

Group 26 – Environmentally Friendly Medium-range Aircraft: Zephyr One

The importance of sustainability, waste reduction, and noise mitigation in the aviation industry is increasing exponentially, as the impact of human-induced emissions become more and more visible. Therefore, we, Group 26, have been tasked with the preliminary design of a “*medium-range, 200 passenger airliner that is considerably quieter and more environmentally friendly than the Airbus A320 family, achieving the goals of ‘Flightpath 2050’*”. The project objective statement is ‘*to design 75% of the aircraft out of recyclable materials, reduce the NO_x and CO_2 emissions by 90% and 75% respectively, and mitigate the noise pollution by 65%*’. In addition to these sustainability requirements, other driving requirements set by safety standards and market analyses greatly influence the outcome of the design process. After a trade-off was performed between several concepts, a Flying-V propelled by two geared turbofans, breathing liquid methane, was chosen as the optimal design for our mission.

With the high-level concept finalized, the design was split into four subsystems: the cabin, the wing planform, structures and the propulsion system. Teams working on each of the subsystems laid out the approach for their parts and components. However, since all of the subsystems are very interconnected (i.e. a super aerodynamic plane won't fit even a single passenger), a proper System's Engineering approach was required in order to maximize the performance of the entire aircraft. So, that is why, a tool was developed to do exactly this.



Using Differential Evolution with custom built-in design iteration, the aircraft design is optimized to have minimal fuel burn over its entire mission. This approach optimizes the engines, the wing planform as well as the cruise altitude and velocity for minimum fuel burn, yielding incredible performance that could never be achieved by manual design-iterations.

In parallel, a comprehensive market and financial analysis have been performed, indicating where the strong points of the aircraft are and what the expected profit and sales price from this aircraft can be.

Resulting from all of this, is our final aircraft design (see picture above). It is called: Zephyr One. Zephyr refers to the warm spring breeze from the West, referring to the positive wind of change that this aircraft will be bringing into the aerospace industry, making it not only more sustainable, but also much more exciting. One hints to the aspect of it being the first One: it is the first commercially viable Flightpath 2050 compatible aircraft, with a possible extra early entry into service, as the aircraft can not only fly on pure synthetic liquid methane but also on liquid natural gas.

While the design phase is completed, a lot of checkboxes still have to be ticked. A full performance and sensitivity analysis of the design will be done, and, additionally, the compliance matrix will be constructed to see if and how well the design meets the set-out requirements. Finally, all of the work done up to now will be fully documented in the final report. After the final report has been handed in, the group will continue with the final review, poster, symposium presentation and the red booklet.

Concluding this summary, a lot of hard work has been put into this project over the course of the last two months, however, some work still remains to be done. With a clear sight of what has to be done, the group is aiming to present the complete, exciting and detailed design on the day of the symposium.