11 - A320-HACK

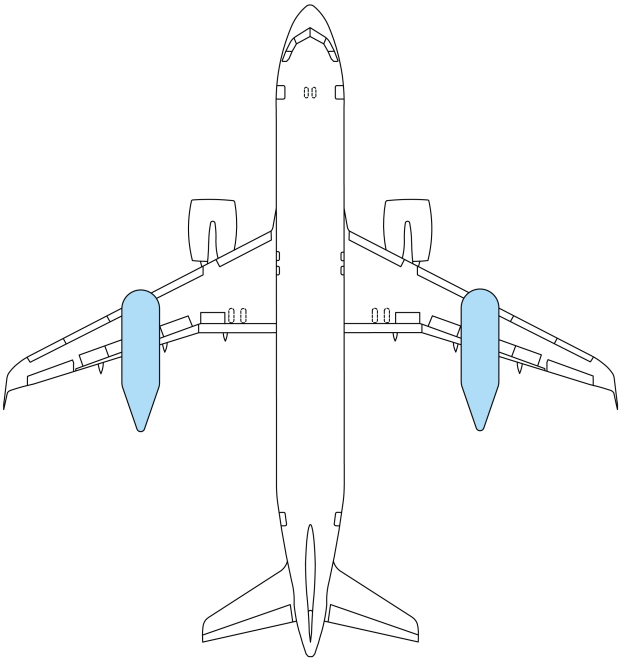
Dear Jury members of Design Synthesis Exercise of 2021,
The aviation sector is growing rapidly, and the number of planes in the skies is rising, leading to higher levels of emissions and a greater climate impact of the industry. Hence, sustainability becomes a greater concern with every new day.

Mission Objective

It is in this context that the A320-HACK project appears. Designed to improve the sustainability of the aviation sector, the A320-HACK (Hydrogen Assisted Combustion of Kerosene) is a competitive, single-aisle, aircraft designed to operate using both kerosene and hydrogen fuels. This hybrid propulsion system should be implemented before 2035 and will lead to significant decrease in climate impact of modern airplanes while maintaining economic attractiveness.

System Design

Firstly, one of the challenges was to design and select the placement of the on-board hydrogen storage system. After multiple considerations, it was selected that A320-HACK will use hydrogen in liquid form (LH_2) that will be stored in wing podded tanks, mounted on top of the wing. This solution allows for a safe storage of the hydrogen, far from passengers and the ground. It also maintains a similar configuration to the original A320neo, thereby reducing developments costs.
Secondly, due to the implementation of the hybrid fuel system, the LEAP-1A engine, used by the A320neo, was redesigned. The temperatures, pressures and other characteristics were altered to operate with both fuels, improve engine efficiency and therefore reduce emissions. The latter are currently being investigated and a detailed analysis will be shortly produced. Additionally, it was decided to replace the APU of A320neo with a Dedicated Power System (DPU) that will supply all the on-board electricity and function using a hydrogen fuel cell. This solution allows to further improve the engine efficiency, as the engine will no longer supply electrical power, while reducing emissions and noise pollution.
The introduction of A320-HACK will also require significant adaptations to the airports operations and logistics. These are investigated for the Rotterdam-The Hague (RTH) Airport, which was selected as a case study for this project. Due to hydrogen presence, the operations during refueling were modified to respect safety regulations while not increasing the turnaround time of the current A320neo. Transportation and refueling will be performed using LH_2 trucks, and the hydrogen will be outsourced from the port of Rotterdam and stored in cryogenic storage tanks at the RTH.
Finally, in the last part of this DSE project, the sustainability impact and cost analysis of A320-HACK will be finalized to generate a business case for the new airplane and prove its market competitiveness. With this, the preliminary design of A320-HACK will be completed and a path for future aviation will be laid.



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