Airships

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Introduction

Hybrid Air Vehicles[1] and FLYING WHALES[2] are both aiming to accelerate aviation's transformation into a low-carbon industry by designing and manufacturing hybrid and lighter-than-air (LTA) aircraft respectively.

The two companies have pursued their common goal by collaborating on the development of industry-specific regulation, working closely with the European Union Aviation Safety Agency (EASA) to produce the certification basis for airship-based aircraft designs. EASA is the first aviation authority to have published a complete set of dedicated certification specifications in a document called Special Condition "SC Gas" Airships[3].

The leadership displayed by these two organisations should encourage other companies to develop their own innovative solutions to the pressing challenges currently posed by the aviation industry. This article explores the environmental and other benefits of hybrid/LTA aircraft and marks a new stage in the companies' ongoing cooperation.

1 Hybrid Air Vehicles is the company behind Airlander technology. Its first production aircraft, Airlander 10, will deliver up to a 90% reduction in carbon emissions compared to other aircraft in its various roles, before attaining zero emissions by 2030. The company's vision is to be the future of zero-carbon aviation. It expects Airlander to be the first large scale aircraft (capable of carrying up to 100 passengers or 10 tonnes) to achieve zero-emissions flight. https://www.hybridairvehicles.com/

2 FLYING WHALES is a French company developing the LCA60T, a rigid airship with a 60-ton cargo capacity. Originally designed to meet longshoring needs for the renewable wood industry in difficult-to-access areas, this LTA aircraft aims to provide a response to numerous logistical and isolation problems worldwide with a very low environmental footprint, thanks to its unique characteristics of loading and unloading while hovering. FLYING WHALES is also developing FLYING WHALES SERVICES, the company operating the LCA60T. https://www.flying-whales.com/

3 https://www.easa.europa.eu/downloads/134946/en

The case for developing entirely new categories to accelerate aviation's transformation

Looking beyond the norm and thinking differently is not always easy but, in the case of aviation, it is crucial for progress.

The International Air Transport Association (IATA) has recently agreed to achieve net-zero carbon emissions by 2050, in line with Paris Agreement targets to limit global warming to 1.5°C. Meanwhile, globalisation means that more people will want to fly and move goods by air: forecasts from ICAO (International Civil Aviation Organization) and IATA signal a strong growth trajectory in the run up to 2050 (typically around 4.5% CAGR)[4].

There are significant opportunities for radical innovation to make major contributions to emissions reductions, enabling the aviation industry to outperform current industry targets. These technological changes may require or promote changes in transport networks to enable existing services to be replaced, and new services to be grown, while severing the link between growth and emissions.

By rapidly deploying radical innovations in roles that can accommodate them, improved overall sector emissions outcomes can be achieved. Improvements in conventional airframe, propulsion and sustainable fuel technologies can then be optimised for those applications and sectors that cannot feasibly be addressed in other, less energy-intensive, ways.

Radical change does not and should not mean putting an end to air travel.

Aviation is a critical part of our society and economy: it enables trade, creates millions of jobs and, most importantly, connects people and cultures – as a society, we are better unified and connected. Radical change in this context means providing transport with solutions that maintain and build on the benefits delivered by aviation without the associated impacts.

Now more than ever, new categories of aviation are needed. This does not necessarily mean 'flight reimagined' through conventional incremental innovation. Achieving low-carbon aviation (or zero-carbon emissions in flight) means we need to rethink how and where conventional aircraft operate, and what alternative aircraft configurations and networks could deliver beyond today's air transport system.

For example, hybrid and LTA aircraft with hovering or short take-off and landing capabilities offer clear pathways towards sustainable aviation in easily addressable roles such as sub-regional air transport, long-haul logistics and special air services. Through radically different physics of lift, these aircraft produce up to 10 times fewer harmful emissions than fixed wing alternatives[5] in the case of hybrid options, and use up to 50 times less fuel than helicopters for LTA aircraft performing hovering manoeuvres[6]. These new categories of aviation offer a world of opportunities, ranging from delivering rapid decarbonisation of growing domestic air travel markets to enabling low-emissions air freight and the transport of outsize equipment such as sustainable energy-generation infrastructure to remote places with less impact.

A new category offering new possibilities: Transforming logistics, air travel and global equality

Hybrid or LTA aircraft create lift in radically different – and more energy efficient – ways than conventional aircraft. This allows them to fly more slowly, delivering very low energy use per revenue km.

Many of today's air services do not require high speed to deliver economic benefits. For example, regional aviation often covers short distances in which the flying time is a small percentage of the overall passenger journey. A hybrid or LTA aircraft can offer more convenient connections and

4 https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg17-23.pdf

5 Based on HAV analysis of Airlander's CO_2 production on a pax.km or tonnes payload.km basis vs the UK Gov CO_2 creation figures for airplanes - https://www.hybridairvehicles.com/news-and-media/overview/insights/airlander-10-will-provide-a-new-option-for-regional-travel/.

6 Based on FLYING WHALES' analysis of LCA60T's CO_2 production on a tonnes payload.km basis vs public data from helicopters.

less lost time in security and airport protocols, delivering near-equivalent journey times to the passenger or payload at only 10% of the carbon footprint. Likewise, the speed of medium- and long-haul freight services is often diluted by handling services and other frictions at source and destination.

In both cases, the next best alternative is often seaborne or road-borne transit, delivering far longer journeys. This leaves a large gap in which hybrid or LTA aircraft can fulfil rapid deliveries and short journey times, at lower costs, with order-of-magnitude reductions in emissions.

The COVID-19 pandemic exposed major vulnerabilities across our global supply chain. One way of adding flexibility and resilience is to supplement conventional systems using low-emissions aircraft that are independent of fixed infrastructure for their operation. In this application, not only do LTA aircraft with hovering capabilities reduce carbon emissions, but they also improve biodiversity by reducing soil artificialisation – these aircraft do not need runways[7].

Both hybrid and LTA aircraft have the potential to provide capacity and flexibility, avoiding reliance on roads and ports by significantly increasing aviation's capacity to deliver goods via air freight.

They can also reinvent point-to-point logistics alongside services and energy infrastructure in more remote regions, unlocking new opportunities by going where other modes of transport are unable to or struggle to access. Hybrid aircraft, and LTAs capable of hovering while loading and unloading, can tap into new territories and groups of people living in remoter parts of the world by minimising the need to access expensive airport infrastructure. While helping to democratise access to goods and produce within more remote territories, these aircraft can also help to boost global equality by enabling people living in isolated places to trade goods and produce across the world.

This capacity to reach landlocked areas makes hybrid and LTA aircraft a key contributor to the United Nations Sustainable Development Goals, including:

- SDG7: Affordable and clean energy – for example, by supporting the complex logistical operation needed to install wind turbines and the creation of high voltage electricity networks
- SDG8: Decent work and economic growth – by unlocking whole regions of the planet
- SDG13: Climate action – by proposing a low-carbon means of transportation

Efficiency, energy sources and green benefits

Hybrid and LTA aircraft offer helicopter-speed air transport with order-of-magnitude improvements in efficiency. With this new development come new possibilities for both sustainability and energy efficiency.

Whether running on conventional fuel, sustainable aviation fuel or hydrogen, the energy source is used efficiently, preserving limited energy and emissions budgets for other aviation sectors such as long-haul aviation, where there are currently no known, available alternative technologies.

Inherently efficient in their design, hybrid aircraft combine buoyant lift with aerodynamic lift and vectored thrust. The lifting gas offsets the weight of the aircraft, meaning that less energy is required to fly. This allows the aircraft to carry substantial cargo while burning very little fuel or to fly for a long time, creating a significant efficiency gain over conventional fixed and rotary wing aircraft – in real terms, this can mean hybrid aircraft typically require 25% or less of the energy of alternate aircraft performing the same task. Adoption of hydrogen-electric technology to deliver most of this energy leads to an expected 90% reduction in emissions per revenue km in most roles at service entry in 2026[8].

7 https://youmatter.world/en/soil-artificialization-erosion-ecosystem-biodiversity/

8 Based on HAV analysis of Airlander's CO_2 production on a pax.km or tonnes payload.km basis vs the UK Gov CO_2 creation figures for airplanes. https://www.hybridairvehicles.com/news-and-media/overview/insights/airlander-10-will-provide-a-new-option-for-regional-travel/

Pushing the limits further, a 100% LTA aircraft relies only on buoyancy to stay airborne. This aerostatic, as opposed to aerodynamic, lift means that the LTA needs no energy to fly. Its propulsion system will be dedicated to cruise – as it has no need to fight gravity – while airborne and maintains a stationary position during hovering, to load and unload cargo. In this perspective, an LTA aircraft can save up to 98% of carbon emissions depending on the type of mission.[9]

Deploying these aircraft into those sectors that can be most easily addressed can deliver significant reductions in overall emissions. For example, 50% of air freight, and the 12% shortest-sector air travel, are together forecast to generate 639 million tonnes of CO_2 per annum by 2050.[10] Hybrid and LTA aircraft can minimise these emissions while enabling continued growth in these sectors.

9 According to a FLYING WHALES' internal study conducted on the basis of a Life Cycle Analysis and the data that are today available on the propulsion system soon to be implemented in the LCA60T

10 Based on HAV analysis of predicted freight demand, total passenger operation figures and the proportion of that number committed to short haul.