From Innovation to Impact: Building Tomorrow's Aerospace Sector

By Paul Adams (Aerospace Technology Institute – ATI, UK)

As ICAO and its Member States advance implementation of the collective long-term global aspirational goal (LTAG) for international aviation of net-zero carbon emissions by 2050, unlocking scalable and coordinated financing has emerged as a central challenge. The ICAO Global Framework for Sustainable Aviation Fuels (SAF), Lower Carbon Aviation Fuels (LCAF) and other Aviation Cleaner Energies, adopted in November 2023 at the Third ICAO Conference on Aviation and Alternative Fuels (CAAF/3), recognises this challenge and places financing as one of its enabling building blocks. A leading example of how targeted public-private investment can accelerate this transition is found in the United Kingdom's Aerospace Technology Institute (ATI).

Catalysing Innovation Through Strategic Investments

Since its inception in 2013, the ATI has been instrumental in channelling substantial investments into cutting-edge aerospace projects in the United Kingdom. With over £3.8 billion of joint government-industry funding allocated to more than 450 R&D projects, the ATI has cultivated a robust ecosystem of innovation. This investment is not just about technological progress; it's a vital component of the UK's economic health and future prosperity. In a time of intense global competition and urgent environmental challenges, the ATI represents a strategic vision for the industry, driving collaboration and turbocharging innovation to secure economic and environmental resilience. These efforts not only advance national decarbonisation goals but also contribute directly to the global cleaner energy transition envisioned by the LTAG and ICAO Global Framework.

The UK has long been home to major aerospace industry players with wings, engines, systems and interiors all being designed and produced within its borders. Many of the ATI's projects are designed to ensure this legacy continues with the next generation of civil aircraft. Notable among these initiatives is Rolls-Royce's UltraFan demonstrator (Figure 1), the world's largest and most efficient aero engine technology demonstrator. This project exemplifies advancements in fuel efficiency and emission reductions, aligning with the UK's commitment to sustainable aviation.

FIGURE 1: Rolls-Royce's UltraFan.

Similarly, Airbus's Wing of Tomorrow programme represents a leap forward in aircraft design, focusing on next-generation carbon composite wings. This initiative aims to enhance aerodynamic performance while ensuring a system of manufacture is developed that support the substantial long term single aisle rate of production.

Innovation as an Engine of Economic Prosperity

The aerospace sector is a cornerstone of the UK economy, significantly contributing to employment, exports, and gross domestic product (GDP). At the heart of this contribution lies continuous investment in R&D, which drives innovation and keeps the UK competitive on the global stage.

Investing in R&D offers impressive returns, both for individual firms and society at large. A comprehensive study by Frontier Economics in 2023 estimated that the average private rate of return on R&D investment is about 20% per annum. This means that for every £1 a firm invests in R&D, it can expect an annual return of 20 pence from the resulting innovations.

The social returns are even more compelling. The same study found that social returns are typically twice as high as private returns, suggesting that society gains 40 pence annually for every £1 invested in R&D. This difference highlights the positive spillover effects of R&D, where benefits extend beyond the innovating firm to other sectors and the economy as a whole.

Specifically within the aerospace sector, ATI's research indicates that the social return on aerospace R&D is approximately 70% over a ten-year period, with private returns around 15%. These figures underscore the substantial and sustained economic benefits derived from investing in aerospace innovation.

Turbocharging Innovation and Global Competitiveness

R&D is the lifeblood of long term innovation, enabling the development of cutting-edge technologies that keep the UK aerospace industry at the forefront of global advancements. Through strategic investments, the ATI has been instrumental in advancing technologies ranging from advanced manufacturing techniques to zero-carbon propulsion systems.

The ATI's 'Destination Zero' strategy sets prioritisation for these investment decisions and aims to guide the sector towards the development of technologies that support its long term goals. It is built on three key roadmaps; ultra-efficient technology, zero carbon aircraft and cross-cutting enabling technologies. This strategic vision ensures that the UK remains a leader in the transition to sustainable aviation, aligning economic growth with environmental responsibility.

Empowering SMEs and Fostering Collaboration

Recognising the vital role of small and medium-sized enterprises (SMEs) in driving innovation, the ATI launched a dedicated SME Programme in 2023. This initiative offers grants of up to £1.5 million, tailored to support high-impact projects contributing to net-zero aviation goals. By streamlining the application process and encouraging collaboration between SMEs and larger firms, the programme is building strength in depth in the UK supply chain and enhancing agility within the aerospace sector.

To date, the ATI has supported 68 startups and early-stage businesses with over £18m of funding, nurturing the next generation of aerospace technologies and innovators and acting as a catalyst for private investment. This is supported by the activities of the ATI Hub which has brought together more than 600 companies and organisations across the whole supply chain to work on strategic innovation opportunities and provided a platform for innovative startups and SMEs.

Advancing Zero-Carbon Emission Flight

The ATI's FlyZero project was a pioneering initiative to convene experts from across the UK aerospace sector – from industry, academia and research organisations – to investigate zero-carbon emission commercial flight. This intensive research project sought to assess the design challenges, manufacturing demands, operational requirements and market opportunity of potential zero-carbon emission aircraft concepts. The FlyZero team concluded that green liquid hydrogen is the most viable zero-carbon emission fuel with the potential to scale to larger aircraft utilising fuel cell, gas turbine and hybrid systems

Building on the work of FlyZero was the ATI's Hydrogen Capability Network (HCN): a 2-year project that developed recommendations for bolstering the UK's capability in fundamental research areas, developing key technologies in the UK, establishing UK-based infrastructure and test facilities, and growing the UK skills base. Publishing its conclusions in May 2025, the HCN found that the UK is well-placed to lead in this emerging global market, but only if it continues to invest, collaborate, and create a coordinated long-term strategy ensure alignment between research, testing, infrastructure and skills. These findings are now being adapted into the ATI's technology strategy to ensure the importance of this area is reflected in its investment portfolio.

Addressing Non-CO_2 Emissions: A Holistic Climate Strategy

While CO_2 emissions remain a major focus in decarbonising aviation, growing scientific evidence shows that non-CO_2 effects— including nitrogen oxides (NO_x), soot particles, and the formation of contrail-induced cirrus clouds—also contribute significantly to aviation's climate impact. These non-CO_2 emissions could be responsible for more than half of aviation's total contribution to global warming, according to recent EU and IPCC studies.

To address this emerging critical area, the ATI launched the Non-CO_2 Programme in partnership with Department for Transport, Department for Business and Trade and Natural Environment Research Council (NERC). This world-leading initiative focuses on understanding, measuring, and ultimately reducing these complex climate impacts. Working with UK research institutions, OEMs, and regulatory bodies, the programme funds projects that explore fuel characteristics, aircraft technologies and knowledge, data and innovative flight operation strategies that mitigate contrail formation and high-altitude Non-CO_2 emissions.

This programme reflects a fundamental truth that achieving true climate neutrality in aviation requires more than reducing CO_2 alone. By investing in science and industry-based solutions to tackle non-CO_2 effects, the UK is taking a leadership role in developing a full-spectrum approach to sustainable aviation.

Sustained Government Support: building investor confidence

The ATI's success is built on strong and continued government support. In the 2023 Autumn Statement, the UK government pledged an additional £975 million for the ATI Programme from 2026 to 2030. This long-term commitment ensures that the UK aerospace sector can plan strategically, innovate boldly, and compete globally.

The government commitment sets a strong signal for industry and private investment, underlining the critical importance of the aerospace industry and supporting long term investment decisions making.

Charting a Sustainable Flight Path for the Future

As the aerospace industry confronts the dual challenge of decarbonisation and environmental stewardship, the ATI is playing a vital role in shaping a resilient, forward-looking UK aerospace sector. From flagship projects like Rolls-Royce UltraFan and Airbus's Wing of Tomorrow, to SME support and the pioneering work on hydrogen and the challenge of non-CO_2 emissions, the ATI ensures that the UK remains at the leading edge of advanced aerospace technology. With sustained public and private sector support, the ATI is poised to deliver not only cleaner and smarter technologies, but also long-term economic value and security by making sure the UK is a key part of the next generation of civil aircraft.