Case Study

Medium Aircraft Tow Tug

Pioneering Zero-Emission Hydrogen Hybrid Powertrain

Situation

Airport operations rely heavily on specialist vehicles such as aircraft tow tugs, which are traditionally powered by diesel engines. These vehicles operate in demanding environments where battery-electric solutions alone cannot meet duty cycle requirements due to power, range or refuelling constraints. As the UK moves toward net zero emissions, there is an urgent need to decarbonise these heavy-duty and specialist fleets without compromising performance, reliability or cost-effectiveness.

A real-world solution was required that could demonstrate the feasibility of hydrogen internal combustion engines (ICE) as a zero-emission alternative for such vehicles.

Solution

ULEMCo developed the ZeHyDA (Zero Emission Hydrogen Demonstration and Assessment) project to address this challenge. The company introduced the world's first HyICE™ powertrain—a 100% hydrogen internal combustion engine integrated with an electric drivetrain to form a series hybrid system.

With collaboration from Teesside International Airport, RAF Leeming and Newcastle University, and with DfT Hydrogen Transport Hub funding, ULEMCo demonstrated the technology's ability to deliver zero emissions while maintaining the operational performance required for specialist fleet applications.

Key project milestones included:

- Conversion and demonstration of a Medium Aircraft Tow Tug (MATT), previously used by the RAF, to operate with the new hydrogen hybrid powertrain.
- Real-world PEMS (Portable Emissions Measurement System) testing to confirm the absence of harmful emissions.
- Development of patented IP covering safe onboard hydrogen management, advanced engine control software, and conversion processes for optimising conventional engines for hydrogen fuel.

The airside hydrogen electric tug is now in operation at Cranfield Airport and is providing valuable real-world data to inform further development. The vehicle is refuelled via a HyQube hydrogen refueller, with plans for future refuelling from a mobile HyTruck unit provided by Fuel Cell Systems.

Benefits

The MATT development and its implementation at Cranfield Airport delivers tangible operational, environmental, and strategic benefits:

Operational

- Proven retrofit capability: Existing diesel specialist vehicles can be converted to hydrogen-electric operation, extending asset life and reducing replacement costs.
- Reliable duty performance: Hydrogen fuel enables long operational periods and rapid refuelling compared with battery-only systems.

Environmental

- Zero harmful emissions confirmed through independent testing, including CO_2, NO_x, and particulate matter.
- Significant contribution to airport and defence sector decarbonisation, aligning with UK net zero targets.

Strategic

- Establishes the feasibility of hydrogen ICE technology as a scalable pathway for hard-to-decarbonise sectors.
- Strengthens the case for a UK-wide hydrogen infrastructure ecosystem through partnerships and real-world deployments.

"This deployment of a hydrogen-electric tow tug marks an exciting advance for aviation ground support and decarbonisation," said Jon Horsley, Programme Manager for Cranfield Hydrogen Integration Incubator (CH2i). *"It demonstrates that zero-emission performance is achievable without compromising operational reliability. Our experience of using the tug at Cranfield has been extremely positive so far, showing that the technology can support real-world operating conditions, integrating with existing systems.*

Conclusion:

ULEMCo's MATT vehicle has proven that hydrogen internal combustion engines can deliver true zero-emission performance in demanding, real-world environments. By combining innovation, retrofit practicality and robust validation, the project represents a major step toward decarbonising specialist fleets and advancing the UK's hydrogen economy.


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