

Power Generation | Series 4000 gas generator set | 776-2,535 kWe

ECONOMICAL, SUSTAINABLE,
RELIABLE, FLEXIBLE.



A Rolls-Royce
solution

The next generation

mtu SERIES 4000
NATURAL GAS**Operational flexibility**

- Quick ramp-up and ramp-down plus a wide range of partial load operation make this product a perfect match for grid stabilization applications.
- Fulfills the highest emission standards.

Low lifecycle costs

- Good serviceability
- Favorable maintenance intervals
- Reduced oil consumption
- No additional exchange of cylinder heads necessary before major overhaul (TBO)
- 84,000 operating hours before major overhaul (TBO)

30% more power

- The new genset increases its performance by 30%, withstanding hot and humid conditions.
- Highly robust against derating

Up to 44.4% el. efficiency

- An advanced, proven **mtu** Series 4000 engine optimized for natural gas operation. Its combustion chambers ensure top levels of efficiency in its performance category.

Digitally connected

The system is equipped with a data logger providing access to digital mtu solutions, including remote monitoring, fast and reliable service support and – coming soon – further features such as predictive failure prevention and operational optimization.

Ignition system

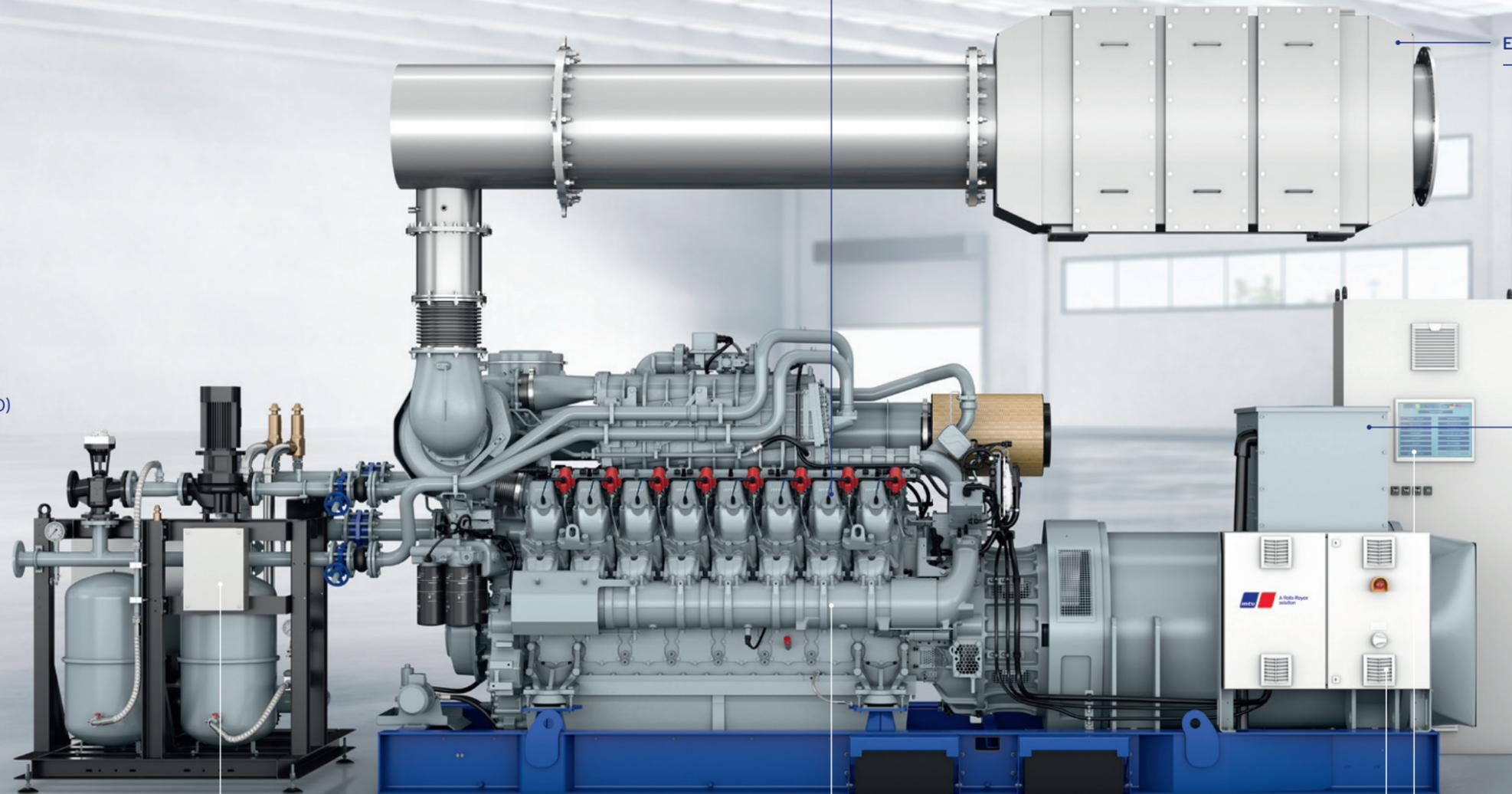
- Ignition systems for individual cylinders allow for the most efficient level of operation for all cylinders, even with variable CH₄ content. The ignition voltage display gives customers information on the state of the spark plugs.

**FAST START
CAPABILITY**FROM 0 TO
100% LOAD IN LESS
THAN 120 SECONDS**EGAT system**

- Exhaust gas aftertreatment system developed in-house and perfectly matched to the engines, for optimized and more efficient operation with maximum performance. The EGAT system can be flexibly integrated into different existing plants.

Generator

- Perfectly tuned to the engine and made by renowned manufacturers, the generator ensures a high level of reliability and optimal efficiency.

**Heat recovery unit**

- Well proven design perfectly suits the genset and provides the basis for optimized auxiliary efficiencies. The unit is fully integrated in the automation concept and is both safe and certified (CE).

Knock detection

- Cylinder-specific knock detection and regulation protect the engine from abnormal operating conditions, and guarantee safe operation even with natural gas containing low levels of methane.

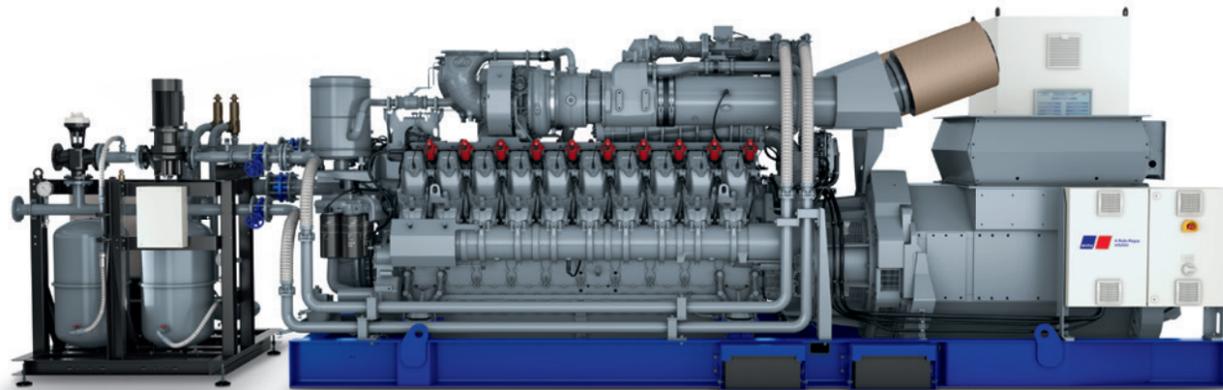
Automation systems MIP & MMC

- Motor interface panel (MIP) with stand-alone **mtu** Module Control (MMC). The MMC provides all the functions necessary for controlling the system. All the auxiliary drives required for the CHP system can be operated from here. The integrated power circuitry minimizes the customer's need for cabling on site.



MORE THAN 20 YEARS OF TOP PERFORMANCE

The new natural gas genset offers the highest power density and the highest kilowatt-per-square-foot ratio in its class. Its smaller footprint enables a 30% improvement in power density compared to its predecessor. In multi-generator sites, fewer gensets are needed to achieve a given power output. The new natural gas genset also has lower installation costs. The natural gas power genset is based on the successful **mtu** Series 4000, delivers from 776–2,535 kW, and has been optimized for hot and humid environments.



Benefits

Designed for maximum performance

The natural gas genset has an effective engine power of 130 kWm/ cylinder – the highest power density in its class thanks to its compact design and small footprint. It offers superb performance at high temperatures and high humidity for use anywhere in the world and delivers 30% more power than its predecessor.

High efficiency

The natural gas genset achieves efficiencies of up to 44.4%, delivering a significant improvement in fuel/energy utilization at high temperatures.

Reduced lifecycle costs

All natural gas genset components are fine-tuned to ensure long service lives and deliver maximum uptime. Long service intervals and easy-to-maintain components mean low maintenance costs. Fast availability of spare parts and low engine oil consumption also help keep lifecycle costs lower overall, with cylinder head lifetimes potentially equivalent to TBO.

Cleaner and more flexible

A significant reduction in nitrous oxide emissions makes the natural gas genset a perfect fit for independent power producers (IPP) and combined heat and power (CHP) applications. With part-load performance down to 30% and a fast start option, its operational flexibility is also ideal for demand response applications. Low emissions - 250 mg/Nm³, 500mg/Nm³, (@5% O₂)NO_x – are achieved without external aftertreatment, even meeting the new expected German unburned THC emissions legislation (<1300mg@5% O₂).

Configuration		8V	12V	16V	20V
Bore/stroke	mm	170/210	170/210	170/210	170/210
Rated speed	rpm	1,500	1,500	1,500	1,500
Mean piston speed	m/s	10.5	10.5	10.5	10.5
Length	mm	4,200	5,000	5,500	6,600
Width	mm	2,000	2,000	2,000	2,000
Height	mm	2,300	2,300	2,300	2,400
Dry weight	kg	11,000	14,000	17,000	21,000

Performance/efficiency (standard conditions)

Configuration (50Hz)		8V		12V		16V		20V	
Genset type		mtu 8V4000 GS		mtu 12V4000 GS		mtu 16V4000 GS		mtu 20V4000 GS	
Engine type		L64	L64 FNER	L64	L64 FNER	L64	L64 FNER	L64	L64 FNER
Output									
Electrical output ¹	kW	1,012	1,013	1,523	1,521	2,028	2,028	2,530	2,538
Thermal output									
Engine heat ²	kW	475	530	712	788	965	1,060	1,200	1,441
Exhaust heat (at 120°C) ³	kW	461	494	691	742	936	995	1,147	1,243
Low temperature (43°C) ⁴	kW	69	59	104	115	127	145	175	150
Input									
Energy input	kW	2,298	2,287	3,438	3,443	4,574	4,583	5,748	5,781
Efficiency									
Electrical efficiency ⁵	%	44	44	44.3	44.2	44.3	44.3	44.1	43.9
Fuel energy utilization	%	84.8	89.0	85.1	88.6	85.9	89.0	84.8	90.3

Configuration (60Hz)		8V		12V		16V		20V	
Genset type		mtu 8V4000 GS		mtu 12V4000 GS		mtu 16V4000 GS		mtu 20V4000 GS	
Engine type		L64 FNER		L64 FNER		L64 FNER		L64 FNER	
Output									
Electrical output ¹	kW	997		1,506		2,012		2,521	
Thermal output									
Engine heat ²	kW	540		800		1,072		1,368	
Exhaust heat (at 120°C) ³	kW	494		742		995		1,236	
Low temperature (43°C) ⁴	kW	69		115		145		211	
Input									
Energy input	kW	2,287		3,456		4,583		5,781	
Efficiency									
Electrical efficiency ⁵	%	43.6		43.6		43.9		43.6	
Fuel energy utilization	%	88.8		88.2		89.0		88.7	



Performance/efficiency (hot & humid conditions)

Configuration (50Hz)		8V		12V		16V		20V	
Genset type		mtu 8V4000 GS		mtu 12V4000 GS		mtu 16V4000 GS		mtu 20V4000 GS	
Engine type		L64 FNER		L64 FNER		L64 FNER		L64 FNER	
Output									
Electrical output ¹	kW	1,013		1,521		2,028		2,535	
Thermal output									
Engine heat ²	kW	604		849		1,173		1,441	
Exhaust heat (at 120°C) ³	kW	480		717		974		1,243	
Low temperature (58°C) ⁴	kW	51		79		93		150	
Input									
Energy input	kW	2,329		3,428		4,622		5,781	
Efficiency									
Electrical efficiency ⁵	%	43.5		44.4		43.9		43.9	
Total efficiency	%	90.0		90.1		90.2		90.3	

Configuration (60Hz)		8V		12V		16V		20V	
Genset type		mtu 8V4000 GS		mtu 12V4000 GS		mtu 16V4000 GS		mtu 20V4000 GS	
Engine type		L64 FNER		L64 FNER		L64 FNER		L64 FNER	
Output									
Electrical output ¹	kW	997		1,506		2,012		2,521	
Thermal output									
Engine heat ²	kW	614		861		1,185		1,454	
Exhaust heat (at 120°C) ³	kW	480		717		974		1,243	
Low temperature (58°C) ⁴	kW	51		79		93		150	
Input									
Energy input	kW	2,329		3,428		4,622		5,781	
Efficiency									
Electrical efficiency ⁵	%	42.8		43.9		43.5		43.6	
Total efficiency	%	89.8		90.0		90.2		90.3	

NOx < 500 mg/Nm³ at 5% O₂ dry
All data refers to maximum load.

- 1) cos-phi = 1.0
- 2) Heat output from engine cooling with tolerance of ± 8%
- 3) Heat output from exhaust (exhaust cooling to 120°C) with tolerance of ± 8%
- 4) Inlet temperature
- 5) Methan number: 72 (standard) or 80 (hot&humid)

Any specifications, descriptions, values, data or other information related to dimensions, power or other technical performance criteria of the goods as provided in this general product information are to be understood as non-binding and may be subject to further changes such as but not limited to technical evolution at any time.

GAS POWER CASE STUDIES

Greenhouse/roses

A CHP plant with a **mtu** engine has been generating electric power and heat to ensure that the roses in the greenhouses of the family-run Wimceco Rose Nursery grow and thrive throughout the year. Greenhouse operator Van Nuffelen says, "We place great value on environmentally friendly and energy-efficient production."

The combined heat and power plant is based on a **mtu** high-speed 12V 4000 L64 gas-powered engine. With an electrical output of 1,523kWe and a thermal output of 1,912kW, it achieves a total efficiency level of 99.9%. The electric power is used primarily for the greenhouse lamps and, if required, is fed into the public grid. The greenhouses, which cover an area of 1.75 hectares, are heated using the heat extracted from the exhaust gas and the engine's cooling system. In addition, the cleaned exhaust gases from the engines are injected into the greenhouses to increase the level of CO₂ and boost plant growth.

Who: Wimceco Rose Nursery

*What: Combined heat and power plant based on a **mtu** high-speed 12V 4000 L64 gas-powered engine.*

Where: Boechout, Belgium



Trigeneration for industry/lighting

Osram is one of the world's leading lighting manufacturers. Its Eichstätt facility plays a major role in halogen lamp production. Apart from halogen lamps for normal lighting in buildings, Eichstätt also supplies car lamps and xenon short-arc lamps for use in cinemas.

A **mtu** trigeneration gas genset has been in service at the Osram plant in Eichstätt since January 2015. The system boasts low emissions and high efficiency and keeps the lighting manufacturer supplied with electrical power, heat and cooling.

The new plant does more than the conventional cogeneration module for combined heat and power (CHP). In winter, it provides heat for the production halls and in summer cools the machine control and laser systems with its absorption refrigerator. Generating cooling power in times of low heat demand enhances the capacity utilization of the plant.

Who: Osram halogen lamp production

*What: Trigeneration module based on a 16V Series 4000 L64 **mtu** engine delivering 1999 kW of electrical power and around 1900 kW of heat.*

Where: Eichstätt, Germany



READY TO GO: CONTAINERIZED SOLUTIONS



1

As a system supplier, we offer a wide variety of solutions. As well as our gas engine systems for use in buildings, we also provide containerized turnkey units. Compact, complete, flexible and autonomous, they are ideally suitable for mobile power generation or for applications that do not offer enough space to accommodate a complete gas engine system. When producing power from natural gas, installing the generator set in a container can be a useful alternative to the more common option of permanently installing a static system in a generator room. Our standardized container generator set is designed to meet the requirements of a variety of applications.

The container includes:

- The generator set
- The switchgear including control and monitoring system
- All necessary connection and supply systems (ventilation, lubricant supply, heat recovery, etc.)

Like all power generation systems, the standard container gensets are capable of fully automatic and continuous operation.

We offer two types of containers:

- Power containers generate electrical power only and are ideal for remote locations or areas with unreliable power supplies. They are often deployed in power stations.
- Combined heat and power units (CHP) generate electricity and thermal energy, for example for operators whose processes require both heat and power.

Advantages of container units:

- Technically mature, proven and eco-friendly gas engine technology for maximum efficiency and reliability
- Completely autonomous overall design that does not require an additional building
- Flexible unit assembly system based on standardized modules and synchronized components
- Readily available, compact turnkey plug & play solutions
- Optimum support thanks to a worldwide service network
- Quality certified to ISO 9001 and DIN EN ISO 14001

1 CHP/CCHP-container

2 Power-container



2

MODULE CONTROL: SYSTEM MONITORING – ANYTIME

We supply you with the complete system engineering package for your installation. One of the most important aspects is the control system technology. If the generator set is the heart of the system, then the module controller (MMC) is its brain. Our industrial-computer-controlled and reliable electronics monitor the engine and the overall system to ensure optimum operation.

The most important features are:

- Drive and control via PLC (programmable logic controller)
- Operation and visual display by means of industrial PC and touch-screen panel with color display
- Visual display of all functional processes and controls
- Numerous additional controls and functions can be integrated (CH₄, gas tank, heat production mode, heat storage, main power usage)
- Networking of multi-module systems via Ethernet
- Ability to be linked with master control system
- Wide choice of interface protocols (Ethernet, Profibus DP, Modbus RTU, Modbus TCP/IP, Profinet)
- Logging of all fault and status messages in a database (up to six months of data can be recorded)
- Optional remote diagnosis via DSL or ISDN
- Optional integration of SMS/E-mail client (notification of faults, daily reporting of all meter readings)

1 Module controller (MMC)



CHP PROJECT PLANNING: INDIVIDUAL ADVICE FOR INDIVIDUAL SOLUTIONS

Our support for your individual CHP system

Choosing of the appropriate CHP system for your demands depends on various factors. That's why we offer you comprehensive support, all the way from the project conception to implementation.

- Help with planning your new CHP module
- Expertise to help you incorporate the CHP module into your application
- Explanations of the technology behind the engine, system and individual components
- Complete proposal with budget price for planning stage and fixed price for implementation
- Design and planning of peripheral systems
- Advice on service solutions during the project stage
- Help with questions on legal situations (EEG, formaldehyde bonus)



New requirements - Our solution

mtu EXHAUST GAS AFTERTREATMENT SYSTEM FOR REDUCED EMISSIONS

From a single source: with the **mtu** EGAT system we present the exhaust aftertreatment solution for gas systems of the **mtu** Series 4000 with a power range from 776 to 2,535 kWe (50Hz) or 762 to 2,521 kWe (60Hz).

Exhaust gas aftertreatment and measurement according to 44. BImSchV

The 44th BImSchV (German ordinance on the Implementation of the Federal Immission Protection Law) has been in force since 2019. According to this regulation, medium-sized combustion plants must be equipped with a suitable exhaust gas aftertreatment system as of 2023. The **mtu** EGAT system is our answer to the demands for stricter emission limits and more stringent requirements such as shortened measurement intervals or the obligation to provide evidence, documentation and reports.

Perfect interaction for higher efficiency

To ensure that your **mtu** gas systems are as cost-efficient, trouble-free and low emissions as possible, we offer an in-house developed exhaust gas aftertreatment system (EGAT), which is optimally adapted to the engines. As a reliable partner, we analyze the respective requirements, installation conditions, necessary installation space, and accessibility for operation and maintenance. We supervise the implementation up to commissioning - and are also happy to ensure a smooth life cycle for the entire system.

Benefits:

-  Perfectly tailored exhaust gas after treatment system from a single source
-  Guaranteed spares and service availability (**mtu** proprietary equipment / developed in-house)
-  Remote maintenance through digital tools accelerates troubleshooting to get you back up and running if need be
-  Comprehensive solutions satisfying all regulations and documentation requirements (Federal Emission Control Ordinance (44. BImSchV)) by integrating in existing MMC systems
-  Airless system eliminates the need for costly compressors
-  Durable construction minimizes operating costs
-  Expert planning, engineering, installation and implementation.
-  **mtu** support with full-service maintenance contracts
-  High SCR conversion rates (up to 90%) optimize engine operation and boost efficiency
-  Our versatile EGAT system can be integrated in all manner of existing installations
-  Low exhaust back pressure design enables continued unrestricted engine operation at maximum power

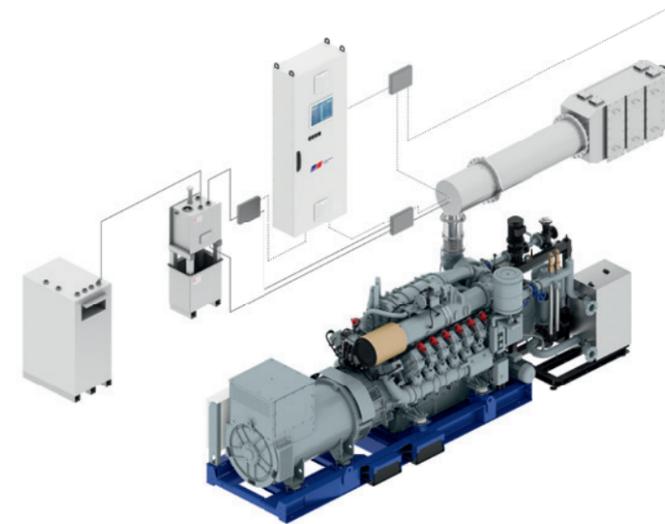
mtu EGAT system: The components

The **mtu** EGAT system enables compliance with the emission levels below for typically tuned **mtu** engines up to 21,000 hours of operation. An SCR catalyst and a downstream oxidation catalyst are

Nitrogen oxides	NOx	100	mg/Nm ³ @ 5 % O ₂ , dry
Carbon monoxide	CO	250	mg/Nm ³ @ 5 % O ₂ , dry
Formaldehyd	HCHO	20	mg/Nm ³ @ 5 % O ₂ , dry
Ammoniak	NH ₃	10	mg/Nm ³ @ 5 % O ₂ , dry

used in the system. The lifetime of both catalyst elements is up to 21,000 operating hours at 90% conversion rate.

The power ranges valid for these values can be found in the engine description, as well as further data in the technical data sheet of the genset and the corresponding EGAT data sheet.



SCR - Selective Catalytic Reduction

The chemical reaction that converts harmful nitrogen oxides (NOx) within exhaust gas into water (H₂O) and nitrogen (N₂).

Oxidation catalyst

The oxidation catalyst downstream of the SCR catalyst is responsible for the oxidation of carbon monoxide (CO) and formaldehyde (HCHO).

EGAT control system

Control and regulation functions of the EGAT system, such as pump control, reducing agent metering and monitoring, are performed by the MMC system control. This also takes over the NOx logging with daily averaging required by the 44th BImSchV. The EGAT system does not require a separate control system but can be integrated into the existing MMC control system and benefit from its advantages such as remote control, data logging, error detection, alarm logging, visualization and digital interfaces.

These components are included:

- Catalyst housing
- RM mixer
- Reducing agent system and sensors
- Day tank

mtu EGAT system: Our all-round service

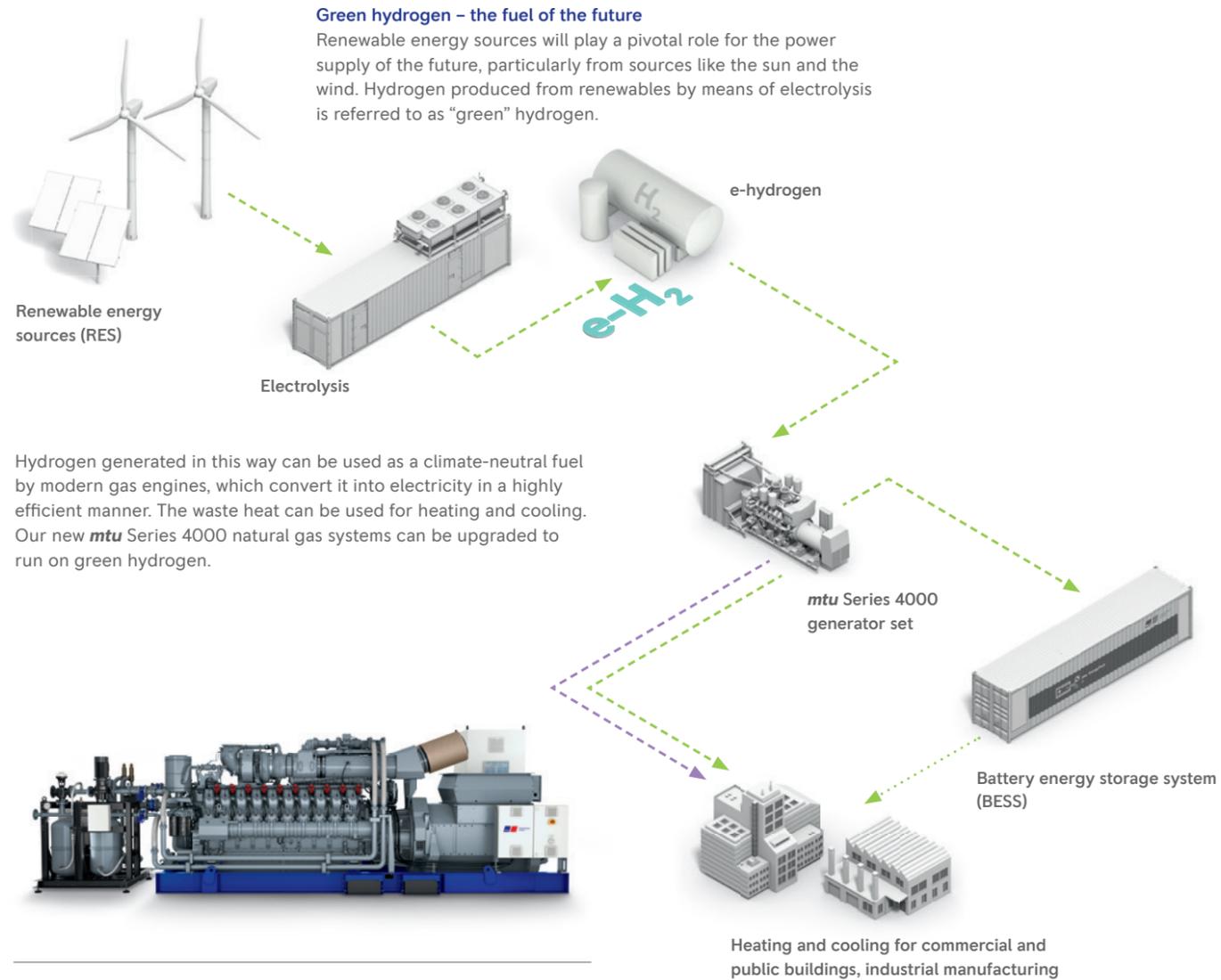
We always want to ensure the highest possible availability. To this end, scheduled preventive maintenance of the EGAT system is aligned with system and genset maintenance tasks. This allows for synergetic effects to be realized and thus for the number and cost of service calls to be kept to a minimum. The existing remote maintenance access from Rolls-Royce enables rapid fault analysis and restart of the EGAT if required.



Decarbonized solutions

BE READY FOR CARBON-FREE ENERGY.

Hydrogen, which can be produced from diverse renewable resources, offers the potential for an energy future with near-zero greenhouse gas emissions. Hydrogen can be used to generate clean electricity, with water vapor and warm air as the only discharge, by advanced gas gensets like our **mtu** Series 4000.



Hydrogen generated in this way can be used as a climate-neutral fuel by modern gas engines, which convert it into electricity in a highly efficient manner. The waste heat can be used for heating and cooling. Our new **mtu** Series 4000 natural gas systems can be upgraded to run on green hydrogen.

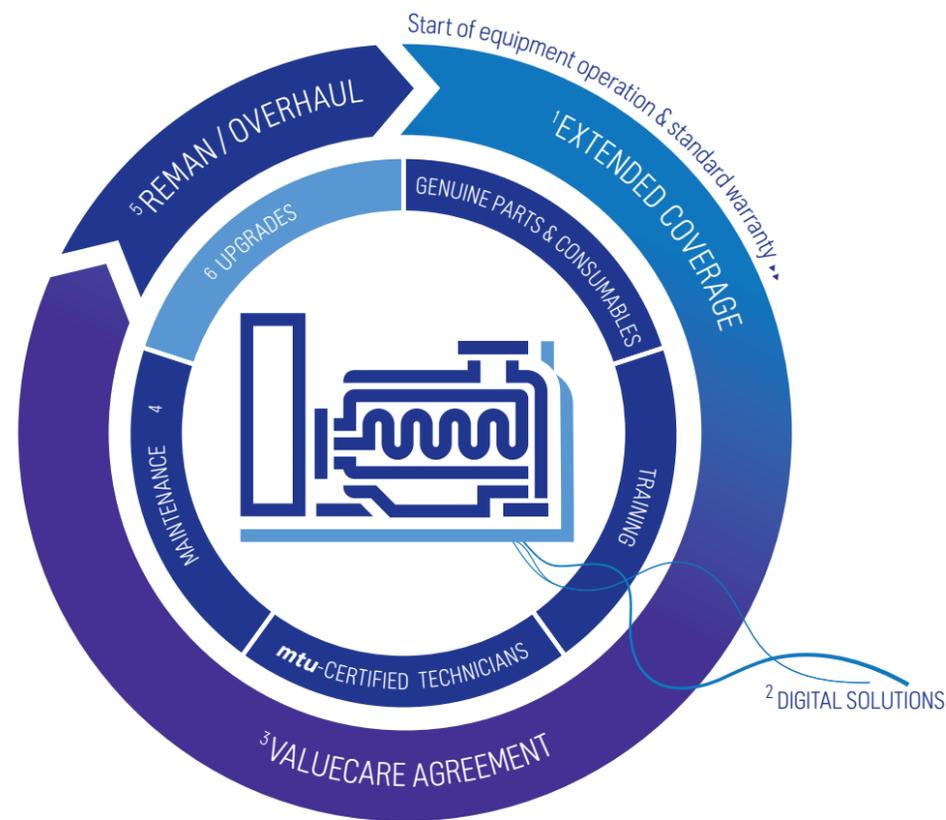
Our new **mtu** Series 4000 natural gas systems can be upgraded to run on green hydrogen.



Service solutions

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. Our digitally-enabled 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.



- 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.
- 6 Maximize the value of your equipment with custom upgrades for changing needs.

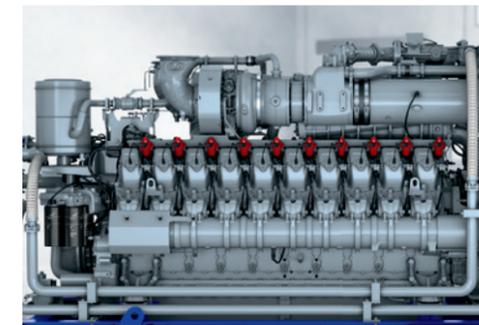
Service solutions designed around your priorities

With tailored solutions to meet your needs, there is a ValueCare Agreement that is just right for you.

	Bronze Ensure parts availability and price stability
	Silver Eliminate unexpected maintenance costs
	Gold Maximize operational uptime

mtu Upgrade Solutions

We know that needs change over time, and that capital investments aren't for the short term. With upgrade solutions designed specifically for your **mtu** systems, you can get the most out of your equipment and extend its useful life.



L33 Efficiency Solution

The L33 Efficiency Solution is designed to extend the life of L61, L62 and L63 **mtu** Series 4000 gas systems. Through a cost-effective, sustainable system overhaul, the existing engine will be manufacturer-certified to the current status of an L33 remanufactured engine, achieving an electrical efficiency gain of about 1.4%. The upgrade also includes an alternator overhaul, new automation system and additional system enhancements. Best of all, it will fit onto the existing L61, L62 or L63 base frame, so no peripheral modifications are required.



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