



JOIN THE JOURNEY TO NET ZERO

Power Generation Symposium | Europe





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Emission reduction

Meeting requirements for today and tomorrow

Dr. Nazari, Behzad; Rolls-Royce Powersystems

Powergen Symposium 2022





Rolls-Royce green & high tech program

Investing in a greener future
500 Mio. EUR over the next 10
years for environmentally
friendly technologies.



Solutions for a **Greener** Tomorrow





Green & high tech

Transformation of our Product Portfolio.



Electrification



Hybrid



Battery



Fuel Cell



Alternative Fuels

Power-to-X



Engine Efficiency



Diesel Engine



Gas Engine

Exhaust Gas Aftertreatment



Digitalisation



Performance
Optimization



Systems Integration

MicroGrid





Agenda

01 **Emissions
Today and tomorrow**

02 **Exhaust Gas Aftertreatment Systems (EGAT)
Customer Key Buying Criteria**

03 ***mtu* EGAT Technology**

04 ***mtu* EGAT Solutions**



01

Emissions

Today & tomorrow

Stationary emission legislation

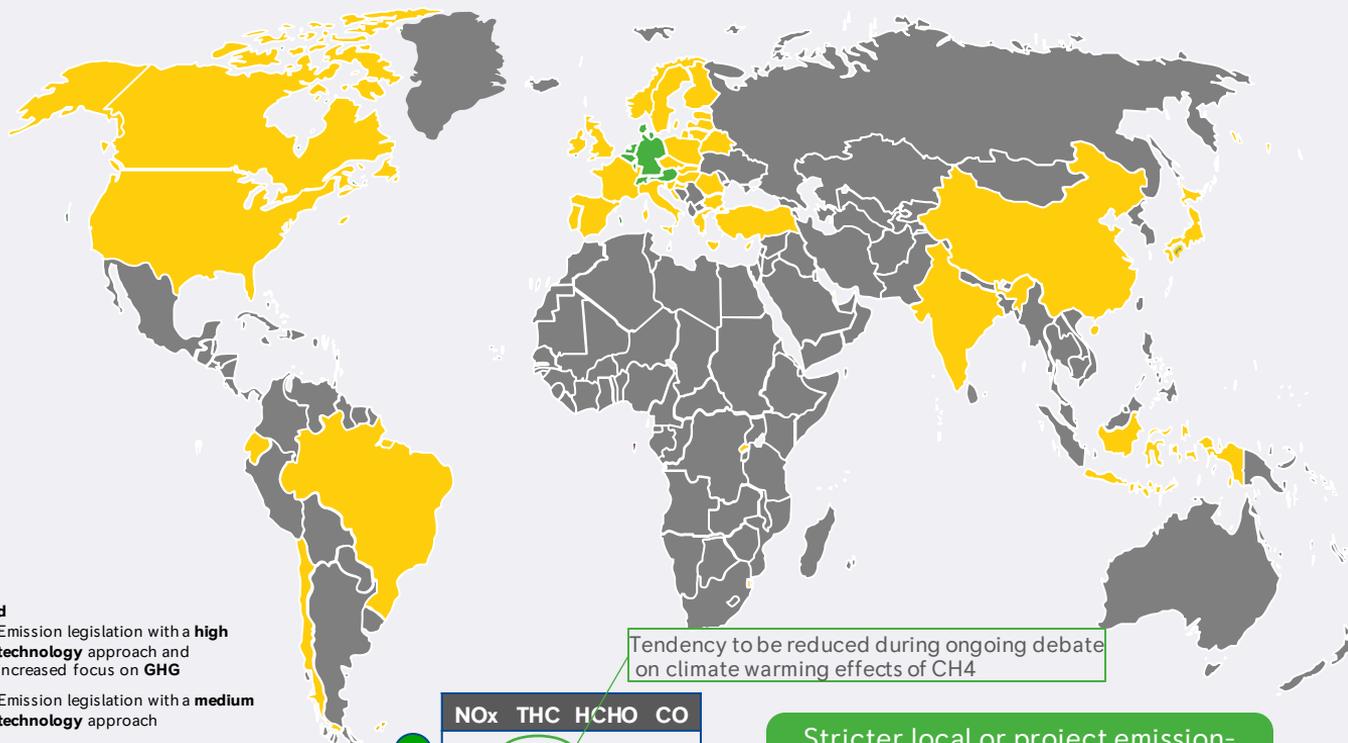
Gas lean-burn

A forecast to 2032

MCPD / 44. BImSchV (E1 level) officially applicable

- by **Jan. 2023** for Bio gas
- by **Jan. 2025** for Natural gas

RRPS already offers today solutions for **E1 level**



- Legend**
- Emission legislation with a **high technology** approach and increased focus on **GHG**
 - Emission legislation with a **medium technology** approach
 - Base or no emission legislation **Standard technology** approach

Tendency to be reduced during ongoing debate on climate warming effects of CH4

	NOx	THC	HCHO	CO
E1	100	1300	20	100
E2	250	-	(20)	(300)
E3	500	-	-	-

Values mg/Nm³ at 5% O₂

Stricter local or project emission-approach can be applied everywhere!



Outlook 2032 Natural / Bio Gas

Lean burn engine

Stationary

SCR will be increasingly
needed for Powergen
applications

Natural Gas

- Natural gas as **transitional technology** (replacing coal and oil)
- **Regarded as sustainable** under rare circumstances and before 2030 (EU taxonomy)

Bio Gas

- **Switch from** use of **biogas in engines to the feed in of biomethane** into gas grids

Hydrogen

- Hydrogen strategies include **transition of natural gas grids**
- Different steps of **hydrogen admixture** in discussion

CO₂ equivalent

- **Switch from CO₂ to CO₂_{eq}** increases focus on methane and other climate gases (*Debate GWP20*)

SCR

- Considered as **BAT** (Best Available Technology)
- May lead to future reduced NOx limits



02

EGAT

Customer Key Buying Criteria (KBC)



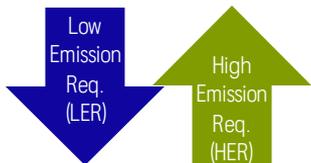
Growing Demands for Exhaust Aftertreatment

Base case 2026:

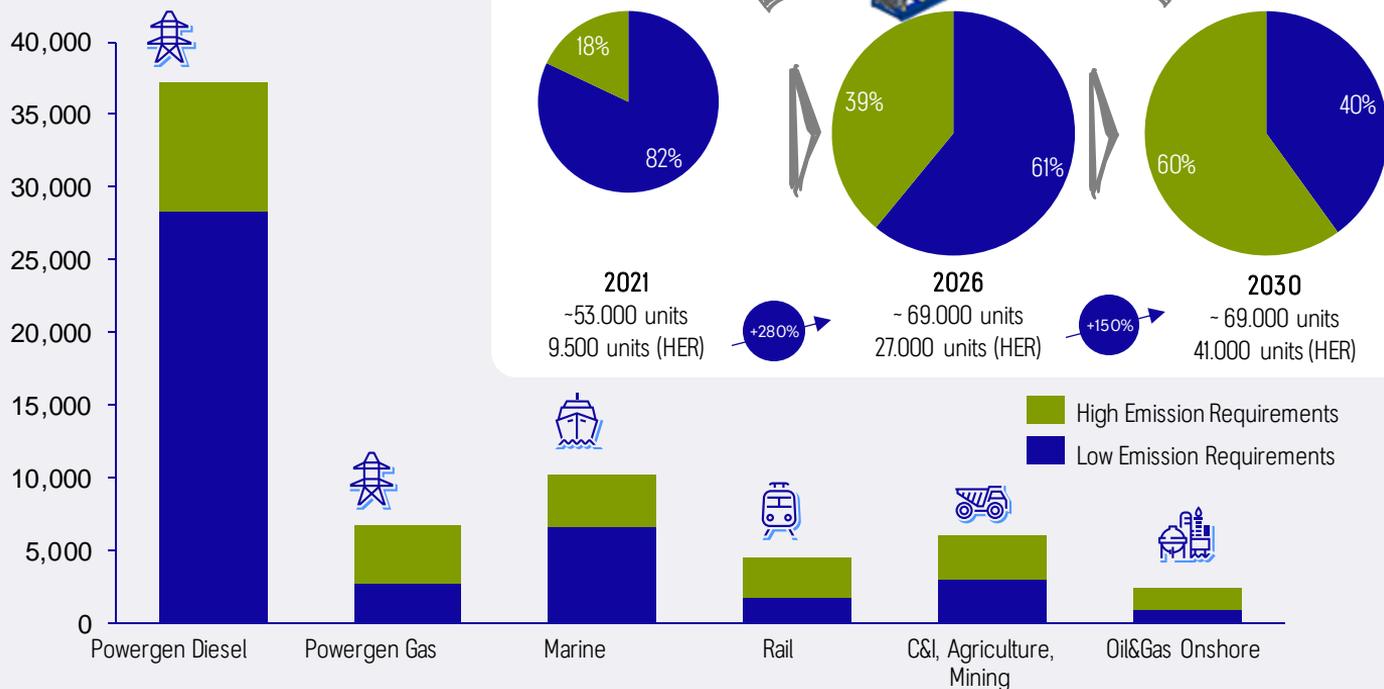
Off-highway markets > 560kW regarding high emission requirements

Increase of more than 200% within five years (absolute)

Further increase expected.



Off-Highway applications base case 2026, >560 kW, Market in units*



Strong growth of markets with high emission qualified products.



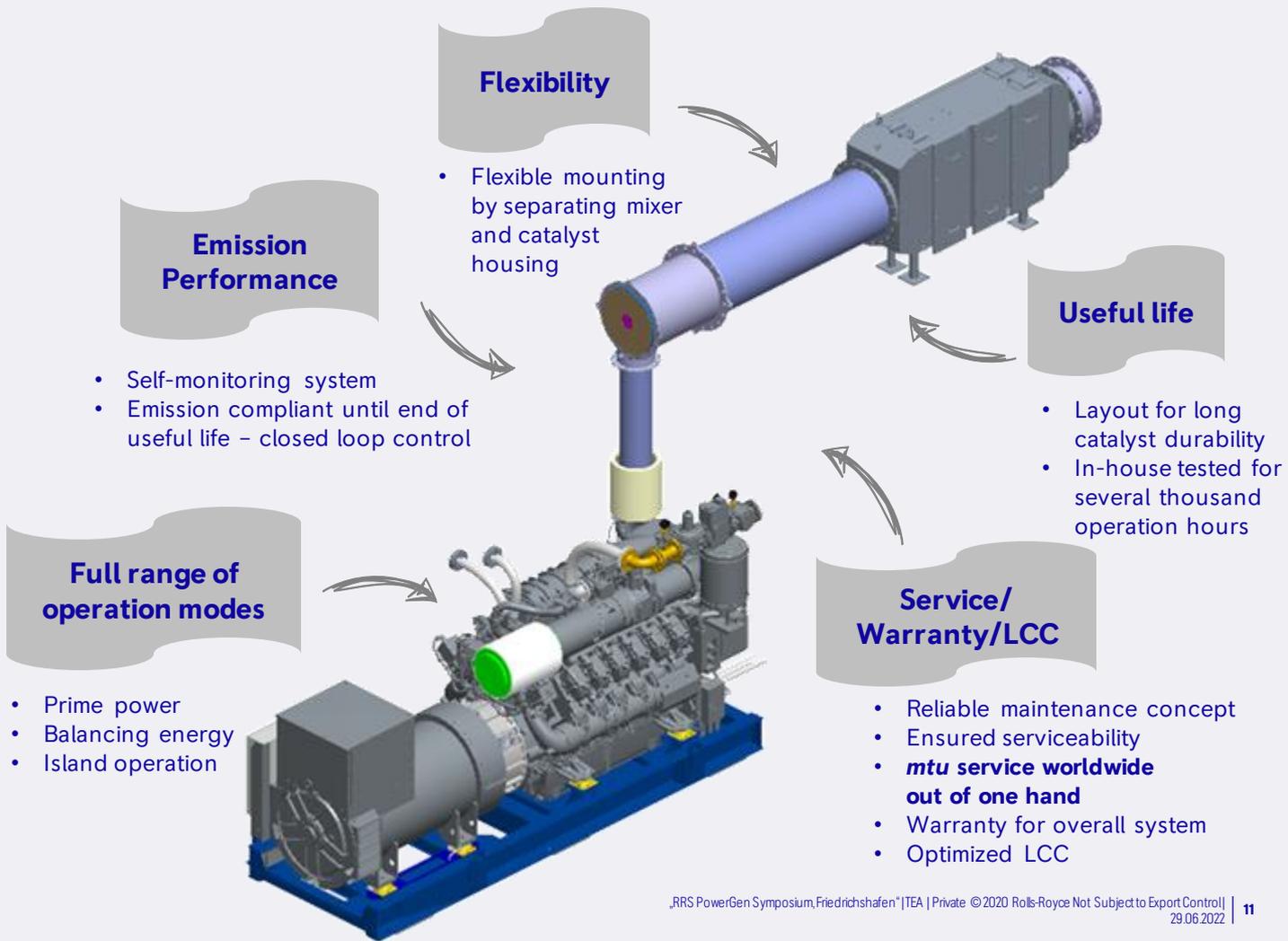
Emission Regulations & KBC

Main drivers for EGAT system to ensure emission regulations

Design based on **Customer key buying criteria**:

- Price & life cycle costs
- Sales & service
- Product capabilities
- Corporate performance

→ **Strong focus on price and life cycle costs and service**





03

mtu EGAT

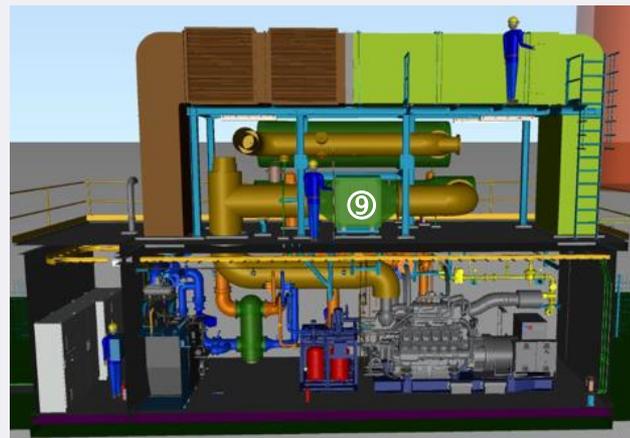
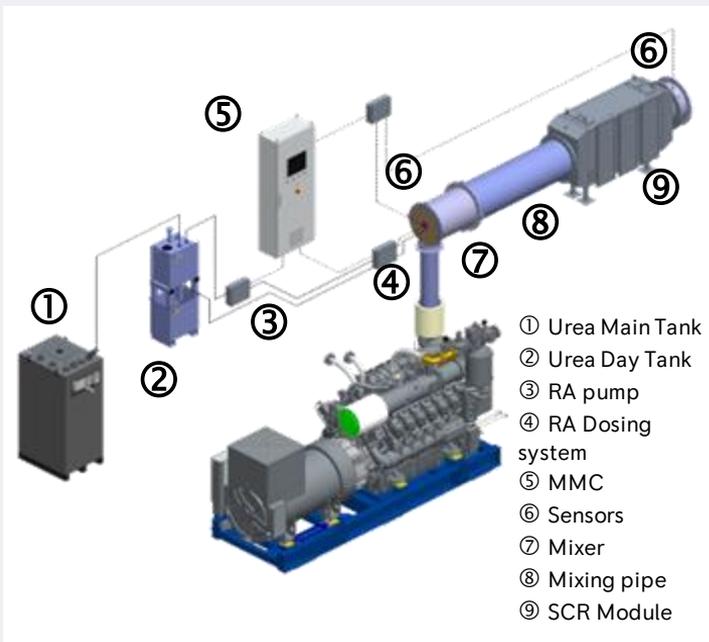
Technology

EGAT system for *mtu* S4000 gas engines

- future emission regulations
- reliable system performance
- modular & scalable system approach fulfilling individual customer requirements
- optimized price and life cycle costs

Scope:

- EGAT for all *mtu* gas engines and all operation modes
- Flexible installation



Benefits:

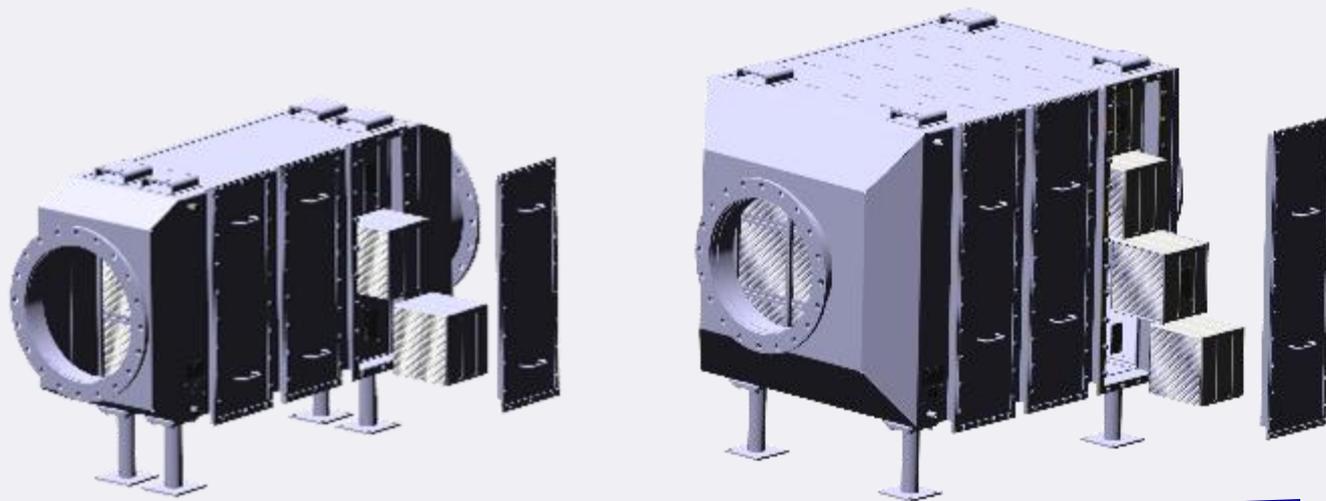
- Compliance to emission legislations (e.g. 44. BlmschV)
- Reduced fuel consumption
- Fully integrated EGAT control
- Modular approach, flexible arrangement
- Easy to maintain



PowerGen Gas - EGAT system sizes

Exhaust Gas Aftertreatment
System "SCR-Oxi"

- 40 different engines
800 kW – 2600 kW
Natural gas and Bio gas
- Different operation modes
- Retrofit and new business
- Catalyst layout for 21.000 h



800 kW

2600 kW

8V – 2x3

12V – 3x3

16V – 3x4

20V – 4x4

- Standardized pre-qualified components for customer solutions
- High flexibility
- Smart packaging
- Serviceability



PowerGen Diesel - Outlook

Integrated and modular EGAT systems (DPF & SCR) for Powergen Diesel applications

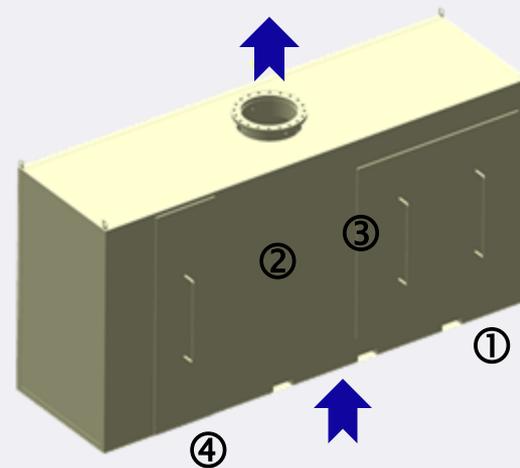
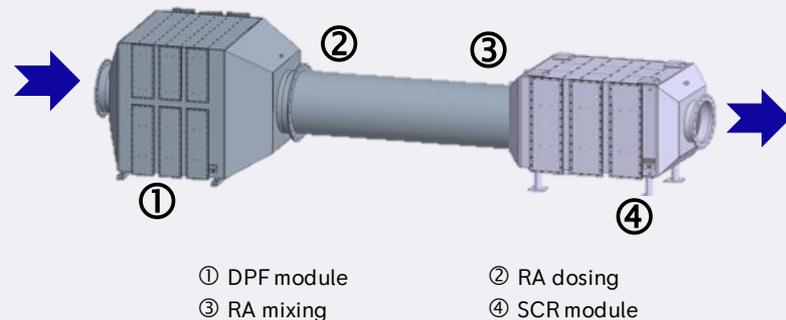
- future emission regulation (Tier4f)
- reliable system performance
- optimized price and life cycle costs

Scope:

- EGAT for Diesel engines
- Combined system DPF + SCR
- Different applications
- “certified” & “non-certified”

Benefits:

- Compliance to emission legislation
- Fully integrated EGAT control
- Plug&Play system
- Modular approach & flexible arrangement





04

mtu EGAT

Solutions

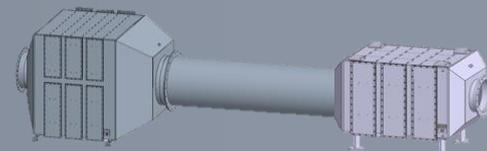
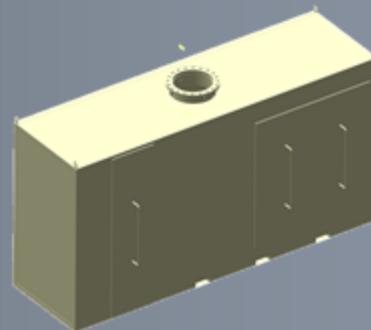
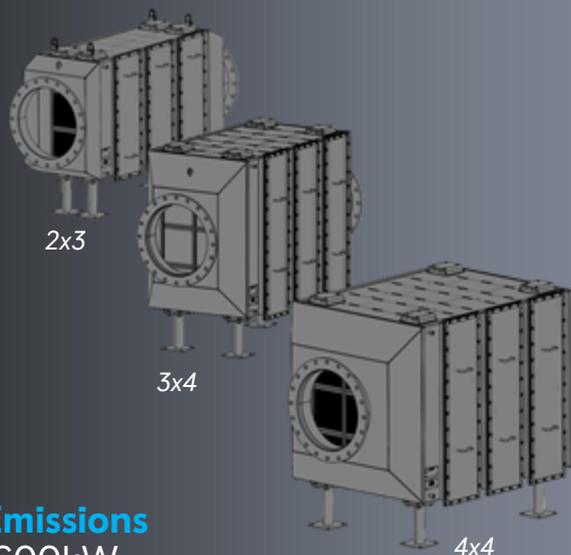
PowerGen Gas – Scopes of delivery

- Different scopes of delivery for every customer's needs
- Standardized components for customized solutions



-
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- Complete combined heat & power plant (CHP)
 - Retrofit to existing CHP units
 - Prepared for future installation of EGAT

EGAT Portfolio PowerGen



Gas Flex Emissions

- 800-2600kW
- 8V/12V/16V/20V4000L64
- four variants (2x3, 3x3, 3x4, 4x4)
- highly competitive

Diesel Powergen

- concept phase
- Integrated box
- Modular system

High-Tech Exhaust Aftertreatment Systems for High-Tech Solutions into a Greener Tomorrow



Plug & Play and
Modular Design
for Mobile & Stationary
Power solutions

Smart Energy
Management for
significant
reduction of CO₂



Thank you for your attention!



A Rolls-Royce
solution