



A Rolls-Royce solution

# ROLLS-ROYCE

Rolls-Royce provides world-class power solutions and complete life-cycle support under our product and solution brand MTU. From electrification to digitalization, we strive to develop propulsion 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.

**Our vision**

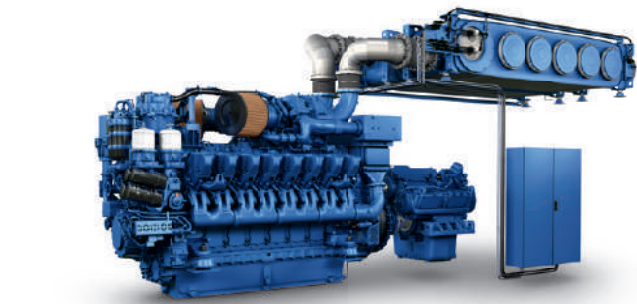
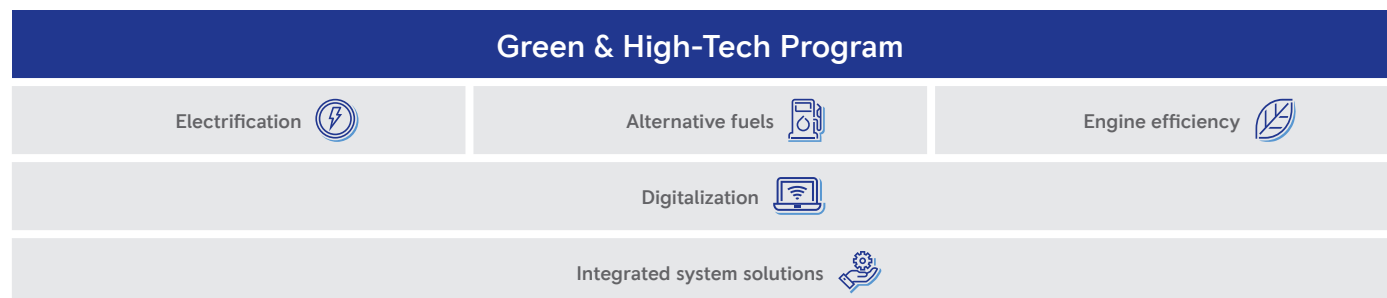
Power Systems, a division of Rolls-Royce plc., is investing heavily in research and development involving new technologies. With our long-term, global approach, we set standards in environmental compatibility, resource conservation, safety and reliability. This enables us to supply competitive, environmentally friendly products to world markets from our base in Germany.

In keeping with the global vision of Rolls-Royce – „Pioneering the power that matters“ – we are working hard to continue to be the partner of choice for power generation, propulsion and service. With our clean, efficient engines and systems, we make a real contribution reducing pollutant emissions and greenhouse gases in cooperation with our customers. By so doing, we support global efforts to protect the climate.

**Green & High-Tech Program**

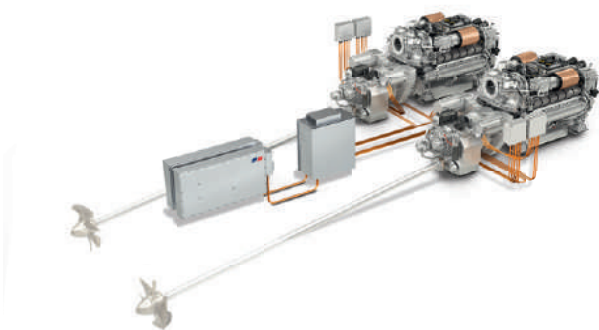
Thanks to over one hundred years of experience in engine construction and systems business, our products continue to set new standards in power efficiency, low fuel consumption and emissions.

At the heart of our Green & High-Tech Program is the development of innovative technologies and systems – as the basis for extremely sustainable, environmentally friendly products of the future. The focus is on engine efficiency, alternative fuels, electrification, digitalization and fully integrated system compatibility.



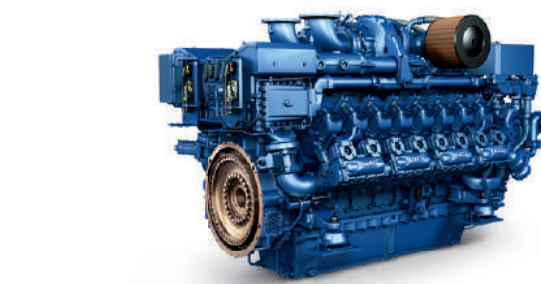
**Engine efficiency**

The predominant driver in the development of modern propulsion and power generation systems is the improvement in efficiency of our systems. The combustion engine is set to remain a component of these systems in the medium term. Further improvements to increase efficiency by optimization of the internal combustion as well as further technological innovations are necessary. In addition, low emissions and therefore "green" diesel propulsion and power generation solutions can only be created by using efficient exhaust gas aftertreatment.



**Electrification**

Hybrid systems can increase the environmental compatibility of mobile applications in future. In a hybrid system, diesel or natural gas engines are combined with electric motors, battery storage devices and power electronics to ensure low emissions, low fuel consumption and excellent power delivery. When it comes to stationary power generation, battery storage systems are important to meet the new demands arising from increasing renewable energy generation, e.g. grid stability or "dark doldrums". Fuel cells have the potential to become an essential technology for the decarbonization of propulsion and energy systems. When operating with hydrogen, produced with energy from renewable sources, the fuel cell will make an even more important contribution to the energy transition.



**Alternative fuels**

Alternative fuels will be a key element for eco-friendly propulsion and power generation systems. Especially from regenerative energy produced synthetic fuels (Power-to-X; e-fuels) will make propulsion and power generation systems increasingly CO<sub>2</sub>-neutral. Relevant fuels reach from Drop-In fuels like e-gas or e-diesel – which can also be used in the existing fleet – up to new fuels as e-methanol or e-hydrogen. It is necessary to maximize the process efficiency of the fuel production as well as to optimize the propulsion and power generation systems for the use of the novel fuels.



**Digitalization**

With new digital technologies it will be possible to develop intelligent and more connected products. Solutions like condition-based maintenance enables more resource-conserving and economical operations. With the aid of artificial intelligence, it will be possible for propulsion and power generation systems to optimize their operation automatically, enabling even further reductions in pollutant and greenhouse gas emissions.



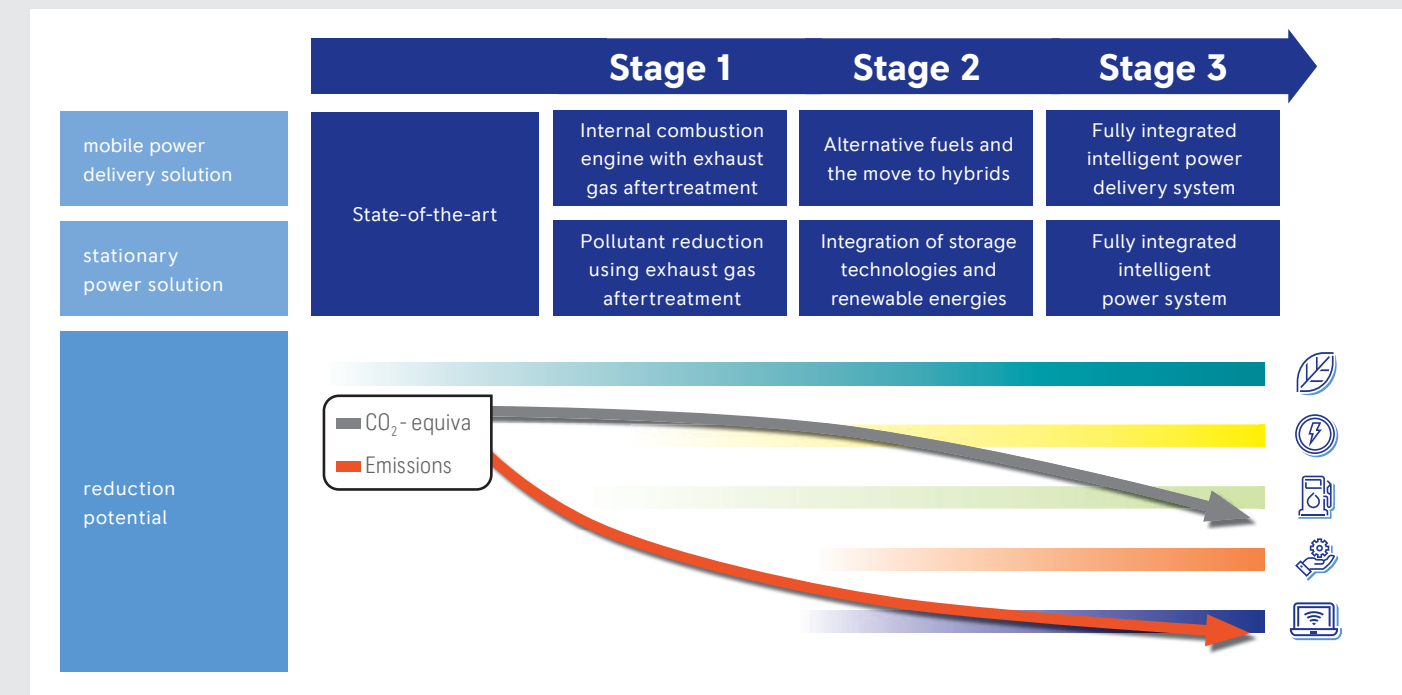
**Integrated system solutions**

Our MELT engineering approach (Mechanical, Electrical, Logical, Thermal) has been developed in order to link and coordinate the individual components and subsystems to optimum effect. On basis of our technology and product portfolio we realize fully integrated systems of the next generation that protect our environment; for instance, fully integrated hybrid marine propulsion systems or decentralised power generation systems as Microgrids. With regards to the energy transition, the cross-sectoral technologies as Power-to-X are of a central importance.

**We combine the individual technologies to create an optimum system that emits significantly less exhaust emissions while delivering improved performance than previous propulsion and power generation solutions.**

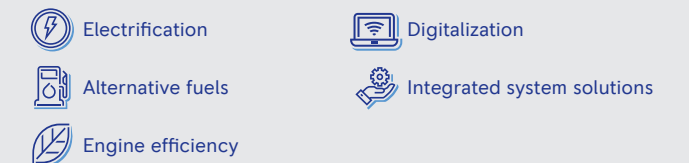
In Stage 1, a combustion engine is equipped with exhaust gas aftertreatment to reduce exhaust emissions. In Stage 2, depending on the application, further components such as electric motors or storage technologies are added. The integration of renewable energies and partial use of alternative fuels will start to reduce the CO<sub>2</sub>-emissions. In Stage 3, a full integrated system including self-optimization together

with higher shares of alternative fuels or the usage of fuel cells will lead to further significant reduction in emissions and fuel consumption. The chart below illustrates this by using the example of a mobile propulsion solution and a stationary power generation solution.



**Fully integrated all-in-one system**

Taking the combustion engine as a basis and adding the technologies of the Green & High-Tech program results in a fully integrated and advanced all-in-one system that is efficient in protecting the environment.



# MEGATRENDS

As part of its strategy, Power Systems wants to provide innovative answers to the major social and economic challenges of today and tomorrow – in the areas of mobility and logistics, infrastructure and energy.

The mobility and energy expectations of a growing world population, rising energy demand, climate change and globalization all require us and our customers to continuously develop and refine the products and solutions we use. Our answer is green power generation, power delivery and power management solutions that conserve resources and significantly reduce the impact on the environment.

- 1 Growing world population and urbanisation
- 2 Growing energy needs

- 3 Climate change
- 4 Globalisation

