AERO 2050: FLYING MORE SUSTAINABLY.

Institution of MECHANICAL ENGINEERS

Roundtable Summary

Improving the world through engineering

CONTENTS

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EXECUTIVE SUMMARY

The aviation sector faces a dual challenge: enabling continued connectivity and economic growth while delivering deep decarbonisation in a system defined by long asset lifetimes, high safety requirements and international interdependence. The Aero 2050: Flying More Sustainably report by the Institution of Mechanical Engineers (IMechE) presents a pragmatic assessment of potential routes towards more sustainable commercial air transport.

IMechE hosted a roundtable on 22 April 2026 in Bristol to bring together representatives from government, industry, academia and professional engineering institutions. The discussion explored how the report's findings can be translated into action, where current policy and funding frameworks are enabling progress and where they are constraining it, and the role of Bristol and the wider West of England region as a national aerospace cluster in delivering sustainable aviation. This paper provides a summary of the discussion.

There was strong consensus that decarbonisation pathways must be technologically diverse, internationally coordinated and, at system level, include aircraft, propulsion systems, fuels, energy, regulation, operations, skills and finance. Participants emphasised that aviation is inherently global and progress will depend on deep international collaboration in technology development, certification standards and fuel supply chains. The UK is well placed to play a leading role in shaping this agenda, but doing so will require sustained engagement with international partners and alignment with global regulatory frameworks.

While progress is being made on innovation, participants highlighted growing risks regarding timescales for certification and production rate scale-up for the alternative fuels required, particularly beyond Technology Readiness Level (TRL) 6.

Sustainable aviation fuels (SAF), hydrogen (combustion and fuel cells) and electric and hybrid systems all have a role to play, but each present different challenges in energy demand, infrastructure, production, certification and workforce capability. Non-CO_2 impacts, particularly contrail formation, were repeatedly highlighted as requiring greater policy attention.

The UK has world class research capability, a strong aerospace cluster in the West of England, and a clear opportunity to capture economic value through technology development, manufacturing, systems integration and certification leadership. However, without clearer signals, coordinated funding mechanisms and targeted government intervention, there is a risk that the UK will fail to convert innovation into deployed systems, ceding industrial leadership to international competitors.

> Decarbonisation of aviation is one of the greatest challenges facing mechanical engineers working in aerospace over the coming decades. Bringing together key figures from the industry to discuss our Aero 2050 report was a meaningful way to examine how engineers are starting to address these challenges, with cutting-edge projects already taking place across the Southwest of England.

Giles Richardson, Aerospace Division, IMechE

Key asks of Government

Drawing on the discussion, IMechE propose the following actions for UK Government:

1. Strengthen support for scale-up and industrialisation beyond TRL 6, using coordinated public finance mechanisms, including targeted use of the National Wealth Fund, British Business Bank and similar instruments.

2. Invest in certification capability by increasing capacity, skills and resources within regulatory bodies to enable timely review and approval of the design, manufacture and operation of aircraft powered by novel propulsion systems and fuels.

3. Address fragmentation in funding and governance, shifting from small, disconnected projects towards integrated, system-level programmes that give confidence across the supply chain.

4. Develop a coherent skills and workforce strategy covering education, re-skilling and certification, with particular focus on hydrogen, electrification, maintenance and ground operations. This should fit into a wider review of engineering skills needs across the government priorities.

5. Use public procurement and early demand signals where appropriate to support emerging technologies and reduce first mover risk.

6. Ensure strong international coordination and leadership, recognising aviation as an inherently global sector. The UK should actively shape and align international standards, certification approaches, fuel supply strategies and research collaboration, positioning itself as a global hub for sustainable aviation innovation and capturing the associated economic and industrial benefits.

SUMMARY OF DISCUSSION

The IMechE Aero 2050: Flying More Sustainably report concluded that aviation decarbonisation will require a mix of fuels and propulsion systems, reflecting differences in aircraft size, range and operational use. Electric and hydrogen technologies are likely to be most suitable for urban and shorter-range aircraft, while longer-range aviation will depend on SAF and advanced turbofan engine technologies for several decades.

Technology pathways

No single solution

A central theme across the discussion was that there is no single technological pathway capable of delivering aviation decarbonisation alone. The future aviation system is likely to remain diverse, with different propulsion and fuel solutions optimised for different aircraft needs.

Participants welcomed the report's disaggregated approach, considering technologies by aircraft type and range rather than pursuing a 'one size fits all' solution. This was seen as essential for avoiding premature lock-in and maintaining optionality as technologies and costs evolve.

Sustainable aviation fuels

SAF were widely recognised as the most immediately deployable decarbonisation option, particularly for long haul aviation and the existing global fleet. Their compatibility with existing aircraft and infrastructure makes SAF an important near- to medium-term solution, especially as a 'drop-in' fuel.

However, several constraints were highlighted:

- SAF production typically requires significantly more energy than kerosene, increasing pressure on low-carbon electricity supply.
- Scale-up is constrained by feedstock availability, such as land use considerations for biofuel, and global supply chain development.
- Long-term pathways relying more on power-to-liquid fuels imply substantial demand for green hydrogen and captured carbon dioxide.

Hydrogen and electric propulsion

Hydrogen offers high energy per unit mass, but much lower energy density per unit volume than kerosene, creating fundamental aircraft integration challenges. These include tank size and placement, impacts on airframe design, and weight penalties, particularly for larger, long-range aircraft.

Hydrogen fuel cells and hydrogen combustion were distinguished as distinct pathways, with different implications for efficiency, contrail formation, safety cases and certification. Fuel cells, while more efficient, introduce significant thermal management challenges and require new system architectures.

Electric and hybrid architectures were recognised as promising for short range and urban applications but constrained by battery energy density. Hybrid systems may play a role in enabling efficiency gains across different flight phases but introduce additional system complexity.

Non-CO_2 impacts

There was strong agreement that non-CO_2 climate impacts, particularly persistent contrails, require much greater attention in policy and technology planning. These impacts vary significantly depending on the type of propulsion system and the atmospheric conditions at operating altitudes.

Participants cautioned against strategies that reduce CO_2 emissions while worsening non-CO_2 effects and highlighted the need for integrated assessment and regulation.

Energy, infrastructure and system constraints

Total energy demand

Delivering sustainable aviation at scale will significantly increase overall energy demand. Participants highlighted that aviation decarbonisation must be considered within the context of broader economy wide electrification, including surface transport, industry and buildings.

Meeting future demand will require:

- Accelerated deployment of low-carbon electricity generation
- Coordination between transport, energy and industrial strategies
- Recognition that aviation decarbonisation is fundamentally constrained by energy system capacity

Infrastructure and logistics

Hydrogen and SAF both pose substantial infrastructure challenges, including production, transport, storage and airport integration. Hydrogen, in particular, presents challenges around safety, bulk handling and international transport.

It was emphasised that even where hydrogen is not used directly as an aviation fuel, it remains a critical enabler of SAF production. This reinforces the need for a coordinated hydrogen strategy across sectors and geographies.

Scale-up, certification and industrialisation

The scale-up gap

Participants repeatedly returned to the challenge of moving technologies from demonstration to deployment. While the UK performs well at early-stage R&D, there is a growing gap at later stages, particularly at and beyond TRL 6.

Funding remains fragmented, often focused on small projects rather than system wide integration. This creates uncertainty for investors and primes and limits the ability of small and medium-sized enterprises to scale.

Certification as a critical bottleneck

Certification was identified as one of the most significant constraints on deployment:

- Novel propulsion systems require new certification frameworks, increasing time and cost.
- Engineering capability is often ahead of regulatory capability, particularly for areas such as additive manufacturing, hydrogen systems and high-voltage electrics.
- Capacity within certification bodies is under pressure, with risks of delays becoming systemic.

Without targeted support, certification risks becoming a de facto brake on innovation rather than an enabler of safe deployment.

Skills and workforce transition

Growing skills gaps

The transition to sustainable aviation will require new skills spanning hydrogen systems, cryogenics, power electronics, high-voltage electrical systems, advanced materials and system integration.

Concerns were raised that:

- University curricula struggle to keep pace with the speed of technological change
- Certification bodies lack familiarity with emerging technologies
- Maintenance and ground handling skills need to be thought about now alongside the technology development to aid deployment

At the same time, participants noted that new technologies provide an opportunity to attract and retain talent to the sector, including from other sectors.

The role of place

The West of England was consistently highlighted as a key national asset, combining OEM presence, suppliers, universities and test facilities. However, participants noted that England lacks clear, place-based coordination mechanisms to support companies through the industrialisation process, unlike elsewhere in the UK and internationally.

Economic opportunity and international competition

The transition to sustainable aviation represents a major industrial opportunity, but also a risk if the UK fails to act decisively. Participants noted:

- Growing international competition, particularly from the EU and United States, where governments are increasingly focused on industrialisation rather than innovation alone
- The importance of securing manufacturing, systems integration and certification activity within the UK
- The value of civil-defence synergies and dual-use technologies

Market forces alone are unlikely to deliver the required investment at scale. Clear government intervention is required to de-risk private capital and provide confidence in long-term pathways.

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