Aerospace Electrification Event, Hosted by ATI and WMG

Challenge session: Energy storage

The session was facilitated by Martin Dowson, Head of Battery Systems Engineering & Research at WMG, Alison Meir, Head of Business Development for WMG Centre High Value Manufacturing (HVM) Catapult, and Doug Campbell, Technical Director at Electroflight.

Outline

Energy storage technology is a critical enabler for More Electric Aircraft (MEA), hybridisation (including hydrogen fuel cells) and fully electric flight. A number of considerations and challenges were identified by the group, including:

- System integration into airframe, including concerns about thermal runaway containment and retrofitting of electrical systems.
- Creating defined use cases for energy storage
- Supply chain challenges, including recyclability, scale up from low volumes and the lifecycle cost of batteries.
- Airside support and infrastructure including charging and conditioning.
- Certification and air-worthiness standards, such as pilot training and integration into flight operations.

The group then prioritised their top three challenges and discussed ways to address them and next steps.

Challenge 1: Energy and power density limitations

It's fair to say that today's battery technology currently can't achieve the performance required for full electrification of aircraft. The gravimetric energy density simply isn't there yet. Experts say density has to increase to >500Wh/kg whilst achieving high power handling capability for this to be possible.

Traditionally automotive engineering has led the development of cell technology however they are now in a phase more focused on cost reduction rather than looking at the energy density levels that would also meet the needs of aerospace. Therefore the aerospace industry will need to pick up the baton and push their requirements into academic research and the cell suppliers.

Challenge 2: Safety requirements and standards

There are a number of safety considerations for energy storage in aircraft. Naturally, accurate range projection and SoX (state of health, performance and charge) assessment is mission critical in an aircraft. For this, it will require extensive modelling, simulation and testing to fully understand how batteries age under different conditions, such as in extreme temperatures and at altitude.

To support this more deterministic approach to cell SoX more research into cell instrumentation is needed to understand both the minimum acceptable and optimum sensing requirements for different aerospace applications.

The group highlighted the need for certification and regulatory frameworks that recognise the specific requirements of energy storage systems in aerospace. This means introducing quality and safety standards, as well as traceability for materials and systems. These steps will go a long way towards engendering trust encouraging public acceptance of electric aircraft. But dedicated testing facilities are needed to demonstrate a means of compliance.

Challenge 3: Hydrogen and fuel cell systems

Hydrogen energy storage and fuel cell systems are an emerging area of potential for aerospace. To accelerate developed in this area, more specialist test house capability needs to be opened up.

The groups discussed particular concerns about storage of pressurised hydrogen on aircraft and what safety implications that might have. Like Li Ion batteries it would require exploration into the safety hazards and risk mitigation strategies. The energy density of the hydrogen storage system and any batteries required as well as the power density of the fuel cell stack need to be considered at a full system level. There is much still to be learned about the requirements of fuel cell systems and hydrogen energy storage at altitude and this will need investment in research and testing at pace. Not only that, but education and reskilling in this specialist area, as well as an overhaul of airside infrastructure.

Final thoughts…

The group agreed that for the UK to lead in this revolutionary area of future mobility, we must take a holistic, cross-sector approach and present a coherent, compelling vision to Government in order to direct funding to the appropriate areas.

It goes without saying, that achieving all of this will require investment in research and testing from all stakeholders, ranging from manufacturers and airline operators, all the way up to Government and regulators.

A culture shift is also needed and the approach to R&D has to become more dynamic. There is a lot we can learn from the automotive sector in terms of pace of development and their ability to fail fast. They are already into their 3rd generation of BEV and still innovating at pace. Aerospace needs to find a way to fail fast at all stages of the process from research through to certification. This will help to focus both the research and to help shape future systems requirements in effect learning where electrification does and doesn't work.

Large, well-established automotive OEMs have built strong links with their suppliers. With these high volumes cell suppliers have the ability to invest in their own R&D but don't necessarily make this accessible to anyone with lower volume requirements. Smaller cell start-ups can still be a disrupter in the market place but will tend to limit the availability of any early samples. This leads to the question of how will aerospace be able to foster the development and get access to the emerging technology they require?