The Future of Clean Flight: Hydrogen Fuel Cells and Aviation

Grace Anderson

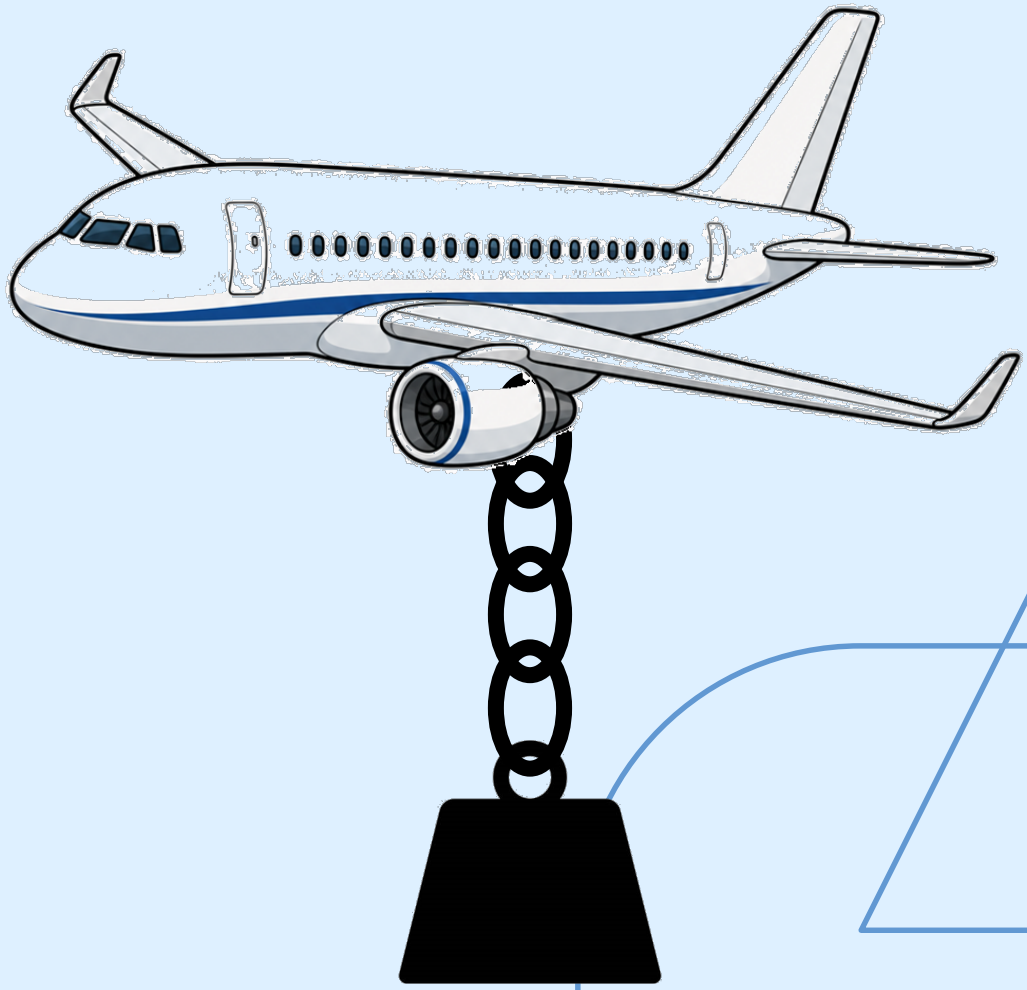
Postdoc at KTH

September 30th, 2026

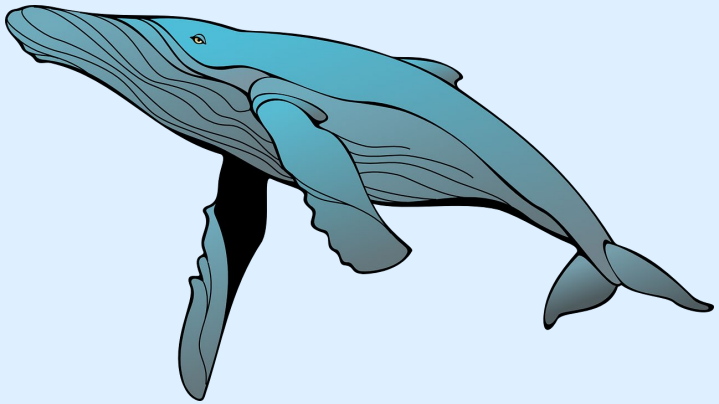
STandUP for ENERGY



1 Gt CO_2 is Emitted Per Year from Aviation



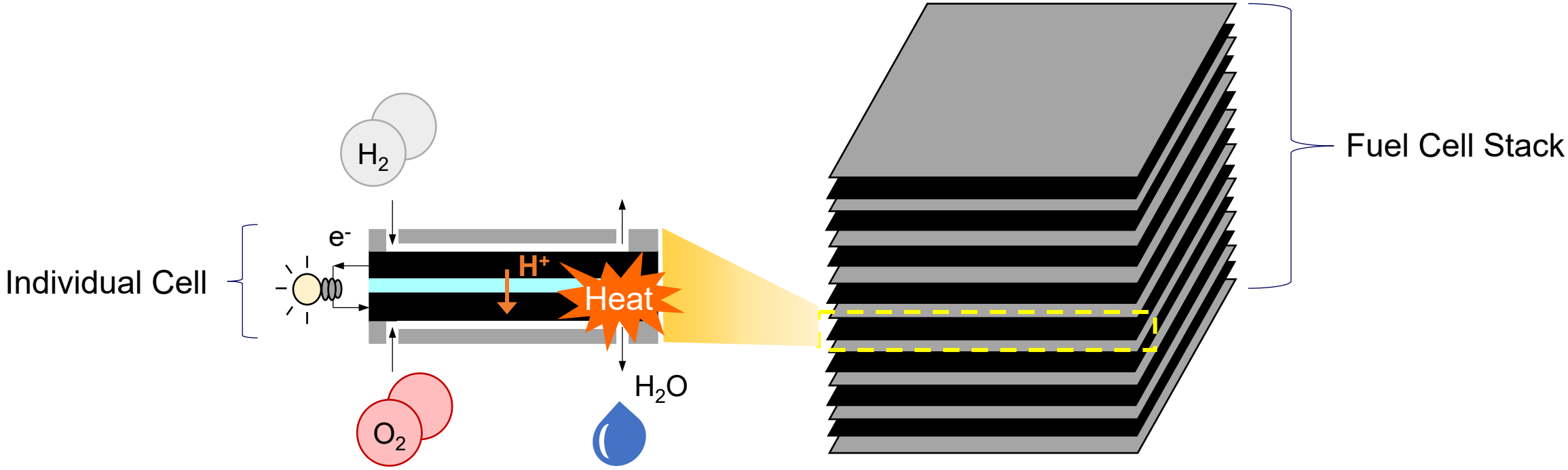
6 Million Blue Whales



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https://www.iea.org/data -and-statistics/charts/ co2-emissions-from-aviation-2015-2024

Fuel Cells: Zero Emission Alternative



Brief History of Fuel -Cell-Powered Aviation



AeroVironment Global Observer – Unmanned Aerial Vehicle (UAV)

2005

First fuel cell powered UAV



Boeing Two-Seat Manned Plane

2008

First piloted airplane powered solely by hydrogen fuel cells



HEAVEN Project -> HY4

2007 - Present

Longest flight: 1,500 km

Four-seat hybrid electric fuel cell powered plane

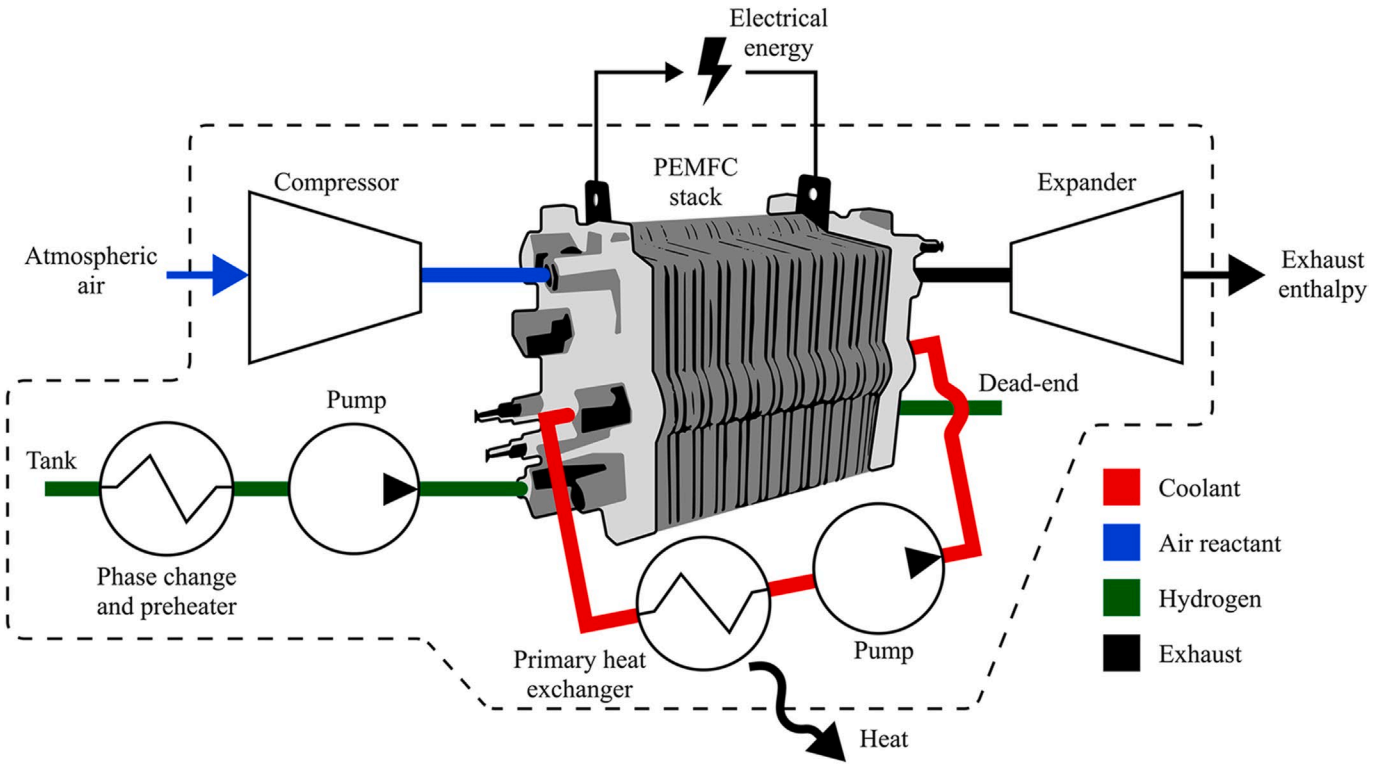


ZeroAvia Hyflyer

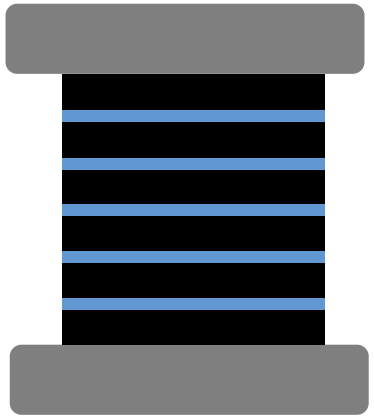
2019 - Present

HyFlyer I: Six-seat hydrogen-electric aircraft
HyFlyer II: 19-seat hybrid aircraft (2023)

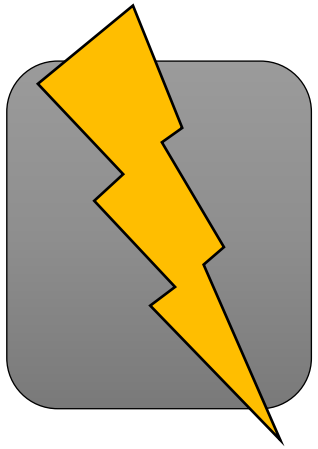
Challenges and Limitations



Fuel Cell Systems Are Complex and Heavy



Increase stack performance to 6 kW/kg



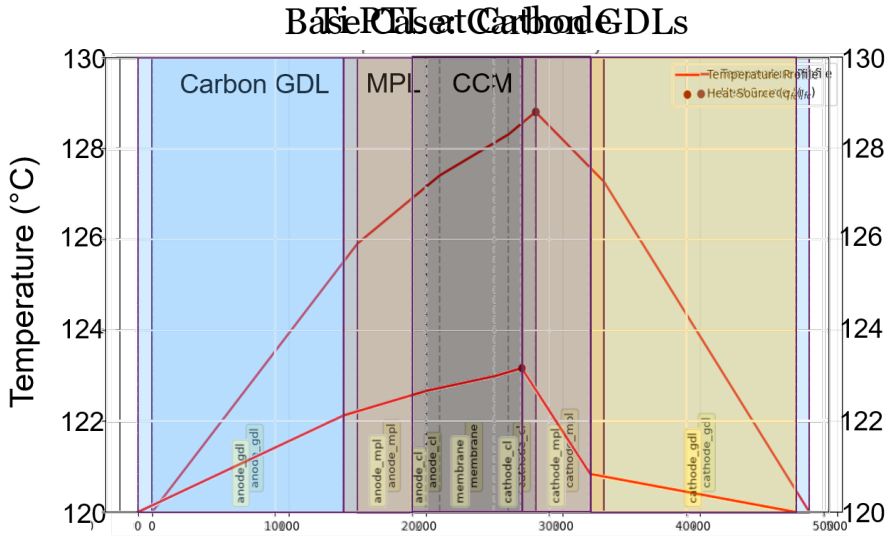
Achieve **system** specific power of 2 kW/kg

Frey, A. C.; Bosak, D.; Madrid, E.; Stonham, J.; Sangan, C. M.; Pountney, O. J. Thermal Management in High Temperature Proton Exchange Membrane Fuel Cells for Aircraft Propulsion Systems. *Progress in Aerospace Sciences* **2025**, *153*, 101052.

Project Approach

Thermal Management

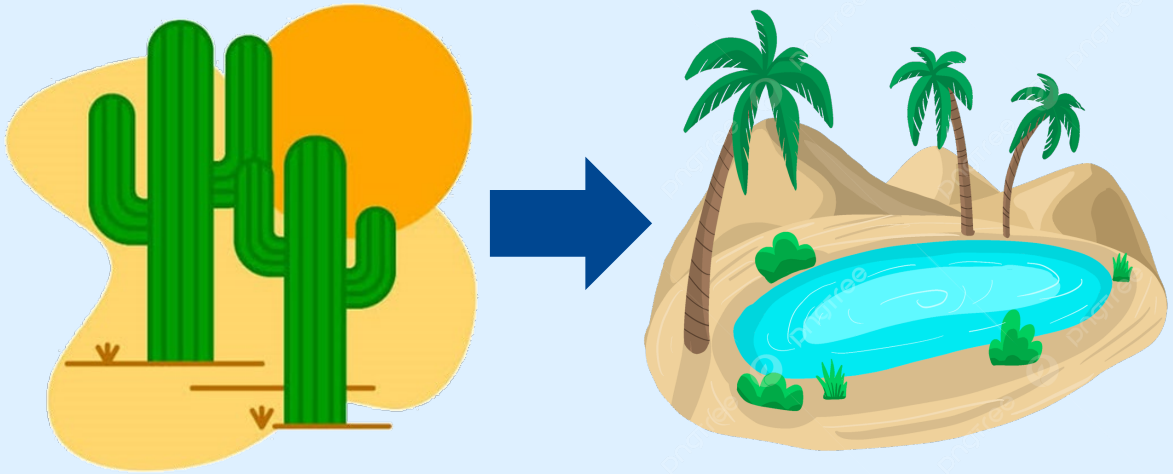
Temperature spikes due to heat generation in the cell during reaction



Improve thermal conductivity to lower cell temperature during operation

Water Management

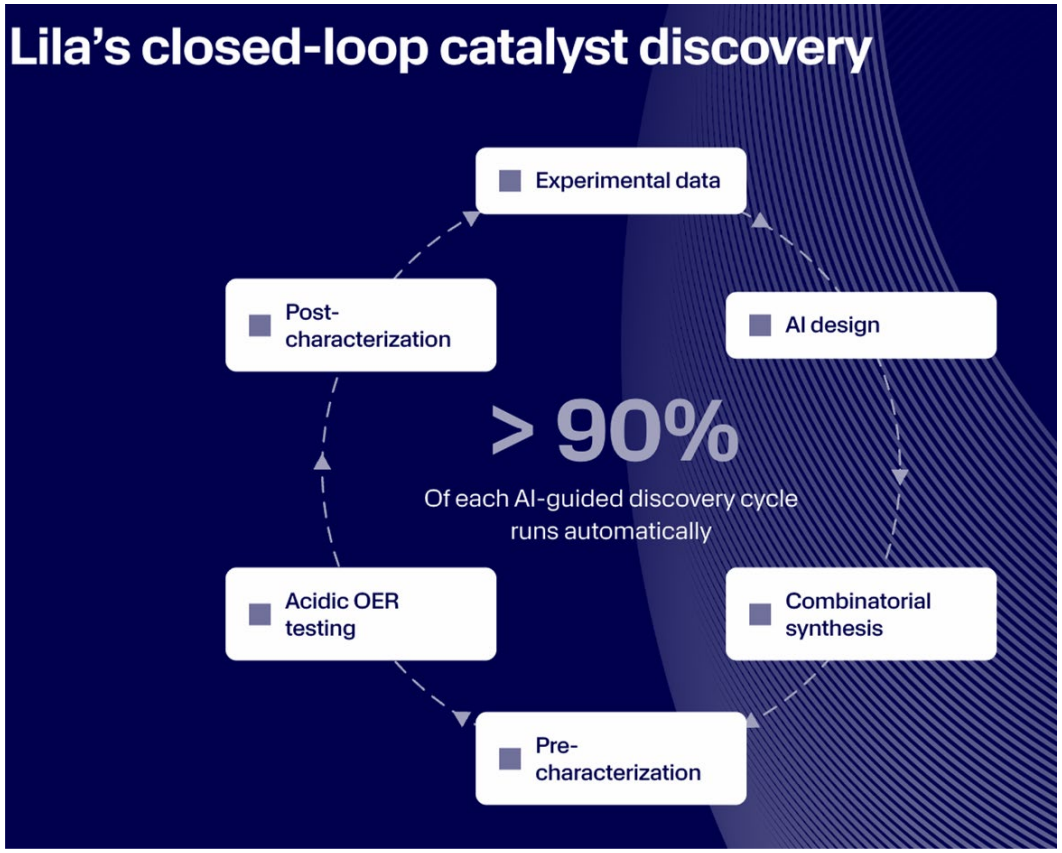
Performance drops when the fuel cell operates at low humidity



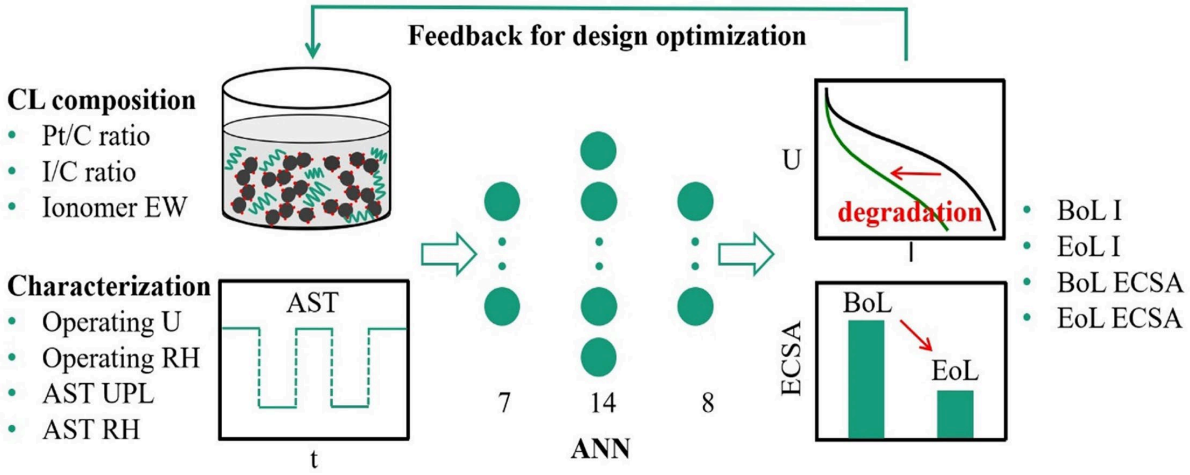
Engineer the layers in the cells to absorb water and maintain higher water content

Using AI to Accelerate Research and Understanding

New Catalyst Discovery



Enhanced Prediction of Durability and Lifetime of Fuel Cells



Jenewein, K. J. et al. AI-Guided High-Throughput Discovery of Iridium- and Ruthenium-Free Palladium-Oxide Catalysts for Durable Acidic Oxygen Evolution. arXiv September 25, 2026.

Hou, Y.; Schneider, P.; Ney, L.; Zamel, N. Optimizing Catalyst Layer Composition of PEM Fuel Cell via Machine Learning: Insights from in-House Experimental Data. *Energy and AI* **2024**, *18*, 100439.

Summary



Fuel cells are a very promising zero-emission alternative to traditional jet -fuel power for aviation



Improving the cell heat and water management could be the key to needed power density improvements



AI can help accelerate search and understanding of fuel cell systems to progress more quickly towards implementation

Thank You! Questions?

My Advisors:
- Göran Lindbergh
- Björn Eriksson

Collaborators:
- Johanna Dombrovskis
- Gert Göransson
- Marcus Liljenberg

My colleagues in the Applied Electrochemistry Group at KTH



Funded by:

VINNOVA
Sweden's Innovation Agency

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