19 - H_2OPPER: the Electric Island Hopper

Aviation is a vital lifeline for island communities. However, air travel is also a significant contributor to global warming and a source of air pollutants. The rising sea levels, caused by global warming, heavily affect the livability of pacific islands, causing drink water shortages and crop failure. For some islands it is already too late and are deemed to disappear in the upcoming years. The only viable solution to reduce the impact on the earth is to decrease the emissions of the aviation industry. Sustainable aviation could be of big importance in the coming years to reduce the effects of climate change. The H_2OPPER is the first step towards the solution by bringing innovation to the present.

Mission Objective

The mission of DSE group 19 is to design a fully electrically propelled net-zero emissions aircraft suitable for island hopping operations. This will be done with a team of ten students within ten weeks. This aircraft shall have a maximum range of 300 nautical miles and shall carry 19 passengers. In addition to climate-neutral propulsion, the structure of the aircraft shall be at least 90% recyclable. All while being commercially competitive.

System Design

The H_2OPPER is a liquid hydrogen powered commuter aircraft. The storage of liquid hydrogen is a demanding task as it has to be stored at -253°C. Moreover, the conversion of hydrogen to electricity leads to large amounts of heat that needs to be dissipated.

The design of the aircraft started with a conceptual design study. The team used this time to establish the functions and requirements that the aircraft needs to adhere to. Certain design options were gathered and analysed to select the most viable design for the H_2OPPER.

The second phase regarded sizing the aircraft and its subsystems. In this phase challenges were identified for which inventive solutions were found:

The first challenge concerns the volume and weight that is needed to accommodate the new type of energy source. In order to store liquid hydrogen large and heavy tanks are needed that are not in line with aerospace applications. To overcome this challenge a composite material tank was designed that takes advantage of a multi-spherical shape.

The second challenge concerns the removal of the heat from the aircraft. The conversion of hydrogen to energy produces a lot of heat which has to be removed from the aircraft. To dissipate this heat, multiple solutions were found. For example, a radiator is placed behind the engines under the wings. The heat from the hydrogen conversion will also be used to heat the cabin during flight and to heat up the liquid hydrogen before it enters the fuel cells.

The last challenge concerns the power supply. Electric aircraft are usually weight constrained; due to the weight of the energy supply. To be able to reduce this weight, several methods were used to decrease the power needs of the aircraft. The main solution to this challenge was reducing the induced drag by attenuating wingtip vertices through the use of wingtip mounted engines.

The H_2OPPER has all the advantages of innovative technology while minimizing its weaknesses. With these characteristics the H_2OPPER is a leap forward in terms of sustainability in a commercially competitive environment.