Zero emissions in three stages: MTU Aero Engines continues Claire technology agenda

* **Evolutionary and revolutionary propulsion concepts and sustainable aviation fuels in the spotlight**

Berlin, June 23, 2022 – Zero-emissions flight is the big goal for the entire aviation industry and a particular vision for MTU Aero Engines. In its Clean Air Engine (Claire) technology agenda, MTU not only sets out possible solutions and potential for sustainable commercial propulsion systems, but also time horizons for achieving zero-emissions flight in three stages. “Alternative, sustainable aviation fuels play an important role,” explains MTU COO Lars Wagner. Claire was unveiled to the public at this year’s ILA, to be held in Berlin from June 22 to 26.

The lodestar for the new version of Claire – which follows the first iteration, released in 2007 – is the goal of the Paris Agreement of limiting the increase in temperatures to 1.5 degrees Celsius compared to pre-industrial levels if at all possible. The aviation industry previously focused on CO2 emissions in setting its targets, but in the future, the influence of nitrogen oxide (NOx) emissions and contrails will also be taken into account as other important parts of aviation’s impact on the climate. “We’re tackling this new challenge,” says Dr. Stefan Weber, Senior Vice President Engineering and Technology at MTU in Munich, “and as part of that, we’ve aligned our entire technology agenda toward the new global objectives.”

The company has charted a clear course, with the propulsion concepts formulated for the near and medium term all aimed at reducing the impact on the climate. At the same time, lowering energy consumption remains important as well. MTU has bold ideas and approaches in this area, going beyond existing ones to tap into further potential. Wagner says, “Our goal with this is to fulfill our role as a technological pace setter worldwide once again.” The company is pursuing a two-pronged strategy here: furthering the evolution of gas turbines based on the Geared Turbofan (GTF), and developing revolutionary propulsion technologies.

**The next step in the evolution of the gas turbine**

Weber continues: “To really harness all the available potential, we’re already working on the second-generation GTF.” The goal here is to further reduce the fan pressure ratio, thereby increasing the bypass ratio. The thermal efficiency of the core engine can also be further improved through approaches such as integrating the design of compressor and turbine components. The company also plans to use new materials. “These new materials must be lightweight, extremely heat-resistant, and able to stand up to environmental influences. We’re focusing on the best material classes, such as sixth-generation single crystals and metal powders for turbines,” explains Dr. Claus Riegler, MTU’s Senior Vice President Technology & Engineering Advanced Programs. Driven by sustainable aviation fuels or liquid hydrogen, the second-generation GTF could already reduce the impact on the climate by as much as 65 percent compared to a gas turbine from the year 2000.

**Revolutionary propulsion concepts**

“We know that the evolution of the gas turbine alone won’t be enough if we are to meet our ambitious climate targets. Revolutionary new propulsion concepts will be needed,” Weber says. MTU is also hard at work in this area. Its two favored revolutionary concepts are the gas turbine-based Water-Enhanced Turbofan (WET Engine) and the Flying Fuel Cell (FFC). MTU’s fuel cell concept, the Flying Fuel Cell, calls for electrifying the entire powertrain, which will make it possible to operate aircraft with nearly zero emissions.

Sustainable alternative fuels (SAFs) and hydrogen will play an important role in all of these efforts. “SAFs open the door to climate-neutral aviation, for which they are absolutely necessary, but that’s not all. They can and should already be used to help achieve direct and significant reductions in climate impact,” Riegler notes. SAFs can be used on a “drop-in” basis right away, meaning that no adjustments are needed in either the aircraft or the engine. The production methods have been developed and approved, but there are only a few facilities capable of operating at an industrial scale. “We need these fuels now. It is imperative to create the necessary production capacity in the short term. We’re working to help achieve that,” MTU’s COO Wagner says forcefully.

**Zero emissions from aviation in three stages**

Here’s what the Claire technology agenda is like in detail. The first stage is determined by the GTF, which has been in use in series since 2016 and is already able to reduce climate impact by a significant amount today when combined with SAFs.

As the second step, to be completed by 2035, the goal is to have not only the next-generation GTF, but also the Water-Enhanced Turbofan – driven by SAFs or hydrogen – ready to use in all thrust categories, along with the Flying Fuel Cell for shorter, regional flights. A GTF powered by hydrogen is also conceivable during this phase. Says Riegler, “These solutions promise significantly lower impact on the climate.” The optimized GTF achieves 65 percent, the WET engine 80, and the FFC 95 percent.

2050 marks the third Claire stage. MTU’s goal is to further improve overall efficiency both for the GTF and for the WET engine. Near drop-in fuels – SAFs with chemical adjustments – can be used to achieve maximum reductions in climate impact. If the WET engine is operated with hydrogen, this would not only have further advantages with regard to climate-related emissions, but would additionally have the potential to reduce weight and the air resistance of the engine thanks to more-compact design and construction.

With improved efficiency, plans call for the Flying Fuel Cell to be used in short- and medium-haul flights as well starting in 2050, further reducing the climate impact of commercial aviation. To achieve this, the experts at MTU plan to further improve the efficiency of individual components to put the goal of zero emissions within reach.

For MTU, one thing is clear: “With an eye to the goals of the Paris Agreement, propulsion systems and sources of energy that make climate-neutral flying possible will have to be brought to market well ahead of 2050,” Wagner explains. Weber adds, “Together with our partners from industry and the academic and research sector, we aim to reduce the impact of aviation on the climate right away.”

**About MTU Aero Engines**

MTU Aero Engines AG is Germany's leading engine manufacturer. The company is a technological leader in low-pressure turbines, high-pressure compressors, turbine center frames as well as manufacturing processes and repair techniques. In the commercial OEM business, the company plays a key role in the development, manufacturing and marketing of high-tech components together with international partners. Some 30 percent of today’s active aircraft in service worldwide have MTU components on board. In the commercial maintenance sector the company ranks among the top 3 service providers for commercial aircraft engines and industrial gas turbines. The activities are combined under the roof of MTU Maintenance. In the military arena, MTU Aero Engines is Germany's industrial lead company for practically all engines operated by the country's military. MTU operates a network of locations around the globe; Munich is home to its corporate headquarters. In fiscal 2021, the company had a workforce of more than 10,000 employees and posted consolidated sales of almost 4.2 billion euros.

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