Boarding for the future

SUSTAINABILITY REPORT
MTU AERO ENGINES AG
FISCAL YEAR 2023

23

Product quality and flight safety

Safety first—for us, safe flight operation is way more than just a legal requirement. In aviation, it is the highest priority, period. That's why we place high demands on safety and quality—for reliable and high-quality products made by MTU.

Product quality and flight safety are very important to MTU. High quality together with product safety and reliability are enshrined in the MTU Principles as key corporate objectives. MTU's quality vision for 2025 also aims at error-free quality and product safety in flight, as well as high customer satisfaction. Our vision is Zero Defects; in this, we stand for sustainable quality management.

A high level of product quality and safety is crucial for customer satisfaction and our competitiveness. "We increase the satisfaction of our stakeholders" is therefore one of our overarching corporate objectives. The secondary objectives for 2023 were defined in more concrete terms, with the aim of underscoring MTU's attractiveness as a partner through the high performance and quality of its products and services.

A model management system for quality

Conditions in the aviation industry are strictly regulated, and the company must comply with the legal requirements imposed upon it as an organization that develops, manufactures, and maintains products, parts, and equipment for the aviation industry. A Group-wide integrated management system (IMS) ensures compliance with laws and internal regulations and clearly assigns responsibilities within the company. One principle of the IMS policy is that "safety takes priority in what we do." The quality framework is enshrined in a management manual that is binding for all employees and managers across the Group. The company's dedicated quality department, Corporate Quality, is directly subordinate to Executive Board member Dr. Silke Maurer, Chief Operating Officer (COO), and reports quarterly to the full Executive Board on quality aspects and flight-related incidents. MTU Safety Management in accordance with the International Civil Aviation Organization (ICAO) standard is part of the IMS and defines how to handle safety-related incidents in MTU facilities and in air traffic. Appropriate organizational structures and responsibilities, such as a Flight Safety Board and a Flight Safety Manager, have also been established.

IMS, our certified integrated management system, supports us in ensuring customer satisfaction, process orientation, and continuous improvement in all phases of development, production, and maintenance. IMS takes into account, for example, the requirements of the standards ISO 9001, EN/AS9100, ISO 14001/EMAS, and ISO 45001, and serves as a model approach in the aviation industry.

And complying with legal requirements concerning safety is subject to strict monitoring by the relevant authorities. These include aviation-authority licenses, approvals, and certifications as well as safety and environmental requirements as legally mandated by regulatory authorities. Through stringent quality standards, we ensure that these are implemented across the Group and at all levels of the value chain in accordance with the law. We have customers and authorities conduct regular internal and external audits of quality issues to ensure that the uniformly high standards within the company comply with regulatory requirements.

Safety throughout the lifecycle

We examine our engine modules for their impact on the environment, health, and safety throughout their development, production, and operation lifecycles. Accordingly, we cover all major stages of a product's service life. The key to continuous progress is the development phase. We take into account all safety and environmental requirements of regulatory authorities in the early stages of developing new engines for later use, and compliance must be documented as part of the certification process. We employ a comprehensive testing program involving test rigs and test series to validate the safe flight operation of our products. This includes being able to ensure safe operation during a hailstorm or a bird strike (following a bird ingestion event) and complying with strict limits on pollutants and noise emissions. MTU components frequently exceed aviation authority requirements, because our customers demand high standards when it comes to fail-safe operation and eco-efficiency.

ENGINE VALIDATION AND CERTIFICATION

→ More in MTU Aeroreport

Certifying and validating an engine is a rigorous process that takes years. It concerns flight safety as well as energy consumption and maintenance intervals.

We use only fault-free and clearly identified components that have been approved by the appropriate aviation authority, are based on approved development documentation, and have been produced or maintained in compliance with aviation regulatory processes by a company officially authorized to do so.

The aviation sector has strict rules governing documentation in order to verify the airworthiness of components and engines. There must be no gaps in documentation for the product's entire service life. We hold our suppliers to the same standards and audit them regularly to ensure compliance. To ensure quality and safety requirements are upheld, we have implemented comprehensive monitoring and testing processes along the entire value chain. Safety-critical components (engine components are categorized into various safety classes) are subjected to particularly rigorous testing to verify their technical quality. Strict requirements also apply to materials. Since fail-safe materials are a basic prerequisite for aviation safety, all engine components, including all materials we use, must be approved by the aviation authorities after undergoing extensive test series.

The reporting year again saw a positive result in that there were no breaches of statutory regulations regarding compliance in connection with the purchase or operation of our products that resulted in a fine, sanction or warning for MTU.

Continuous monitoring of quality

We set great store by customer complaints as an indicator of our customers' satisfaction with the quality of MTU products. We follow up and analyze all customer complaints submitted to us relating to products delivered in substandard quality. Appropriate measures are then defined and implemented so as to permanently eliminate the cause of the defects. Success of these measures is closely monitored. Customer complaints are assessed at the site level. At most of our sites, the number of customer complaints fell or remained constant in the reporting year.

Geared turbofan fleet management plan

In the course of 2023, it emerged that the service life of components in the share handled by program partner Pratt & Whitney may be limited under certain circumstances. The reason for this is a rare condition of the powder metal used in the production process. As a result, there was a need for a comprehensive inspection program for PW1100G-JM geared turbofan engines. In the coming years, an additional 600 to 700 shop visits will be necessary to inspect the relevant components and replace them if necessary as a preventive measure.

Further development of safety management system underway

At MTU, we develop and refine our quality system together with our standards and regulations on an ongoing basis. This involves applying the ideas that emerge, for example, from collaboration in the Aero Engine Supplier Quality Group (AESQ) or from regular exchanges of experience and information among our quality managers in the aviation industry. Continuous development primarily concerns MTU's body of rules and regulations and its internal quality reporting system.

We include all our employees in our high quality standards: managers and employees receive site-specific training on quality issues, and all employees receive IMS training. In addition, we are committed to a positive no-blame culture at MTU, characterized by openness and collaboration, and raise awareness about and provide ongoing training on this subject.

In the reporting year, MTU began further developing its safety management system in light of new regulatory requirements from the European aviation authority. A new training concept with mandatory online training for all employees and in-depth training for MTU safety personnel was rolled out for the German sites as a first step. In addition, Quality Day 2023 was dedicated to the topic of flight safety and the safety management system as part of the Passion for Quality initiative. The implementation of the new industry-wide AS13100 standard, which was jointly developed in the AESQ, also made further progress in 2023. This standard must be incorporated into MTU's body of rules and regulations and find practical application with MTU and its suppliers. MTU is also working on a new edition of the standard, which will incorporate initial lessons learned.

GRI: 3-3, 301-2, 416-1, 416-2

Climate impact of aircraft engines

With innovative propulsion products, MTU is often a technology pacesetter. We are also hard at work on new generations of propulsion systems that will be even more sustainable. With our Claire agenda, we have more forward-looking concepts than ever before.

Zero emissions–this is MTU's vision and overall goal when it comes to reducing the climate impact of propulsion systems in flight operations. By taking on responsibility for climate action, we want to help achieve the goals laid out in the Paris Agreement, which serves as a focal point in our technology development. We base our own objectives on the EU Green Deal, which is derived from the Paris target of a 1.5 degree increase and aims to achieve climate neutrality by 2050. In our **Claire (Clean Air Engine) technology agenda**, we have formulated possible solutions for aircraft engines and ways they can reduce climate impact and energy consumption. We aim to achieve these goals in three stages. Our efforts here no longer focus solely on carbon emissions, but on the overall climate impact of air traffic. In addition to CO_2 emissions, this also includes non-CO_2 effects, triggered mainly by the emission of nitrogen oxides and the formation of contrails. MTU realigned its Claire agenda in 2022 to reflect this paradigm shift.

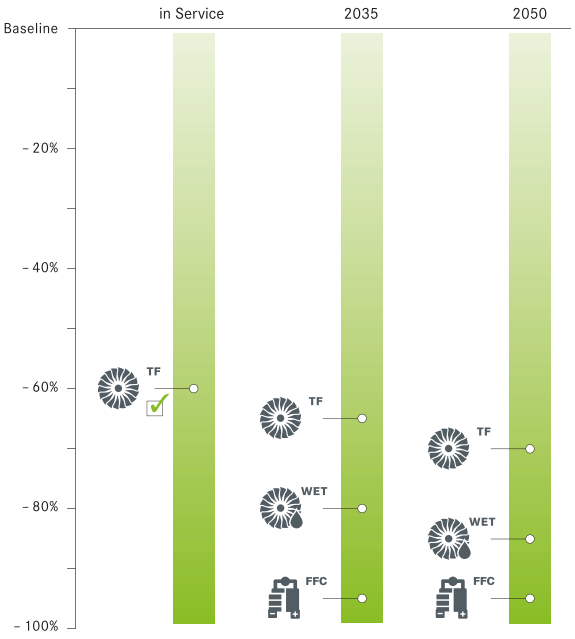
"We are transforming aviation with innovative concepts, great enthusiasm, and a vision of emissions-free flight. For this major aviation goal, we are investing in the development of new and alternative propulsion technologies. Turning visions into reality has always been our way."

Dr. Stefan Weber,
SVP Engineering & Technology and member of the Corporate Sustainability Board of MTU Aero Engines AG

Because of the longer product cycles in aviation, climate goals for propulsion systems take a long-term perspective and are established in memoranda of understanding by stakeholders (airlines, aviation industry, research, aviation authorities), such as Fly the Green Deal, Europe's vision for climate-neutral aviation. To be effective across the board in 2050 and help in achieving climate neutrality, products that enable climate-neutral flight must be brought to market well before then. That is why we are ramping up the development of completely new propulsion concepts that go above and beyond the conventional gas turbine. For these revolutionary engine architectures, we collaborate with partners from industry, academia, and research, such as Bauhaus Luftfahrt or the German Aerospace Center. In parallel, MTU is working to enhance existing propulsion systems, such as the highly efficient geared turbofan (GTF) together with our partner Pratt & Whitney, and to couple these with sustainable fuels.

Three stages toward emissions-free flight with Claire

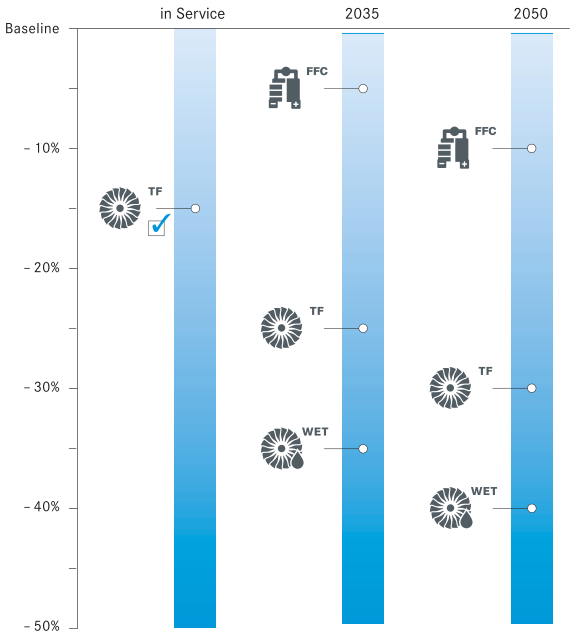
Climate impact



Reducing climate impact*
(Global WarmingPotential)
Climate impact is a result of **CO_2 and NO_x emissions** and of **contrail formation**

Reducing energy consumption*
Energy consumption refers to the **energy required** for a standard mission

Energy consumption



Alternative fuels
All concepts run on **100% SAF** or **hydrogen** from **100% green energy**

Noise reduction
All concepts meet future **noise emission limits**

TF = Turbofan WET = Water-enhanced turbofan FFC = Flying fuel cell
* compared to a kerosene-powered gas turbine from the year 2000

Evolutionary refinement based on the geared turbofan

Together with Pratt & Whitney, MTU offers a highly efficient propulsion concept: the GTF™ engine family used in modern narrowbody aircraft–the Airbus A320neo and A220 as well as the Embraer E-Jet E2 family. Per flight, engines from the GTF family reduce energy consumption and CO_2 emissions by up to 20% compared to the previous generation. Since its entry into service, the GTF™ engine family has logged 26 million flight hours, saving 14 million metric tons of CO_2 (according to Pratt & Whitney as of the end of 2023). It has also achieved significant improvements regarding nitrogen oxides (NO_x), with 50% fewer emissions than the previous model.

Fast facts: Geared turbofan

IN THE AIR

26
million flight hours and 900 million passengers on board

LESS IN THE TANK

5
billion liters less kerosene consumed

GOOD FOR THE CLIMATE

14
million metric tons of CO_2 saved

Compared to the previous engine generation, as of the end of 2023, according to information from Pratt & Whitney

The GTF Advantage, a technologically improved version for the A320neo family, is currently undergoing trials. It has also already been successfully tested with 100% sustainable aviation fuel (SAF). Entry into service is planned in the next few years. To exploit the GTF's full potential, MTU is working with Pratt & Whitney to prepare the next generation of the product. Many of the technologies required for this are being developed as part of the German Federal Aviation Research Program (LuFo). MTU is concentrating on its GTF components, namely, the high-pressure compressor and the high-speed low-pressure turbine.

Sustainable aviation fuel

Alternative fuels from renewable energy

SAFs (sustainable aviation fuels) are sustainably produced alternatives that can be used as drop-in fuels, i.e. without major adjustments. They are playing a major role on the way to climate-neutral aviation. MTU maintains an ongoing dialogue with relevant stakeholders and participates in studies to support the introduction of SAF; for example, through its membership in the Aviation Initiative for Renewable Energy in Germany (aireg e.V.), an association of airlines, manufacturers, and research institutions. An aireg study on sustainable fuels conducted with the involvement of MTU highlighted the great potential of SAF.

V2500 ENGINE ON 100% SUSTAINABLE AVIATION FUEL SUCCESSFULLY TESTED

→ Press Release

IAE International Aero Engines AG (IAE) announced it has successfully tested the V2500 engine with 100% sustainable aviation fuel (SAF) at MTU Maintenance Hannover, Germany. IAE is a multinational consortium comprised of Pratt & Whitney, an RTX business, Pratt & Whitney Aero Engines International GmbH, Japanese Aero Engines Corporation and MTU Aero Engines AG.

In addition, in the reporting year MTU signed a letter of intent to initiate a research collaboration for power-to-liquid aviation fuels (PtL). The endeavor will involve representatives from MTU, Lufthansa, DLR, Airbus, and Munich Airport. PtL represents the next generation of SAFs and is particularly promising from an environmental and scaling perspective. The collaboration will pool the strengths of leading aviation companies and science to accelerate the technology selection, market introduction, and industrial scaling of PtL aviation fuels in Germany. It will also address other issues, such as the effect on local air quality, maintenance requirements, and the use of pure PtLs, i.e. those without the addition of fossil kerosene.

In the long term, hydrogen will serve as the basis for climate-neutral propulsion of the future. We see three application possibilities: it can be burned directly in a gas turbine engine, converted into an SAF, or converted into electrical energy by means of a fuel cell. MTU, aircraft manufacturers, and industry are working on bringing climate-friendly hydrogen technologies to aviation and building up the requisite infrastructure.

MTU DEVELOPS FUEL SYSTEM FOR LIQUID HYDROGEN WITH PARTNER

→ To the press release

MTU is partnering with the company MT Aerospace to jointly develop a complete liquid hydrogen fuel system. The first application is to be MTU's Flying Fuel Cell™ (FFC). Joint development work on the LH_2 fuel system for commercial aviation applications began more than three years ago. In terms of system technology, this fuel system could, with slight modifications, also be used for direct hydrogen combustion in aircraft gas turbines.

Achieving climate neutrality with revolutionary propulsion concepts

Wet combustion is better for the climate: Our WET concept

Evolutionary technological development will not be enough to achieve climate neutrality by 2050. Revolutionary propulsion concepts are needed. MTU's favored technology is the Water-Enhanced Turbofan (WET). Utilizing thermal energy from the exhaust gas stream, the WET concept uses a heat exchanger to vaporize water, which is then injected into the combustor. The water for this purpose is extracted from the exhaust gas by means of a condenser. "Wet" combustion of this kind massively reduces nitrogen oxide emissions, while also substantially decreasing fuel consumption, CO_2 emissions, and the formation of contrails. As part of SWITCH, one of the largest technology projects to emerge from the first call issued by the European Commission's Clean Aviation research program, both innovative WET and hybrid-electric technologies are being developed. SWITCH was launched in 2023. Within three years, the project aims to ground-test a hybrid-electric gas turbine engine based on the geared turbofan, and to bring the WET concept to a level of technological maturity that includes successful component validation in the laboratory. Within the framework of SWITCH, an international consortium is working together under the leadership of MTU. The industry partners are Airbus, Pratt & Whitney, Collins Aerospace and GKN Aerospace; further partners include DLR and universities.

Virtually emissions-free in the air: Flying Fuel Cell™

Another revolutionary propulsion concept in aviation is the full electrification of the powertrain. MTU calls its version of this the Flying Fuel Cell. It will initially be used on shorter routes in the feeder and regional aircraft sector starting in 2035. As its efficiency improves, the Flying Fuel Cell will expand to short- and medium-haul routes, further reducing the climate impact of commercial aviation. This propulsion system does not produce any emissions of CO_2, NO_x, or particulates. The Flying Fuel Cell scored points in the second Clean Aviation call in 2023 and was accepted as a funded project under the title Hydrogen-Electric Zero Emission Propulsion System (HEROPS).

MTU ACQUIRES ELECTRIC MOTOR DEVELOPER EMOSYS GMBH

eMoSys GmbH

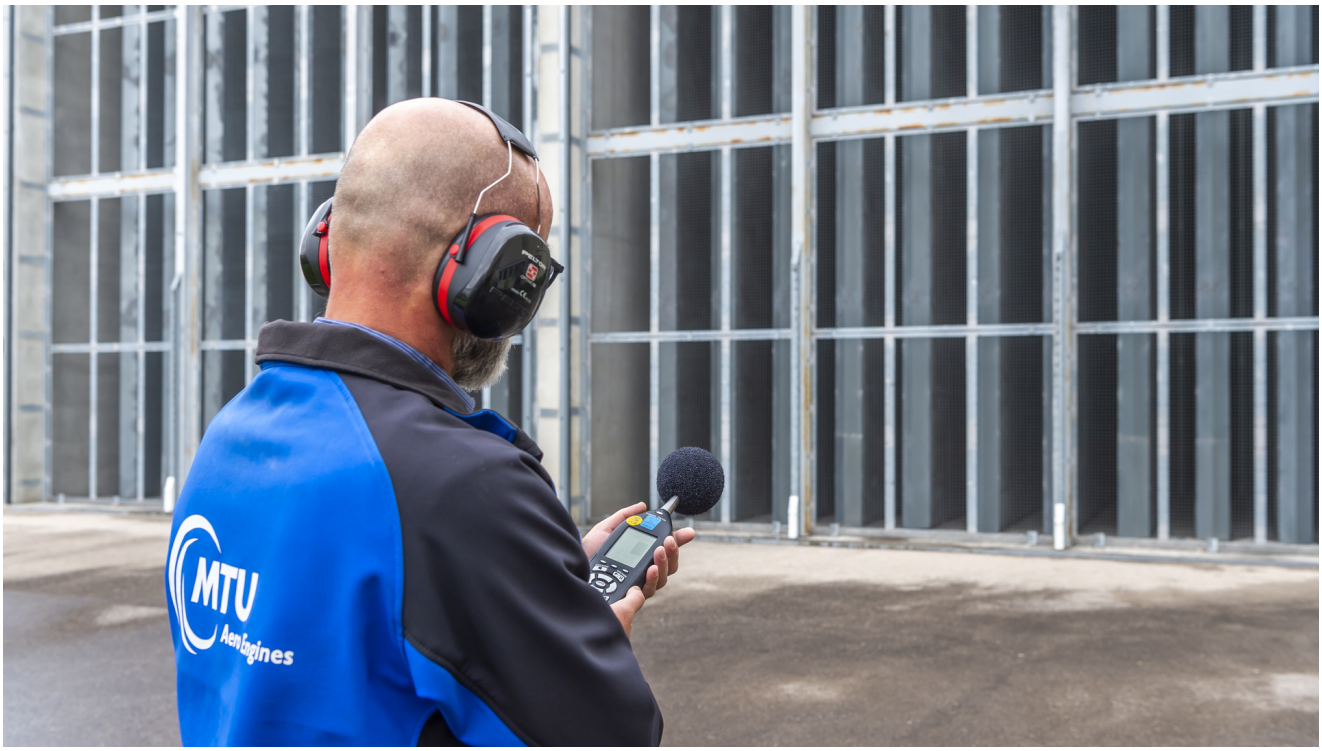
→ To the press release

MTU is acquiring eMoSys GmbH, a company specializing in electric motors and located in Starnberg, Germany. With this step, MTU is expanding its expertise and activities in the field of propulsion system electrification. “We need highly efficient and absolutely reliable electric motors for our Flying Fuel Cell, and eMoSys motors offer the highest power density known today,” says Lars Wagner, MTU CEO, about the acquisition.

GRI: 3-3, 201-2, 302-5, 305-3

Health impact of aircraft engines

Our product development team is working to make aviation considerably quieter and cleaner. Reducing aircraft noise and exhaust emissions are declared goals of our Clean Air Engine technology agenda. Our revolutionary propulsion concepts open up completely new possibilities.



We are committed to active and integrated environmental protection that takes account of the significant impact our products have on the environment and society. Our efforts here take our commitment beyond climate action: with concepts for quieter and cleaner engines, we can improve the situation for residents living near and around airports in terms of noise pollution and local air quality. As with our approach to climate action, we have established several pillars to anchor the issue of aircraft noise in the company. In our global Code of Conduct, we commit to environmental protection and explicitly to reducing noise and exhaust emissions from aircraft engines. We want to set standards in this area, and we have formulated our goal accordingly. The MTU Principles also include the requirement to create products with lower noise and pollutant emissions under the heading “Environment & society.”

To receive certification from aviation authorities both aircraft and engines must meet noise and emissions limits set by the International Civil Aviation Organization (ICAO); in the past, these limits have been successively tightened. National aviation authorities are responsible for certification. Furthermore, at almost every airport in the world, the fees charged for takeoff and landing are dependent on the noise emissions of the aircraft model.

In the certification of new aircraft models, noise is measured using a standardized process at three defined points and then cumulated. Aircraft noise has decreased continuously since the 1960s, by a total of about 17 EPNdB (effective perceived noise decibels; a specific unit for measuring the relative noisiness of aircraft) or about 70%.

How is aircraft noise generated?

Aircraft noise is caused by both the engine and the aircraft itself. Noise during takeoff is largely due to the engine's fan and nozzles; during landing, the aircraft also adds to noise as a result of turbulence around the fuselage, wings, and landing gear. The core engine accounts for a relatively small proportion of aircraft noise. www.fluglaerm-portal.de

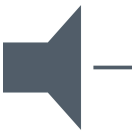
We support the noise targets of the European aviation industry

With our Clean Air Engine (Claire) technology agenda, we are pursuing not only climate action targets → Climate impact of aircraft engines, but also targets for reducing aircraft noise emissions. Achieving future noise limits is one of the agenda's core elements. MTU's acoustics experts are involved in our projects at every stage of product development, from technology management to subsequent propulsion system design and optimization.

When developing future propulsion systems, we support the goals of the European aviation industry and research sector's Strategic Research and Innovation Agenda (SRIA), which calls to reduce noise to 65% of its 2000 levels by 2050. With the first-generation geared turbofan, which we offer together with our partner Pratt & Whitney, we have already significantly reduced aircraft noise emissions as part of Claire Stage 1. They are on average 15–20 EPNdB (cumulated over the three ICAO measuring points) below the current legally stipulated noise emission class, ICAO Stage 4.

Fast facts: Geared turbofan

LESS AIRCRAFT NOISE



– 75 %
smaller noise footprint

QUIETER FLIGHTS

26
million flight hours

CLEANER FLIGHTS

50 %
lower NO_x emissions

Noise footprint describes the spread of aircraft noise in the sensitive area around airports, improvements based on 75 dB noise contour and in comparison to its predecessor

The geared turbofan from Claire Stage 1 has an architecture that harbors vast potential for further reducing noise compared to conventional turbofans. By making improvements to the latest generation, we want to achieve the goal of a 50% reduction in aircraft and engine noise emissions by 2035 (base year 2000).

According to the SRIA, new engine architectures are even to achieve a 65% drop in noise emissions by 2050 (base year 2000). Our efforts here include our new propulsion concept, the (hydrogen-powered) Flying Fuel Cell™, which can achieve massive reductions in noise because the fan is the powertrain's sole source of noise. Starting it 2035, it could initially be used on shorter routes in the feeder and regional aircraft sector, and later also fly on short- and medium-haul routes.

We want to reduce pollutants to zero

In addition to contributing to climate effects and generating noise, air traffic also has an impact on local air quality at airports and in surrounding areas. The combustion process in engines produces pollutants in the form of nitrogen oxides (NO_x), carbon monoxide (CO), unburned hydrocarbons (UHC), and soot/particulate matter. In terms of the impact these have on health, NO_x, and particulate matter emissions are the most significant. To obtain type certification, aircraft and propulsion systems must meet ICAO environmental standards. ICAO has defined limits for the levels of NO_x, CO, UHC, and soot emitted by aircraft engines. All of the engines in which MTU holds a workshare meet the ICAO certification standards. Engines are also certified with regard to compliance with ultra-fine particle emissions. Unlike with noise emissions, we have less scope to influence NO_x and particulate matter emissions and the health effects because the combustor is not part of our portfolio for commercial engine programs. We can make a difference here only indirectly by improving the efficiency of the engine. For example, with the geared turbofan we have succeeded in significantly reducing NO_x emissions, which are 50% lower than those of its predecessor. Sustainable fuels can also make a big difference in this regard. In initial tests, the German Aerospace Center (DLR) has shown that particulate emissions from combustion are significantly lower with sustainable aviation fuels (SAFs) than with conventional aviation fuels. Using hydrogen as a fuel reduces them even further. More about SAF in the chapter Climate impact of aircraft engines

Our development of revolutionary propulsion concepts, which is part of our climate action activities, also holds great potential for reducing pollutant emissions. Our Water-Enhanced Turbofan (WET) and Flying Fuel Cell (FFC) concepts can significantly reduce pollutant emissions or even avoid them altogether. WET works by injecting water into the combustor, which, based on what we know so far, can cut NO_x emissions by over 80%. Hydrogen-powered fuel cells would actually emit nothing but water.

GRI: 3-3

Research & development

We are a technology leader in aviation, drawing our immense innovative strength from extensive research and development work aimed at transforming aviation with pioneering ideas and concepts.

The Paris Agreement triggered a paradigm shift in aviation. While previous targets focused on direct CO_2 effects on the climate, in the future, targets will take into account aviation's total climate impact. This also includes non-CO_2 effects; for example, the impact on the climate caused by nitrogen oxides and water emissions and by contrails and the resulting cloud formation. Fly the Green Deal, the vision of the Advisory Council for Aviation Research and Innovation for sustainable aviation in Europe, has taken up this approach. The European Green Deal defines a 55% reduction in greenhouse gas emissions by 2030 and climate neutrality by 2050 as intermediate steps on the way to the climate targets of the Paris Agreement. With its Fit for 55 package, the European Commission has presented measures to help achieve these goals. Such measures include adapting the European emissions trading system and introducing a minimum quota for the use of sustainable aviation fuel. However, in addition to these steps, the situation calls for innovative solutions for aircraft and propulsion systems–precisely what MTU is working on.

EUROPE EXPLORES PATHS TO CLIMATE-NEUTRAL AIR TRAVEL

→ More in the Aeroreport of MTU

Achieving climate-neutral air travel by 2050 would mean we can continue to fly with a clear conscience. Researchers are working hard to make this happen.

Robust innovation and technology processes at MTU

MTU manages technology development for future products using a multistage process. And over the long term, pilot concepts are developed with the help of a technology radar, and the development of enabling technologies initiated. Pilot concepts currently include the next generation of the geared turbofan (Gen2 GTF), the Water-Enhanced Turbofan (WET), and the Flying Fuel Cell™ (FFC). In the medium term, advanced product designs are created and technology requirements derived from them. One example of an advanced product design that has already been fleshed out is the next-generation geared turbofan. An Innovation Board regularly discusses all topics related to technology and innovation and initiates technology projects and studies. → More on this under Climate impact of aircraft engines

The basis of this technology process is our culture of innovation, which we cultivate with a variety of initiatives. These include a Group-wide innovation management concept; the Inno Lab, our creative think tank; and Ideation Challenges through which we gather and evaluate ideas from employees related to a specific field of innovation, such as our partner network featuring centers of competence.

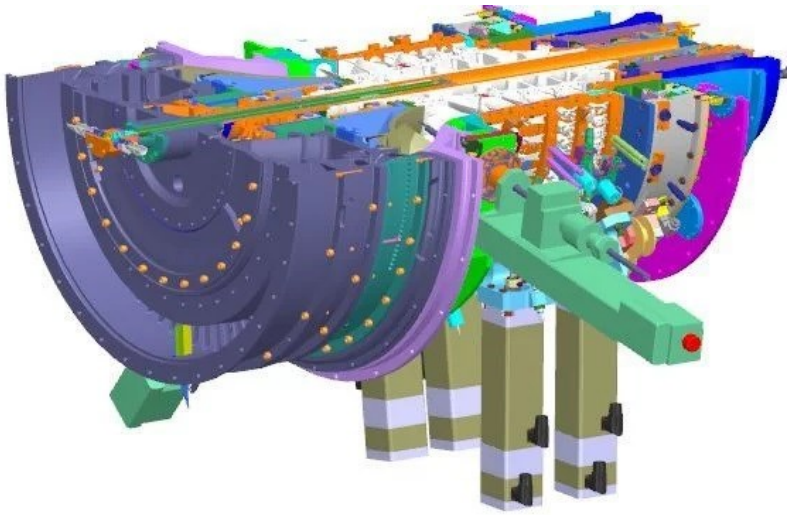
We are engine experts!

Our employees have top qualifications in fields as diverse as acoustics, fuel cells, 3D printing, and bionics. A total of around 1,100 engineers work at MTU, collaborating with seven centers of competence and numerous elite university institutes to create new and innovative solutions for the future. We also achieve our excellent position by patenting our work; in 2023, MTU's patent portfolio contained 2,542 individual patents.

Trend and technology radar

What will be the global trends affecting our core business in 2040? What opportunities do these developments offer and how should we as a company respond to them? Companies today have to know what scenarios are possible if they want to be best prepared for the future. As part of its Disruption Aviation 2040 project, MTU assembled an interdisciplinary team to investigate these questions and identify trends and technologies that are relevant for MTU and its environment. Sustainability was put on the radar as a trend area with several relevant topics in the areas of carbon footprint and circular economy and recycling identified, e.g. sustainable supply chains, climate regulations, and carbon capture. As MTU is already very well positioned in the field of future technologies, particularly with regard to alternative propulsion systems, other questions have been included. The various trends and developments identified in the course of the project are now being monitored further, and some of the topics have also been incorporated into Innoverse, MTU's innovation management platform.

CLEAN SKY 2: MTU IS WORKING ON DEMONSTRATORS



→ To the press release

As part of the European Clean Sky 2 research program, MTU is further optimizing its low-pressure turbine (LPT) and high-pressure compressor (HPC) components and building two demonstrators. One is EMVAL (Engine Material VALidation), to validate new LPT technologies, and the other is a twin-shaft compressor rig for new compressor technologies.

"Even in challenging times, we're consistently investing in our future with an eye to remaining at the forefront of technology. Our goal is clear: we want to make aviation of the future emissions-free. At the same time, we're also investing in comprehensive measures to make our sites climate-neutral."

Lars Wagner, CEO and Chief Sustainability Officer of MTU Aero Engines AG

Research and development budget increased

In 2023, MTU again invested heavily in sustainable innovation and technologies: our investment in research and development (R&D) in 2023 was 15% higher than the previous year, for a total of EUR 306 million (2022: EUR 265 million); as a proportion of revenue, it amounted to 5.7% (2022: 5.0%). With our R&D activities, we are actively promoting sustainable, zero-emission aviation while investing in MTU's future at the same time. R&D activities in 2023 focused on performance improvements in the geared turbofan programs, technology studies for future generations of propulsion systems–with an emphasis on the next-generation geared turbofan, the Water-Enhanced Turbofan, and the Flying Fuel Cell–and the expansion of capabilities in the area of virtual engines.

PIONEERING INVESTMENTS

306 million €

is how much we invested in R&D in 2023 with one clear goal: the decarbonization of aviation.

Global network of around 100 partners

To sustain MTU's technological expertise, it is important to be adequately plugged into the research landscape. We maintain a network of some 100 universities, research institutions, and companies around the world. → MTU's research network MTU is involved in major research programs in Germany (the Federal Aviation Research Program, or LuFo) and Europe (such as Horizon Europe, Clean Aviation, and Clean Hydrogen) that push the development of ecologically efficient propulsion technologies for aviation. These programs bring together researchers from a wide range of manufacturers, universities, and major research institutions.

One cutting-edge technology program is the SWITCH project, which combines MTU's Water-Enhanced Turbofan with hybrid-electric propulsion elements based on the geared turbofan. Our Flying Fuel Cell™ scored points in the second Clean Aviation call in 2023 and was accepted as a funded project under the acronym HEROPS.

KICKOFF FOR THE HEROPS TECHNOLOGY PROGRAM

→ To the press release

And we're off: the new HEROPS (Hydrogen-Electric Zero Emission Propulsion System) technology program for clean aviation was launched in mid-January. Around 30 representatives of the partners from industry, research, and academia came to MTU in Munich for the kickoff.

In addition, MTU is a founding member of Bauhaus Luftfahrt: a visionary think tank with an international dimension that pursues novel, unconventional, holistic, and interdisciplinary research. It brings industry and science together under one roof, focusing primarily on exploring the socioeconomic, political, and ecological aspects of aviation, designing visionary aircraft and propulsion concepts, unearthing promising technologies for the future, and devising knowledge management strategies.

GRI: 3-3