**A Practical Journey Into Hydrogen Aviation Research: My Secondment at the University of Birmingham**

By Dr Zekun Guo

As the only researcher in energy engineering within my department (Data Science, AI and Modelling Centre) at the University of Hull, I have long been exploring questions around hydrogen aviation, multi-energy optimisation, and the future of airport energy systems. The work is exciting, but it also requires careful navigation—especially when working in an environment where my specialism does not have an immediate peer group.

For this reason, my secondment to the **Birmingham Energy Institute (BEI)** at the University of Birmingham came at a particularly meaningful time. It offered not only technical insight but also a well-established research ecosystem that helped me clarify the direction of my work.

A person giving a presentation in front of a large screen

AI-generated content may be incorrect.

**Travelling Between Hull and Birmingham: A Small but Useful Rhythm**

The journey itself became part of the experience. Travelling from Hull to Birmingham takes around **three hours by train**, assuming no delays. The trip is not always the most comfortable—balancing a laptop on a moving table, squeezing in reading, coding, replying to emails, and occasionally dozing off when the carriage gets too warm.

Yet stepping onto the Birmingham campus always felt worthwhile. The BEI has a distinctive atmosphere: structured, research-driven, and collaborative. Walking through the building, it’s common to see teams gathered around diagrams, debating system constraints, or preparing data for modelling work. For someone working largely on their own field at Hull, this environment was refreshing and grounding.

**Structured Collaboration and Meaningful Academic Dialogue**

Throughout the secondment, **Professor Sara Walker** provided consistent guidance. In our weekly meetings, she helped position my work within a broader systems context—how hydrogen integrates with airport infrastructure, where bottlenecks might occur, what constraints matter most, and how this research could support national strategies.

Sara also connected me with excellent researchers across BEI and the HI-ACT network. This included:

* **Dr Hadi Heidary,** with whom I discussed high-resolution hydrogen demand modelling for airports.
* **Dr Saeed Harati,** who shared insights on storage configurations and scalability;
* **Dr Tongtong Zhang and Dr Jian Song,** who played an essential role in developing a techno-economic framework for hydrogen supply chains and even visited me in Hull for in-person discussions.

These exchanges were not simply technical—they helped me reorganise my research into a clearer and more coherent direction.

A person and person standing in a room

AI-generated content may be incorrect.

A group of people standing in front of a fence

AI-generated content may be incorrect.

**Expanding the Network: HI-ACT All Hands Meeting in Glasgow**

During the secondment, I also attended the **HI-ACT All Hands Meeting** in Glasgow, which further broadened my perspective.

There, I met **Professor David Flynn** and the HI-ACT Work Package 3 colleagues, and we discussed the coupling between hydrogen systems and transport electrification digital twins—particularly how future hydrogen production, storage, and refuelling demands will interact with power system planning.

These conversations were highly stimulating. As someone working at the intersection of **data science, optimisation, and AI**, I left Glasgow with a much clearer view of how modern AI techniques—forecasting, reinforcement learning, hierarchical optimisation—could be integrated into hydrogen-aviation and multi-energy system modelling.

A group of people posing for a photo

AI-generated content may be incorrect.

**Research Outcomes: Turning Fragmented Ideas into a Structured Research Pathway**

Over the course of the secondment, several concrete outcomes were achieved:

* Development of a **2040 hydrogen demand scenario model for Birmingham Airport (BHX)**, including flight schedules, energy requirements, and infrastructure assumptions.
* A preliminary hydrogen supply chain optimisation framework, combining cost, emissions, operational feasibility, and spatial constraints.
* Presented at the **APEN-Disco workshop** in Cardiff and was invited to submit a journal paper to **Applied Energy**.
* Collaborative work on a **review article** synthesising the technology readiness, economics, and system-level considerations of hydrogen aviation.

Beyond these outputs, the secondment helped establish a **sustained collaboration mechanism** between Hull, Birmingham and the HI-ACT consortium: regular meetings, shared modelling tools, potential conversations about future grant proposals.

**Impact: Clarity, Collaboration, and a More Coherent Direction Forward**

This experience had several important impacts on my work:

**1. A clearer research roadmap**

The structured environment at BEI and HI-ACT helped me refine the long-term direction of my research—particularly in hydrogen-powered aviation, airport energy systems, and AI-enabled optimisation.

**2. A stable collaboration network**

Working with Sara and the HI-ACT researchers established a foundation for ongoing collaboration that will benefit future projects, publications, and student development.

**3. Stronger alignment with national and industrial needs**

The insights gained—particularly around system constraints, deployment feasibility, and cross-sector coupling—will help shape future engagement with airports, energy companies, and policymakers.

**Looking Ahead**

Moving forward, I aim to deepen research in three areas:

* **Hydrogen aviation system modelling,** with a focus on future airport infrastructure requirements;
* **Multi-energy system optimisation,** integrating hydrogen systems with electricity networks;
* **AI-driven forecasting and control,** bridging data science methods with energy engineering problems that urgently require smarter solutions.

The secondment was not simply an academic exercise—it was a practical step toward building a more connected research ecosystem between Hull, Birmingham, and the wider HI-ACT community. It clarified the next stages of my research and strengthened the collaborations needed to pursue them effectively.