

# Researchers analyze retrofit hydrogen-powered aircraft configurations

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As technologists search for approaches to reduce our global carbon

footprint and stave off the worst ravages of climate change, they are turning to an old friend—hydrogen. The potential of hydrogen fuel cells for generating power is enormous although not without issues.

[Published](#) in the *International Journal of Sustainable Aviation*, a team from the UK and Romania discuss [hydrogen](#)-powered [aircraft](#) configurations. The concept of replacing carbon-rich jet fuel with zero-carbon hydrogen is high on the agenda.

The team has compared the performance of a regional aircraft, the ATR 72-600, using three different propulsion systems: conventional jet fuel, direct hydrogen combustion, and hydrogen fuel cells. Bassam Rakhshani and Tony Leslie of the University of the West of Scotland in Paisley, UK, and Alexandru Stan of Premium Aerotec Ghimbav (Airbus) in Romania used Simulink, a computational tool, to model and analyze [power requirements](#), [fuel consumption](#), propulsion efficiency, and emissions.

The findings show that hydrogen propulsion, either through direct combustion in a jet engine or using fuel cells, reduces fuel mass significantly. Specifically, hydrogen fuel cells achieve a 50% reduction, and direct hydrogen combustion an 80% reduction compared to traditional jet fuel.

This efficiency is attributed to hydrogen's higher energy density when compared to conventional jet fuel. However, the researchers also found a significant drawback: the increased weight from hydrogen storage, which negatively impacts overall aircraft performance.

The [aviation industry](#) is estimated to contribute 2–3% of global carbon dioxide emissions, and that percentage is set to double by 2050. There thus remains an urgent need to make aviation more sustainable. As it stands, hydrogen propulsion, alongside [electric propulsion](#), could be the

answer, but new technology is needed to overcome that storage weight-gain problem in order to achieve near-zero aircraft carbon emissions.

The transition to hydrogen-powered aircraft has other challenges: shorter operational ranges with current technology, lower passenger capacity, higher operational costs, and the need for new refueling infrastructure. There are also the safety issues to consider.

Nevertheless, the companies are looking at how they might retrofit their aircraft. It is possible that the development of novel storage systems might address some of these issues.

**More information:** Bassam Rakhshani et al, A steady-state model-based evaluation of performance characteristics and feasibility analysis of retrofit hydrogen-powered aircraft configurations, *International Journal of Sustainable Aviation* (2024). [DOI: 10.1504/IJSA.2024.138699](https://doi.org/10.1504/IJSA.2024.138699)

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