Securing Flight's Clean Future with Cryogenics and Superconductivity

Joshua Feldman, a graduate student in the University of Illinois at Urbana-Champaign's Haran Research Group, headed by Professor Kiruba Haran, is currently working to solve a rather lofty problem… literally. He and the Haran team are addressing the uncertain outcome of airline travel in an envirocentric future by developing a superconducting motor with the help of cryogenics. The goal is to produce a fully superconducting motor with an output of roughly 2.5 MW.

The International Civil Aviation Organization's Air Transport Bureau reports that just over 2% of today's global greenhouse gas emissions come from air travel, and that number is expected to at least triple in the next 30 years. While 2% may read as a small impact, aviation is one of the fastest growing polluters on the planet. Some round trips, like New York to London, produce an average of 986 kg of carbon dioxide per passenger. According to Atmosfair, a German nonprofit monitoring and fighting the effects of air travel on the environment, that's more pollution from a single individual in one trip than a person living in one of the 56 lowest-emission countries will produce in a year.

This forecast has been cause for concern among climate activists and engineers alike. Groups around the world are investigating alternative propulsion methods and research is pointing to a promising option.

Artist's rendering of an advanced commercial transport aircraft concept utilizing CHEETA systems. *Image: Grainger College of Engineering/University of Illinois*

Launched early this year, the Cryogenic Hydrogen Energy Electric Transport Aircraft (CHEETA), a $6 million, three-year collaboration between the University of Illinois and several other research institutions, is designing a fully electric concept airplane for commercial air travel and developing the technologies necessary for the plane's realization. The group includes Boeing Research and Technology, General Electric Global Research, the Ohio State University, Massachusetts Institute of Technology, the University of Arkansas, the University of Dayton Research Institute and Rensselaer Polytechnic Institute. Including Haran's group, with its superconducting propulsion motors, each of the teams is responsible for a different component of the plane including aerodynamics, fuel storage, electronics and power systems, among others.

"Rising greenhouse gas emissions are worrying, the rise and volatility of fuel prices threatens the global economy by making air travel less economical, and noise from jet engines irritates local communities. These problems point to electric propulsion, using alternative fuels, as our solution," said Feldman in an interview with ***Cold Facts***. The proposed alternative fuel? Liquid hydrogen.

Given that weight and size are critical factors for any piece of aviation equipment, superconducting motors are an ideal solution. In addition to eco-friendly emissions, the motors will yield two benefits: increases in both power density and specific power. Superconducting motors can output more power than non-superconducting motors, while weighing less and taking up less space.