08 - WorldBus

Earth's warming due to human greenhouse gas emissions is a worldwide problem that is affecting our climate disastrously. In order to limit the Earth's warming, it is essential that humans decrease their carbon footprint in all aspects of their lives. Due to these environmental concerns, a shift between travel modes can already be witnessed. Local journeys are completed more and more using bicycles and public transport. For regional city-to-city connections trains are becoming more frequent, and electric cars can be used for difficult-to-reach locations. However, long-distance travel remains a niche that seemingly only aviation can fill.

Mission Objective

The aim of the project as a whole is to design a climate-friendly aircraft that can fly passengers sustainably between major international airports worldwide. As a hard requirement, the team was instructed to reach a decrease in emissions of 90% compared to current aviation options. Furthermore, the maximum door-to-door travel time was set to be 24 hours.

System Design

Following a detailed trade-off in which multiple aircraft configurations, such as blended wing body and multi-fuselage aircraft, were carefully investigated, the team decided to design a high-wing double-floor truss-braced aircraft. This choice was made primarily for logistic and aerodynamic purposes. A similar trade-off was performed for the propulsion system. Here, two propellants were investigated: kerosene and hydrogen. It soon followed that, in order to satisfy the environmental requirements, liquid hydrogen was the only viable propellant solution. The propulsion system trade-off was concluded with the selection of an engine type. It was chosen to work with the existing Rolls Royce Trent 1000 engine, which will be adapted adequately to use hydrogen as a fuel. Before the design stage was started, the team first performed a market analysis, to evaluate the financial feasibility of the project. Fortunately, it could be concluded that there is sufficient demand for the product of the mission and the project will lead to a positive return on investment and, thus, the team could continue the design phase. In the design phase, the team was confronted with some interesting challenges that arise from the use of liquid hydrogen. In order to have enough propellant to cover 19,000km, it was found that a tank length of more than 30m was required for a fuselage diameter of 6.25m. After investigating the controllability and stability of the design, it was decided to put the fuel tank in the middle of the cabin, splitting the cabin up into two parts. The large fuel take also posed challenges in terms of tank dimensions. The large tank and fuselage length strongly increased the weight and, thus, indirectly the wing span. As the team was keeping in mind the fact that the aircraft should be able to be integrated into current airport infrastructure, the wing span should not exceed 80m. To do so, aerodynamic performance was analysed and appropriate wing dimensions and characteristics were established. In order to keep the weight as low as possible it was decided to use the innovative carbon fiber-reinforced plastic as the main structural material for the wing and fuselage. The mission's operations were analysed as well, and innovations were incorporated. For example, external green taxiing systems and ground power units are used to reduce emissions. The last weeks will be dedicated to finalising the discussed design and ensuring that killer requirements have been met. With hydrogen as our pristine fuel, our flights become a planet-friendly jewel!