6 - Wigeon, a long range eVTOL aircraft

Currently, regional intercity travel is plagued by long travel times, a high environmental impact and expensive infrastructure. In an attempt to mitigate these issues, eVTOLs provide not only much shorter travel times and more flexibility, but also do this with zero emissions. Other advantages include a high level of comfort, a low operating cost and low noise levels. Although none of these aircraft are commercially available yet, their future impact cannot be underestimated. In 2021, already 1.2 M US$ have been invested into eVTOL research, a market size that is expected to increase to 15M US$ by 2024. In an attempt to enter this emerging market, the Wigeon was developed, a long range eVTOL aircraft for 4 passengers.

Mission Objective

After conducting an extensive market study, it was decided that an eVTOL carrying 4 passengers over a range of 300 km would fulfil the needs of a large customer base, and outperform most competitors. The customers mainly include commuters, business travellers and tourists with a higher income, with the aircraft being operated either by companies or privately. Furthermore, to reduce the initial investment, a minimal infrastructure is required for operations, as the Wigeon can take off from a regular helipad. The high level requirements were captured in the mission need statement:

"Provide sustainable, personal aerial transportation for inter-city travel that is competitive with the current transportation methods while requiring minimal infrastructure."

As the range of 300 km would be the highest in the eVTOL market, a large demand is expected. Because the battery technology required to fulfil the range is not yet available, the first aircraft will be sold around 2031. The full production capability of 200 aircraft per year will be reached in 2035. The retail price per aircraft will be 2M US$.

System Design

The wigeon has a tandem wing design with both wings of equal size. Transitioning between vertical to horizontal flight is done by rotating the two wings. Thrust is provided by 12 electrical engines distributed equally over the leading edge of both wings. This positioning of the propellers enables the Wigeon to provide sufficient lift, even at lower speeds. Aerodynamic efficiency is increased by placing propellers in the wingtips and having them rotate against the direction of the wingtip vortices. The power required to operate the aircraft is fully provided by solid-state lithium batteries. Throughout the design process, safety was considered of the utmost importance. Redundancy was build into critical systems. The Wigeon is able to safely land after an engine failure in any flight phase. Furthermore, the aircraft structure was designed considering crashworthiness as an important parameter.

With a cruise speed of 260 km/h, the aircraft is able to fly a 300 km mission in just over 1 hour and 15 minutes. Charging the batteries takes 30 minutes, keeping turnaround times low. Since the aircraft is operated by a single pilot, and uses electricity as an energy source, operating costs are kept at a minimum. For an aircraft that is used commercially at a rate of three flights a day, an operational life of 15 years is expected, requiring new batteries only once. Waste at end-of-life is minimal, as the Wigeon is constructed mainly out of recyclable aluminium.