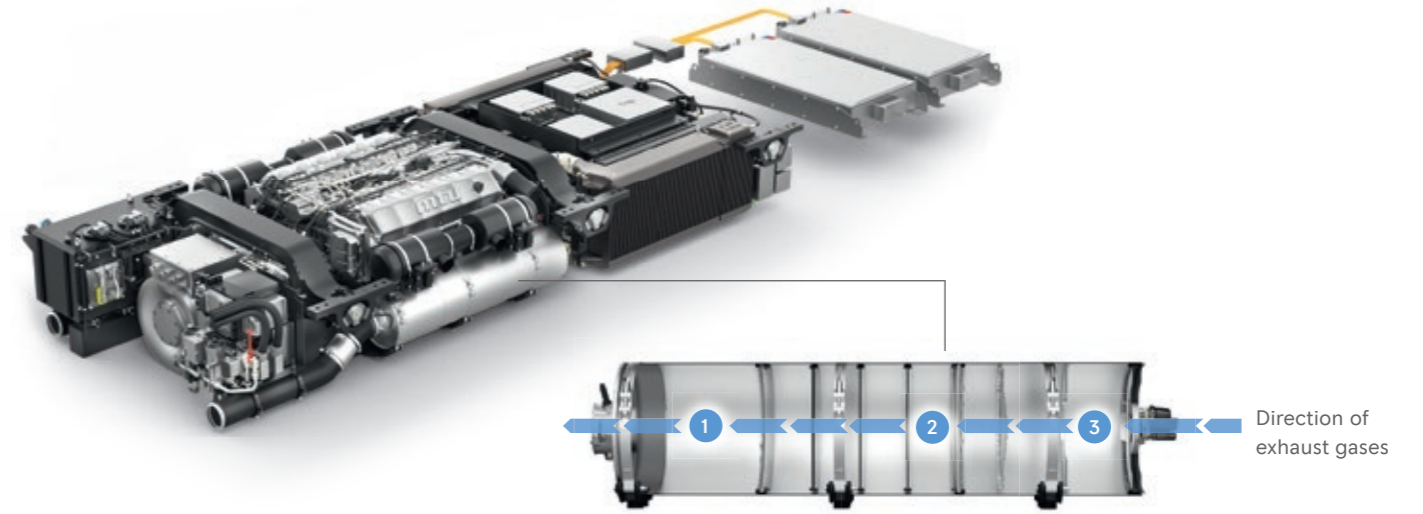
## CLEAN EFFICIENCY.

Our advanced emission reduction solutions combine key technologies to meet current and future emissions standards as well as reduce fuel consumption. They are designed to ensure smooth system component interaction and clean operational efficiency.



Example based on the Series 4000:  
EU Stage IIIB and V with DPF and DOC.  
IIIA w/o aftertreatment.

## KEY GREEN TECHNOLOGIES.



Example based on the PowerPack Series 1600:  
EU Stage IIIB with SCR,  
EU Stage V with SCR plus DPF and DOC

#### 1 Selective catalytic reduction (SCR)

Our SCR solution removes up to 90 percent of nitrogen oxide from exhaust gas. A closed-loop control system prevents ammonia slip during operation. Its fuel and space-efficient design is also very maintenance friendly.

#### 2 Diesel particulate filter (DPF)

Our diesel particulate filters reduce soot emissions to levels that, in some cases, are well below statutory limits.

#### 3 Diesel oxidation catalyst (DOC)

Easy to install and highly effective in the breakdown of exhaust pollutants – our diesel oxidation catalysts exceed regulatory standards.

#### 4 Two-stage turbocharging

With our two-stage turbocharging, engines achieve high output across a wide speed range and superb fuel efficiency. Their space-saving engine integration offers additional benefits.

#### 5 Exhaust gas recirculation (EGR)

Modern EGR solutions can reduce nitrogen oxide generation within the cylinder by more than 40%. We have designed a highly compact one that integrates all EGR components. It enables the cost-effective upgrade of rail vehicles for compliance with new emissions standards.

#### 6 Common rail injection

Our common rail injection solutions have been enhancing rail engine combustion processes for over 20 years already, making them especially clean and economical.

Emission reduction solutions

# SERIES EMISSIONS CERTIFICATIONS.

\* EU IIIA type approved. Under special preconditions certification available on request.  
 \*\* For rail specific usage please contact your local partner.  
 \*\*\* Engines for industrial applications with EU Stage V/Tier 4 certification

Engine model	Emissions standards						
	Emission optimized w/o certificate	UIC IIIA	EU Stage IIIA compliant	EU Stage IIIB compliant	EU Stage V	EPA Tier 3 compliant	EU Nonroad St V (2016/1628) + EPA Nonroad T4
PowerPacks for roof and underfloor installations							
PowerPack Series 1800			■	■	■	■	
PowerPack Series 1600				■	■		
System solutions and engines for engine room installation							
Series 1300***							■
Series 1500***							■
Series 1600				■	■		
12V/16V 2000**	■						
8V/12V/16V/20V 4000 R43*		■	■				
20V 4000 R63		■	■				
12V/16V 4000 R54						■	
12V/16V 4000 R64/74/84				■	■		



Digital solutions supporting your business

## DELIVERING ACTIONABLE INSIGHTS THROUGH DIGITAL SOLUTIONS

# 06

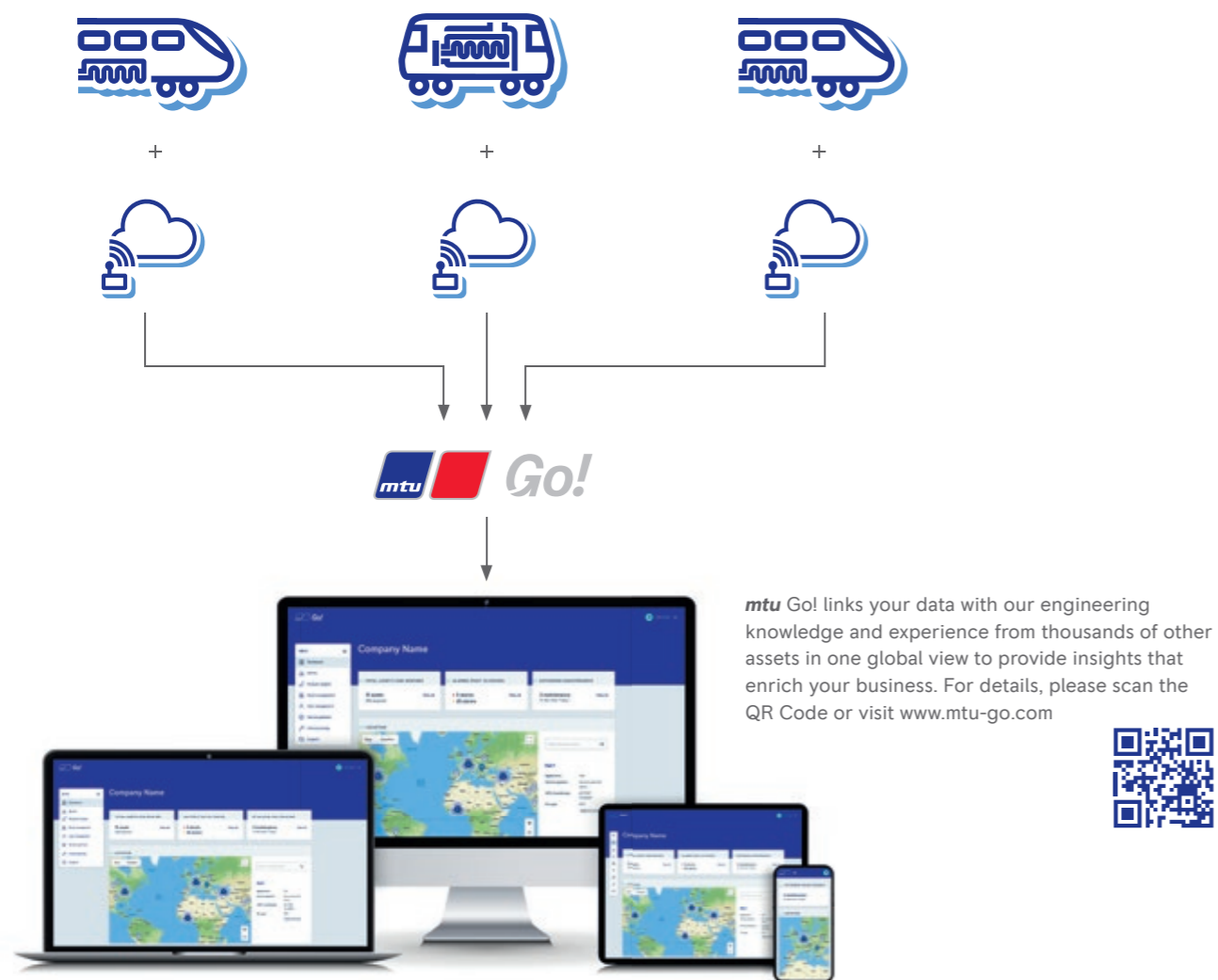
We offer you the best possible equipment service by incorporating digitalization in a holistic service approach. This helps improve our service and helps you operate your equipment more effectively.

Our digital platform **mtu** Go! offers you the opportunity to analyze system data quickly, determine important action steps, and plan them optimally, either independently or together with our service department. Ensure that your business runs smoothly with **mtu** Go! digital service solutions.

Digital rail solutions

# HOW DIGITAL SOLUTIONS OPTIMIZE YOUR RAIL BUSINESS.

Rail applications have great demands on engines and drive systems. Ensuring that propulsions are constantly available for optimum use, means making the right maintenance decisions. Our digital solutions enable you to keep track of operating hours, system alarms and maintenance schedules so you can plan service intervals more effectively.



## Delivering actionable insights through digital solutions



**Connect all your equipment**

**Data collection from your fleet, asset, system and engine**

Connectivity is the basis for all the advantages of digitally supported service. Using our edge software connected to the control unit, you and your service network can monitor relevant deviations from the optimum condition remotely. We offer several ways of collecting data, including the creation of interfaces to already existing data sets. In doing so, we always adhere to the highest data privacy and security standards of our industry.

**Access your data**

- Remote monitoring, available for individual assets, as well as complete fleets worldwide
- Different device and software options ensure optimal connectivity
- Data privacy and security to the highest industry standards



**Monitor your fleet**

**Visualization of data for a quick and accurate overview of your fleet**

With the **mtu Go!** platform, predefined users, such as on-site technicians or managers, can view the system data and perform initial analyses by using diagnostic tools. By accessing the same information, your service network can provide fast support in handling alarms and planning necessary maintenance together with you. Open APIs allow you to interface directly to your existing dashboards or systems.

**Keep track of your data**

- All important data and alarms available at a glance for efficient fleet monitoring
- Intuitive and clear design for easy operation
- Visual comparison of data using the diagnostic tools for initial analyses



**Manage your fleet**

**Digital solutions for your detailed data analysis on necessary actions**

Supported by **mtu Go!** your Service Network is able to analyze all relevant data from your equipment and compare it with data sets from other systems. From this we together can proactively derive recommendations for action.

In future, the analysis can be enriched with additional external data sets, such as environmental influences or time schedules. Cross-linking data will create new opportunities for optimizing business processes.

**Learn from your data (under development)**

- Algorithms for proactive early detection of deviations
- Troubleshooting based on large amounts of data with artificial intelligence
- Comparison with data outside own fleet leads for faster knowledge transfer and optimal service tool for initial analyses



Service

KEEPING YOUR BUSINESS  
RUNNING SMOOTHLY.

07

Remanufactured and repowering solutions

# EXCHANGE AND SAVE.

Factory remanufactured products deliver the same high standards of performance, service life and quality as new products, along with identical warranty coverage – at a fraction of the cost. And with design and model-related updates, they also feature similar technological advancements. Developed by R&D engineers, the remanufacturing process saves you time and money, while benefiting the environment through the reuse of materials. To help you work efficiently, a wide range of remanufactured parts, engines and systems are available worldwide.

**Optimize fuel economy**

As you evaluate your long-term power needs, you must consider a variety of factors. Factory remanufactured products are a smart solution, helping you to reduce the total lifecycle cost of your equipment.

**Maximize uptime**

Factory remanufactured products put your equipment back to work faster than an overhaul, which reduces downtime, service time and indirect costs such as storage.

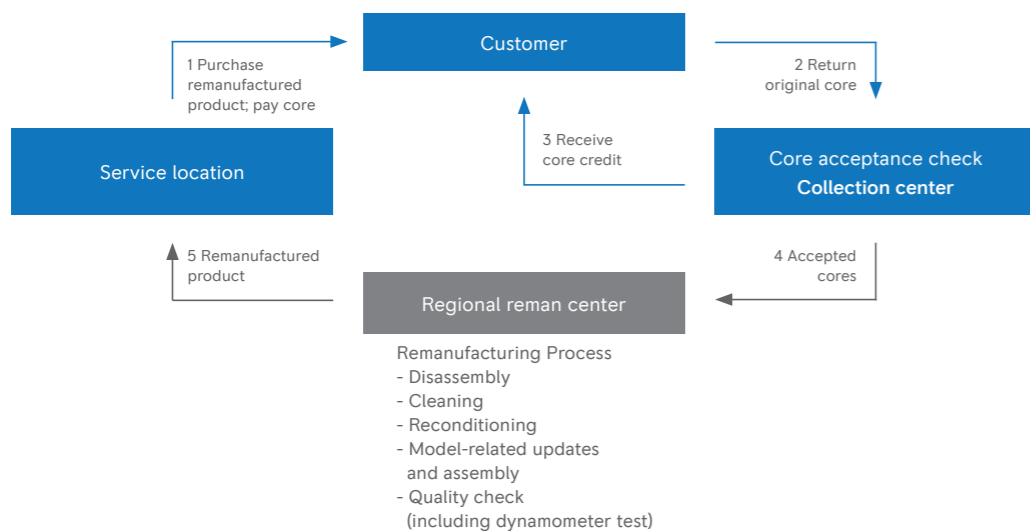
**Avoid the unexpected**

All products are remanufactured to strict to our standards by certified technicians at our regional reman centers can remanufacture our parts, engines or systems to original factory specifications.

**Work with one source**

Since remanufacturing is an efficient use of resources and energy, factory remanufactured products benefit the environment as well.

Exchange Process



- 1 Customer purchases remanufactured product from local service partner and pays the core deposit.
- 2 Customer's original core is returned to collection center by local service partner for core acceptance check.
- 3 Customer receives core credit based on the core's technical condition.
- 4 Accepted cores are sent to regional reman centers, where the remanufacturing process takes place.
- 5 Remanufactured products are delivered to our service partners and made available for purchase.

Repowering solutions

# ECONOMIC ALTERNATIVES.

Reconditioning and repowering solutions for locomotives and railcars offer a tried and tested economic alternative to placing a new order with four positive effects:

- Using a modern diesel engine reduces operating and maintenance costs while maximizing the economic benefits.
- Legally stipulated exhaust gas emission standards are met and noise levels significantly reduced.
- Vehicle availability and reliability are brought up to the level of a new vehicle.
- The cost of investment is considerably lower than a new vehicle.

Following conversion, the reduced operating costs enable many potential savings:

- Reduction in fuel costs.
- Extended maintenance intervals and minimized costs thanks to new maintenance concept.
- Legal requirements are met by proven combustion technology; lower fuel and oil consumption lead to reduced pollutant emissions, thus benefitting the environment.
- Lower investment costs through reduced reserve locomotive stock.
- Limited downtime thanks to high availability and reliability.

As a rail industry partner with extensive experience, we not only repower engines, but also provide a comprehensive package of other support services:

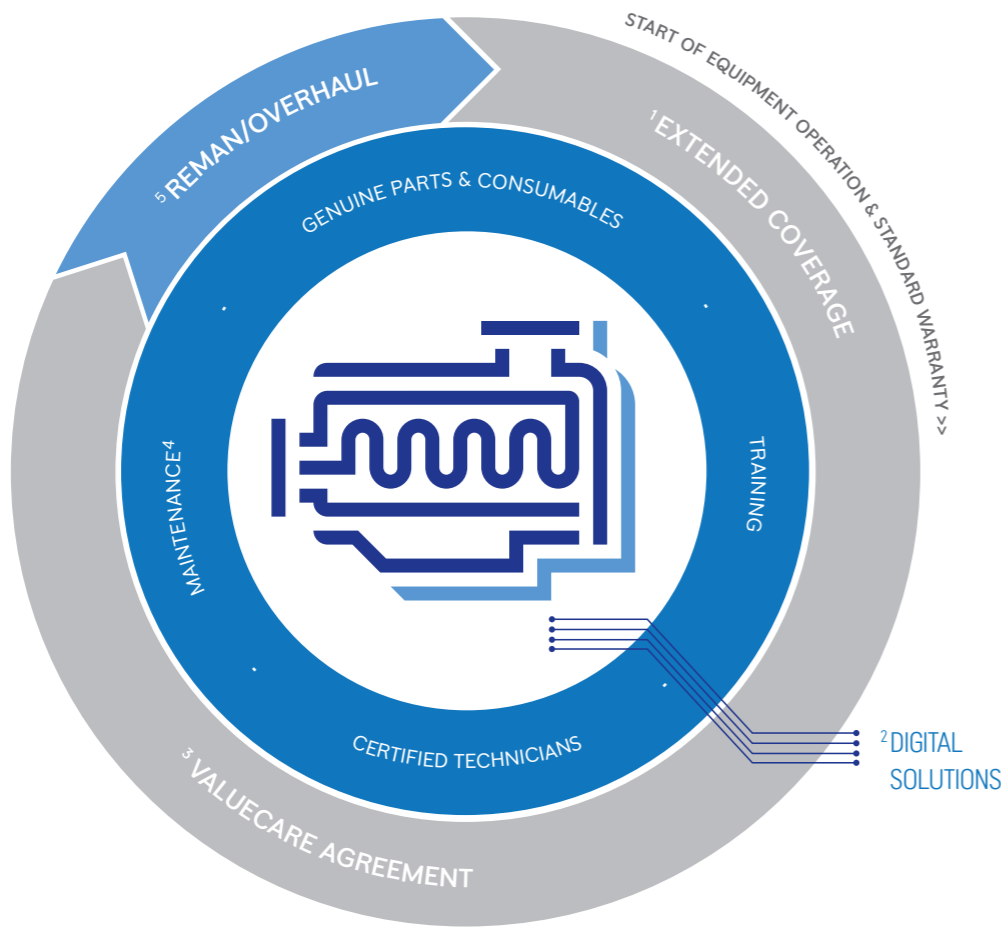
- From the design phase to drive system implementation – active support and professional engineering at all stages of the repowering project.
- Supply of the latest, extensively tested engines and PowerPacks featuring compact designs and excellent power-to-weight ratios enabling easy installation, even of higher outputs without permissible axle loads being exceeded.



Complete lifecycle solutions

# ENSURE A LONG, RELIABLE LIFE.

As your equipment ages, its needs – and yours – change. Our full portfolio of service solutions wrap around your investment, providing 360 degrees of customized support, for optimal value at every stage of life.



- 1 Avoid the unexpected with added protection beyond the standard warranty.
- 2 Make better decisions faster with digitally-enhanced tools.
- 3 Maximize availability and optimize lifecycle costs with a ValueCare Agreement.
- 4 Improve system performance and extend equipment life with on-demand support.
- 5 Keep a good thing going with factory reman/overhaul solutions.

Preventive maintenance

# DON'T LET THE UNKNOWN LEAVE YOU UNPREPARED.

With large investments, lifecycle costs can be significant. It's often the unforeseen costs lurking below the surface – things like fuel consumption, unplanned downtime and repairs – that have the greatest potential to impact your business. That's why it pays to invest in our superior power systems and plan ahead with preventive maintenance. There's no better way to optimize fuel economy, maximize uptime and avoid the unexpected.

**Optimize fuel economy.**

Fuel consumption accounts for up to 90 percent of total lifecycle costs depending on the application—by far one of the most significant costs associated with your equipment. Well-maintained engines deliver industry-leading fuel efficiency, helping you keep fuel costs down over the long term.

**Maximize uptime.**

Preventive maintenance services can be planned around your schedule, so your equipment is available when you need it most.

**Avoid the unexpected.**

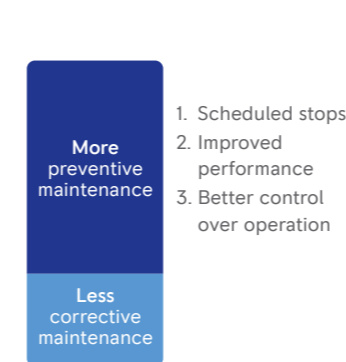
Planned maintenance helps solve problems before they start, helping you avoid unexpected downtime and resolve problems early before they escalate.

**Work with one source.**

We keep maintenance simple, safe and efficient. Our factory-approved methods and expert technicians ensure everything is done correctly according to our proprietary preventive maintenance schedules, optimizing the availability of your equipment, reducing lifecycle costs and helping you avoid unforeseen problems.

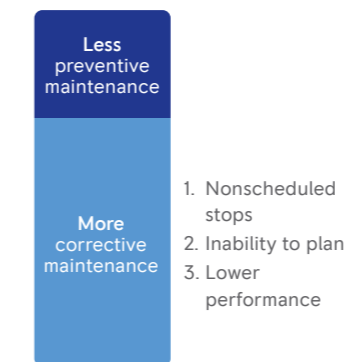
## The importance of preventive maintenance

When preventive maintenance is a high priority.

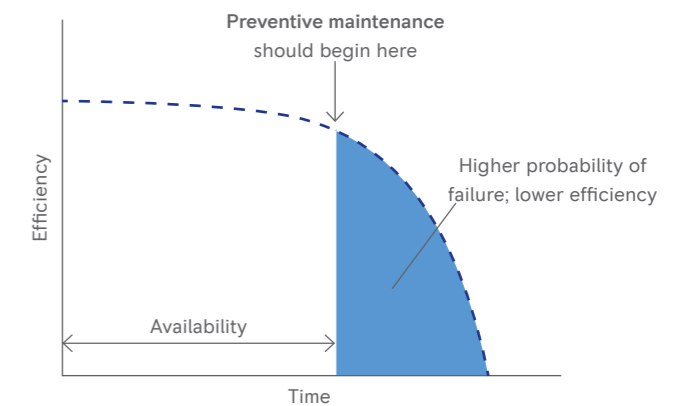


- 1. Scheduled stops
- 2. Improved performance
- 3. Better control over operation

When preventive maintenance is a low priority.



- 1. Nonscheduled stops
- 2. Inability to plan
- 3. Lower performance



We focus on preventive maintenance to reduce the downtime and added costs of corrective maintenance.

Delaying maintenance increases unexpected failures and decreases performance and fuel economy.

ValueCare agreements

# FOCUS ON YOUR OPERATIONS. LEAVE THE REST TO US.

You've got a tough job. With us as your partner, you'll get the power, performance and peace of mind to get it done right. The digitally connected power systems of our ValueCare agreements make it easy to keep your business running smoothly and reduce total cost of ownership by maximizing uptime, optimizing lifecycle costs and helping you avoid equipment-related business disruptions through preventive maintenance.

**Service solutions designed around your priorities**

ValueCare agreements make it easy to optimize lifecycle costs, maximize uptime and devote more time and resources to your core business, with tailored solutions to move your business forward.



Bronze	Silver	Gold
<p><b>Ensure parts availability and price stability</b></p> <ul style="list-style-type: none"> <li>– Digital connectivity (<i>mtu</i> Go! Connect) and access to <i>mtu</i> Go! platform</li> <li>– Automated delivery of parts (preventive) at a predefined rate based on operating hours</li> <li>– Preventive maintenance labor options to fit your business needs</li> <li>– Dedicated support for technical issues</li> <li>– Quarterly reporting of completed and upcoming maintenance and costs</li> <li>– Annual on-site engine health check by our technician</li> </ul>	<p><b>Eliminate unexpected maintenance costs</b></p> <ul style="list-style-type: none"> <li>– Proactive maintenance planning, troubleshooting and remote engine health monitoring</li> <li>– Fixed pricing per operating hour for maintenance and repairs</li> <li>– Key corrective maintenance components always in-stock at our main warehouses</li> <li>– 24/7 standby service with remote technical support</li> <li>– Quarterly reports, including reliability analysis (mean time between failure)</li> </ul> <p style="text-align: center;"><i>Silver also includes all benefits of Bronze level</i></p>	<p><b>Maximize operational uptime</b></p> <ul style="list-style-type: none"> <li>– Operational uptime commitment to meet or exceed your availability targets</li> <li>– Regular supervision by local service partner (e.g. monitoring of parts stock, improvements)</li> <li>– 24/7 emergency assistance with on-site support</li> <li>– Monthly reports, including availability and average repair times</li> <li>– Asset health monitoring</li> <li>– Annual performance meetings and trend analysis with us to address technical updates, engine fleet data, operational optimization and more</li> </ul> <p style="text-align: center;"><i>Gold also includes all benefits of Silver &amp; Bronze levels</i></p>

Service network

# LOCAL SUPPORT. WORLDWIDE.

Whenever and wherever you need expert support, our specialists are available. Our global service network of more than 1,200 locations – backed by our cutting-edge parts logistics centers – provides you this assurance. To find your local distributor, visit [www.mtu-solutions.com](http://www.mtu-solutions.com).

**Local support. Worldwide.**

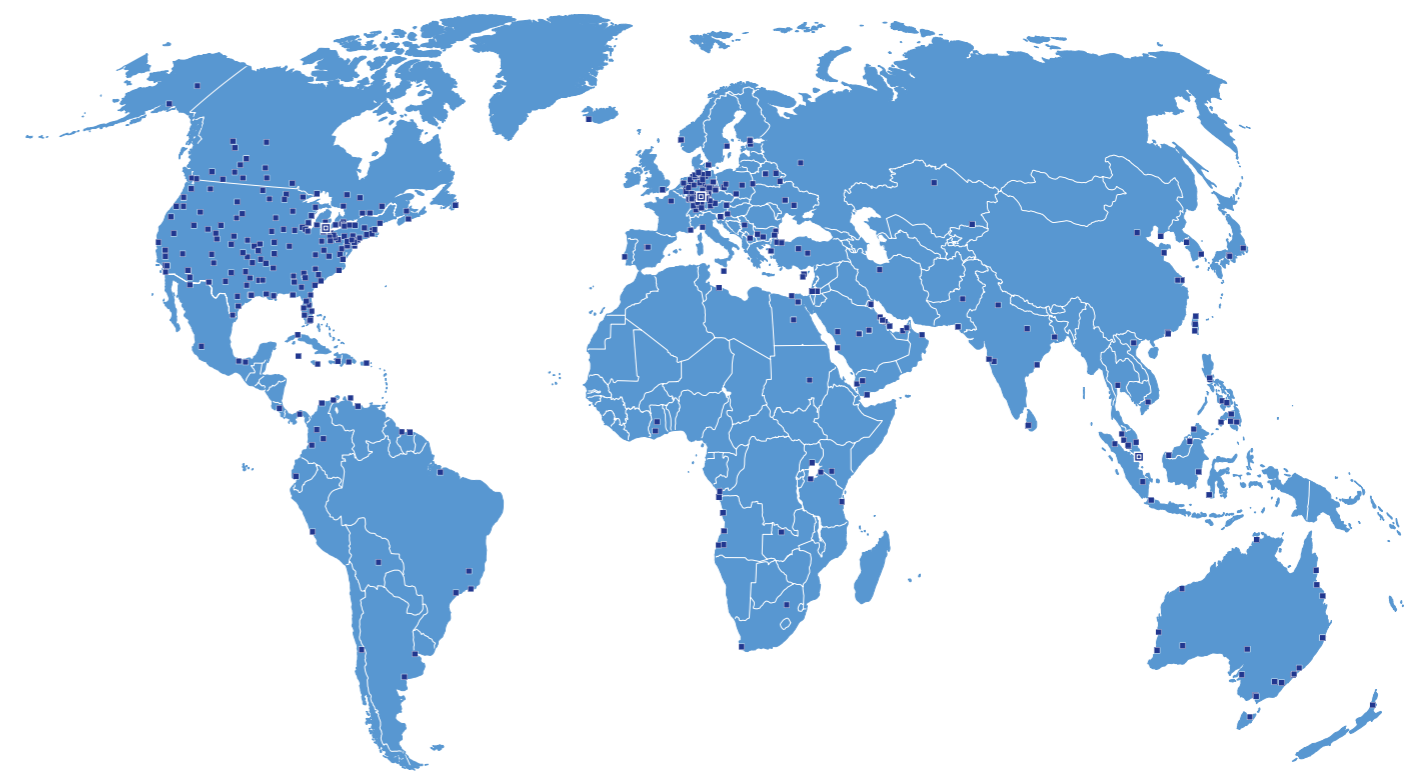
We ensure that you receive individualized support from our global network of more than 1,200 service centers—anywhere, anytime. Local support. Worldwide.

**Always on call, 24/7**

Whether it's connecting you with a local service partner or assigning an urgent problem to a dedicated team of our experts, we're ready to assist you – wherever you are, whatever you need.

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