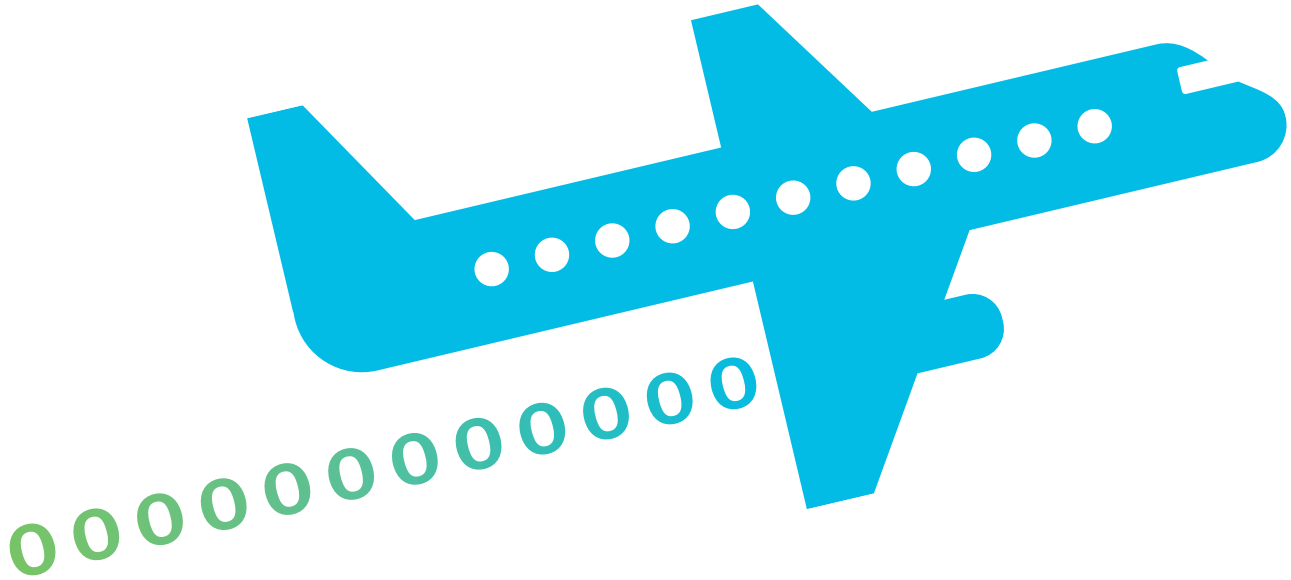
The sky's the limit

The role of zero emission flight in reaching net zero

green alliance...



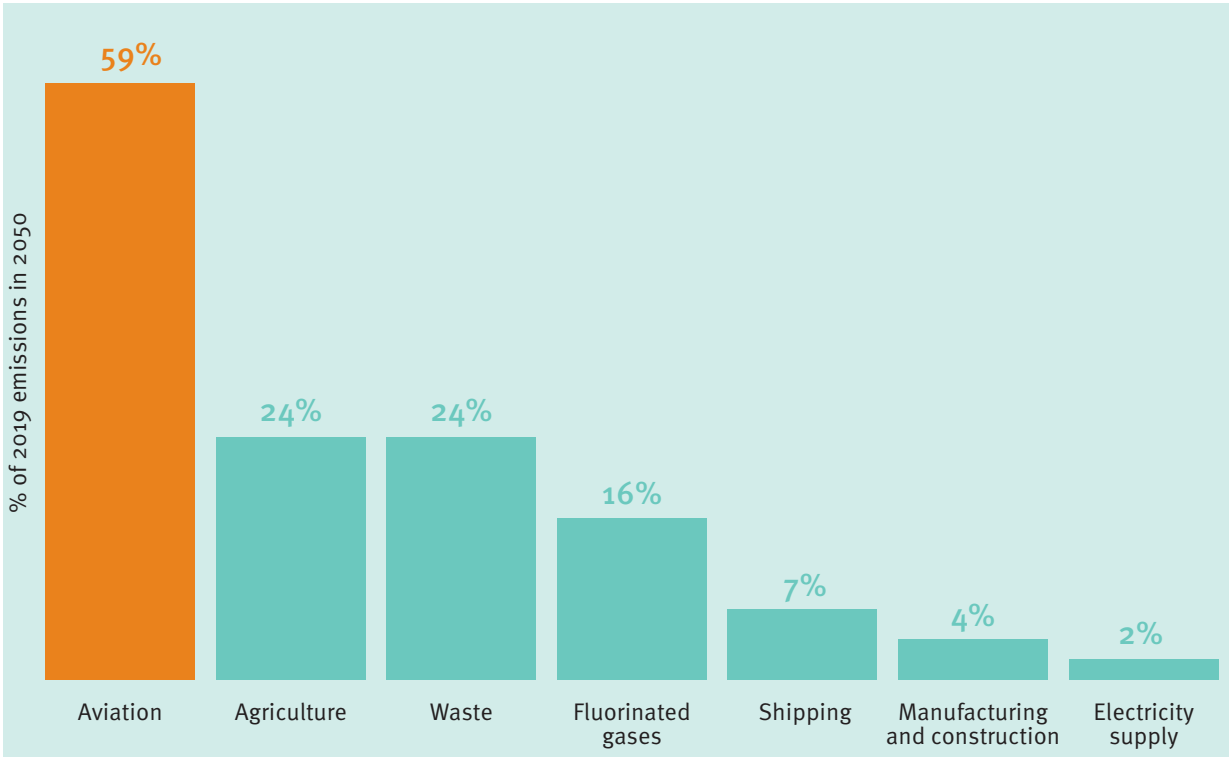
Introduction

Aviation will be one of the only sectors still emitting carbon in 2050. On current projections, it is unlikely to make any significant decarbonisation progress until the 2040s.

The UK government's current approach to cutting the climate impact of aviation is not a complete solution. In particular, the route to zero emission flights (ZEF) has not been strategically formulated.

Here, we outline the potential of ZEF, its importance in reaching a net zero carbon economy, and what is needed to commercialise it.

Aviation is the sector that will make the least progress in cutting greenhouse gas emissions by 2050[1]



[1] Climate Change Committee, 2020, *Sixth carbon budget*

What is zero emission flight?

Conventional aircraft

Jet fuel is stored in the wings and aircraft design is optimised for kerosene.

Sustainable aviation fuelled (SAF) aircraft

Jet fuel is directly substituted for SAF. No changes are made to the aircraft.

Zero emission

Hydrogen powered aircraft

Propulsion occurs through hydrogen combustion (where hydrogen is burned as fuel) or hydrogen fuel cells (where hydrogen powers batteries). New aircraft and refuelling systems are needed.

Battery electric aircraft

A dense, high power battery system propels an electric motor, typically in smaller and lighter aircraft.

What role could zero emission flight play in government strategy?

Three approaches combined can help aviation reach net zero

Demand management

Reducing how much we fly will cut emissions, but there are few plans to address demand.

The Department for Transport (DfT) predicts passenger demand will rise by 70 per cent by 2050, hugely exceeding the 25 per cent increase recommended in the Climate Change Committee's advice to the government.

Sustainable aviation fuel (SAF)

Using SAF does not eliminate emissions burned in the atmosphere but it can reduce lifecycle emissions.

It does not address non-CO_2 emissions which account for a significant proportion of aviation's global warming impact.

Some feedstocks will be difficult to scale up due to limited supply or the need for them elsewhere in the energy system.

Some SAF feedstocks could cause issues, like encouraging the creation of waste for fuel.

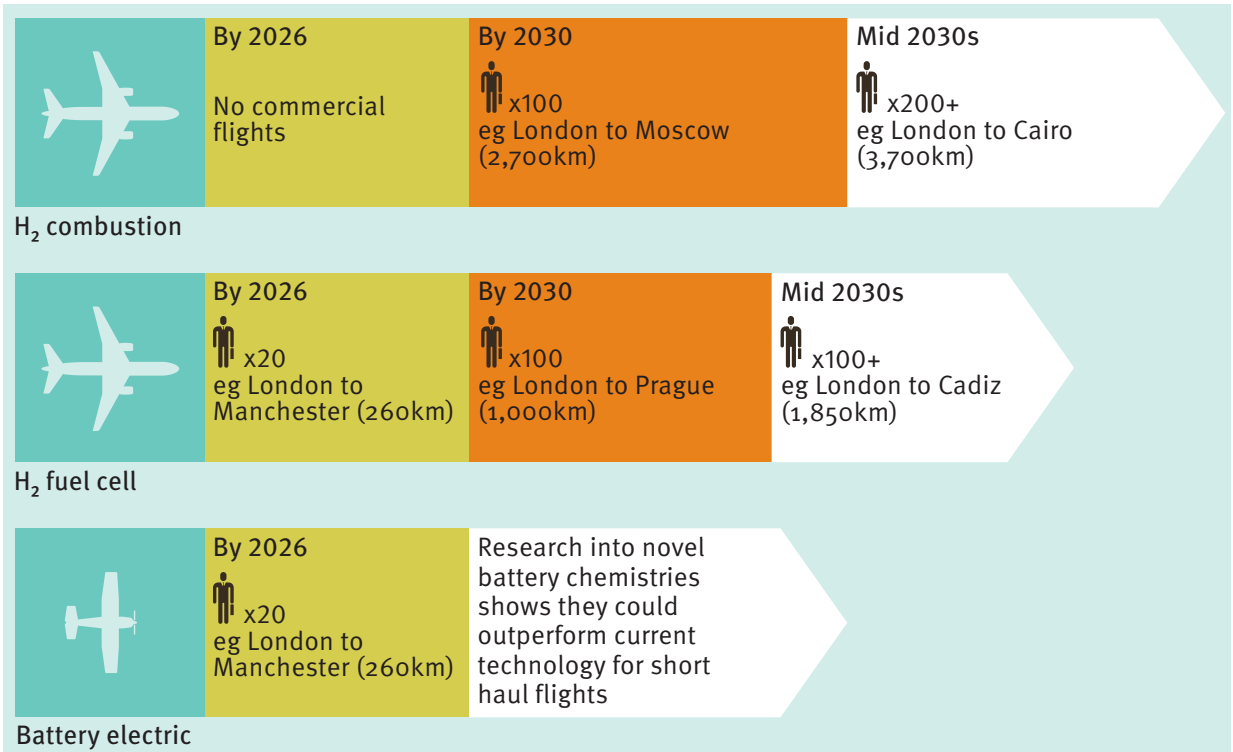
Zero emission flight (ZEF)

ZEF is an opportunity to mitigate aviation's significant climate impact and move the sector closer to net zero.

As an emerging technology, the UK could gain a competitive advantage and become a world leader in the industry.

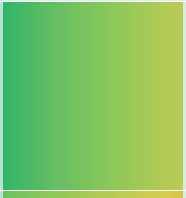
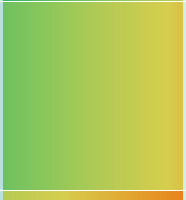
Current strategy lacks a concrete pathway to facilitate its rapid scale-up.

The potential of zero emission flight

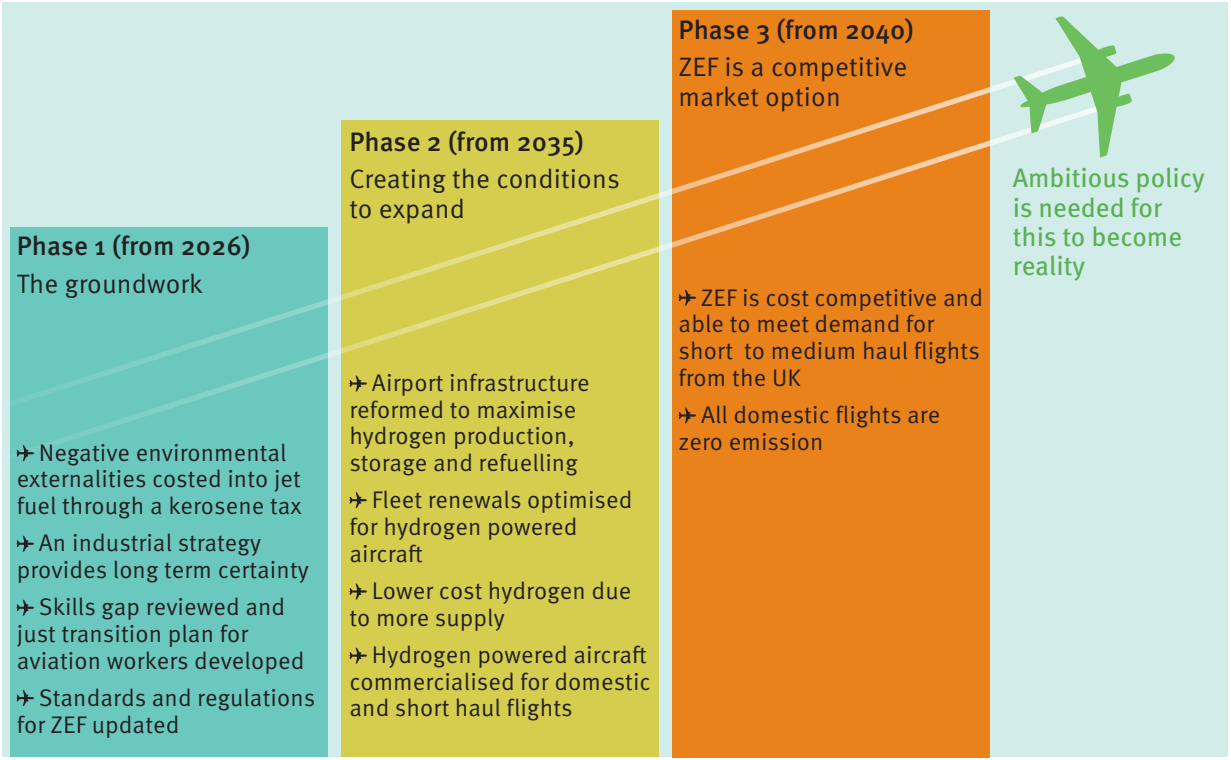


[2] The potential has been determined by reviewing a range of industry projections and academic estimations.

Although a big improvement, zero emission flight still isn't 100% green

Technology	How green?		
Hydrogen fuel cell		+ No in-flight CO_2 emissions and a total warming impact 75 to 90% lower than jet fuel + No disproportionate demand on resources (providing the industry generates its own green hydrogen)	– Wastewater emitted during flight. (innovative wastewater recycling could reduce this)
Hydrogen combustion		+ No in-flight CO_2 emissions and a total warming impact 50 to 75% lower than jet fuel + No disproportionate demand on resources (providing the industry generates its own green hydrogen)	– Wastewater emitted in flight (innovative wastewater recycling could reduce this) – Nitrous oxide (NOx) emitted in flight
Battery electric		+ No in-flight emissions and, as electricity goes greener, the lifecycle emissions of batteries will also decrease	– High demand for critical raw materials, which can have negative environmental impacts
SAF		+ Although CO_2 is emitted during flight, lifecycle emissions are lower than kerosene	– Other, non-CO_2 emissions are still emitted – Demand for feedstock risks encouraging waste or placing pressure on land that could be used for food – Low potential to scale up

A clear pathway to commercialise zero emission flight



The sky's the limit:
The role of zero emission flight in reaching net zero

Authors
Jasmine Dhaliwal and Helena Bennett

Acknowledgments
With thanks to Cranfield Aerospace Solutions and ZeroAvia for their insights.

We are grateful to the European Climate Foundation and the Quadrature Climate Foundation for supporting this research.

Green Alliance
Green Alliance is an independent think tank and charity focused on ambitious leadership for the environment. Since 1979, we have been working with the most influential leaders in business, NGOs and politics to accelerate political action and create transformative policy for a green and prosperous UK.

The Green Alliance Trust
Registered charity no 1045395
Company limited by guarantee
(England and Wales) no. 3037633

Published by Green Alliance
February 2024

Designed by Howdy

Green Alliance
18th Floor
Millbank Tower
21-24 Millbank
London SW1P 4QP

020 7233 7433
ga@green-alliance.org.uk

www.green-alliance.org.uk
@GreenAllianceUK
blog: www.greenallianceblog.org.uk