Creating an Electric Future for Aviation: Projet HERA

For the past two years, a team of students from the University of Sherbrooke's Faculty of Engineering has been pursuing an ambitious goal. They set out to demonstrate that electric aviation can take flight, and they built an electric-powered airplane to prove it.

The goals of *Projet HERA* (HERA Project) were two-fold: first, to demonstrate the advantages of electrification in aeronautics, and second, to acquire an in-depth understanding of aeronautic electrification through practical learning and hands-on experience.

They succeeded. The team converted an existing homebuilt KR-2 airplane from combustion power to 100% electric battery power. Beyond the team's technical achievements, the project's true success was the learning the students gained and contributed in the process. Participation in this project has equipped the team to tackle the changes being rapidly brought on by a global push for electrification of transportation.

At a Glance

- **One 100% electric airplane**
- **Two years of study and dedication**
- **27 students with an electrifying future**

The Three Es of Electrification: Economy, Efficiency & Environment

Electrification is truly one of the hottest topics in engineering today. Electric vehicles have gained traction and become mainstream. Now, the race is on to take electrification to the air.

The benefits promise to be impressive, from making air travel more affordable by lowering fuel costs to improving the environment by making residential zones near airports quieter and reducing toxic emissions. As fuel represents about 50% of the cost of aircraft ownership, and commercial aviation is responsible for about 2% of global carbon emissions (International Air Transport Association IATA), electric flight makes business and environmental sense.

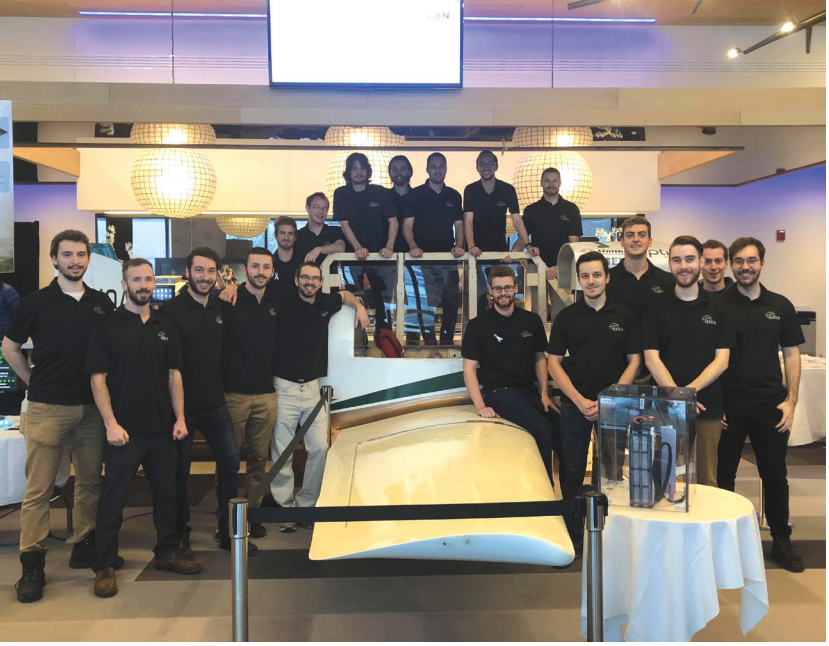
The first manned, electrically propelled flight of a small aircraft took place in 1973 and lasted only a few minutes. The recent successes with hybrid electrification suggest that small electric aircraft could be on the market in the next few years. For commercial aviation, however, electric propulsion remains a significant challenge, and is unlikely to become a standard solution until at least 2050.

Technical Challenges

The main challenge HERA Project faces is as old as flight itself: propulsion. The plane must have enough battery power (energy storage) and a powerful enough motor for the plane's weight if it is to get air bound.

Unfortunately, even the most advanced battery technology available today cannot produce as much energy per kilogram as jet fuel. As the battery's storage increases, so too, typically, does its weight – meaning that it then requires even more power to get off the ground. One approach is to design smaller, lighter batteries, power systems, and converters capable of storing and handling much greater amounts of power.

To ensure an appropriate power/weight ratio, the HERA Project team needed to keep the weight of their plane under 1,000 pounds. They used three groups of six battery blocks (a total of 18 blocks containing 2,016 cells), which each provided more than 5 kW of power. Two blocks were positioned one in the nose and one at the rear of the plane. At the outset, the team planned to convert the plane to only hybrid electric power. By January 2019, halfway into the project, they had the confidence to go 100% electric. Seven electrical engineering students joined the project, bringing the team from 14 students to 21.



Improving Design with Simulation

Maya HTT came on board as a sponsor of HERA Project in mid-2018, six months after the December 2017 kick-off. Since then, Maya HTT has contributed expertise in thermal simulation and provided ongoing coaching and mentoring in the software (NX Amesim and Star CCM+) used to improve two significant areas of the aircraft's design: the battery and the nose.

Advanced 3D modelling and simulation software made it possible for the team to modify and optimize the aircraft design. Maya HTT provided the help needed to complete a representative simulation of the battery pack in NX Amesim and to perform a computational fluid dynamics (CFD) study to obtain data on the critical components housed inside the aircraft nose.

In the future, electrification could open the door to radically different and far more aerodynamic aircraft designs than is currently possible with fuel-carrying craft. The design-space exploration capabilities of modern simulation software will surely facilitate breakthroughs as engineers overcome fuel and propulsion challenges.

Partners in Hands-on Learning

The team's excitement for the bold challenge they have undertaken is palpable and contagious. As Antoine Gaillardetz, leader of the battery team, described what HERA Project means to the students, his enthusiasm for the project and his appreciation for the generous support provided by sponsors and partners such as Maya HTT was evident. He described how helpful it was to have ready access to the expertise of a responsive partner, and that nothing would have been possible without the project's sponsors, including the Maya HTT team.

Lauded as one of the most interesting projects presented at Expo MégaGÉNIALE 2020, HERA Project has generated plenty of buzz and excitement, along with media coverage at every stage. This project clearly has the potential to transform not only the students' future careers but to advance insights into electrification. It might even have the power to bring about positive change in the world, and a better future.

> ***"Maya HTT's sponsorship helped this project take flight from a simple idea to reality. The Projet HERA team is grateful for the valuable support and expertise Maya HTT contributed."***
>
> Antoine Gaillardetz
>
> Mechanical engineering student

Propelling Success

The question on everyone's mind is whether the craft will successfully take flight. Early this year, in January 2020, the team performed ground tests of the propulsion system, with encouraging results. All signs point to Projet HERA being able to take flight.

Although the results of a future air test are unknown, it is not too early to declare the project an unmitigated success. Why? Twenty-one students have developed a better understanding of what it takes to make electric flight a reality. They have grown, broadened their horizons, and helped their careers take flight, while becoming part of the engineering community. Maya HTT is proud to be a sponsor of this team's trajectory and journey.

Bravo HERA Project!

MégaGÉNIALE + U of S

MégaGÉNIALE is the largest university engineering fair in Canada. The exhibit presents the projects of students graduating from the University of Sherbrooke's Faculty of Engineering in civil engineering, chemical engineering, biotechnology, electric engineering, computer engineering and mechanical engineering.

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About Maya HTT

- **Industry-leading software developer and provider of engineering services in computer aided engineering (CAE), computer aided design (CAD), computer aided manufacturing (CAM), product lifecycle management (PLM), and datacenter infrastructure management (DCIM)**
- **Extensive experience in design, analysis, systems integration and deployment**
- **Specializing in mechatronics, thermal, fluid and structural analysis, and composites**
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