Group 15

HumanAir

No one should have to choose between saving lives and saving the environment. Mission Aviation Fellowship (MAF) is an organisation that operates in the humanitarian aviation sector, providing much needed support to isolated communities. Currently, MAF uses small fossil fuel-powered aircraft, like the Cessna 206. But, in light of accelerating climate change, MAF recognises that they must reduce their emissions. Thus, the organisation has devoted itself to replacing its fleet with a more environmentally and economically sustainable alternative.

THE OBJECTIVE

Supplying an aircraft to MAF requires navigating a very constrained design space. MAF wishes to reduce their aircraft emissions by 50%, while maintaining current operations. This means reliable operation during multi-leg, long-distance flights in some of the toughest conditions: high altitudes and temperatures, short unpaved airstrips, and humid, mountainous environments. Moreover, most of their bases only have access to jet fuel, with electricity either unreliable or completely unavailable. With donations their primary source of funding, MAF can only invest little capital, making development of SAF or electricity supplies to these bases unfeasible. MAF therefore commissioned the HumanAir project team to design a small-sized aircraft and corresponding ground facilities that can reduce current Cessna 206 CO_2 emissions by 50%, while ensuring similar performance, economic viability, and market entry by 2030.

THE DESIGN

The team embraced a customer-centric design philosophy, identifying the most optimal and reliable solution able to meet MAF's operational needs. Through trade-offs and analyses, a high-wing, hybrid-electric, general aviation aircraft emerged as the best solution these requirements. The design incorporates several noteworthy features that enhance both performance and sustainability. Notably, the aircraft is powered by a parallel hybrid-electric drive, capable of operating on fuel, electricity, or both simultaneously. This will allow MAF to reduce their emissions while still being able to perform critical long-distance flights. In total, the proposed design reduces CO_2 emissions by 50% compared to the Cessna 206, significantly lowering environmental impact. Additionally, a retractable landing gear enhances aerodynamic efficiency and overall performance. On the ground, a full solar farm and battery charging system ensure the aircraft can be powered independently using 100% green energy. By using conventional structures, the design avoids costs associated with retraining MAF operational staff, and additional adaptations to existing facilities. These benefits are reflected in a unit cost of $1.5M and an operational cost under $300 per hour. This not only supports MAF's goals but also significantly enhances its financial sustainability by keeping all costs low. Overall, the new aircraft and its supporting infrastructure align perfectly with MAF's mission, securing both economic and ecological advantages for the organisation.

In the final phase of the DSE, emphasis will be placed on ensuring that the optimal design parameters are chosen using the developed software tools. Furthermore, the ultimate design selection will be validated to confirm that all mission requirements are fulfilled and that there are no conflicts between the subsystem interfaces.

Saving lives or saving the environment shouldn't be a choice, and thanks to our design, it doesn't have to be.