Airbus Strategy for Sustainable Aviation

Dave Best - Head of Strategy, Business Development & Commercial Sales

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Airbus in the UK

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DEFENCE AND SPACE

HELICOPTERS

10,500
UK workforce

£3.9bn*
UK turnover

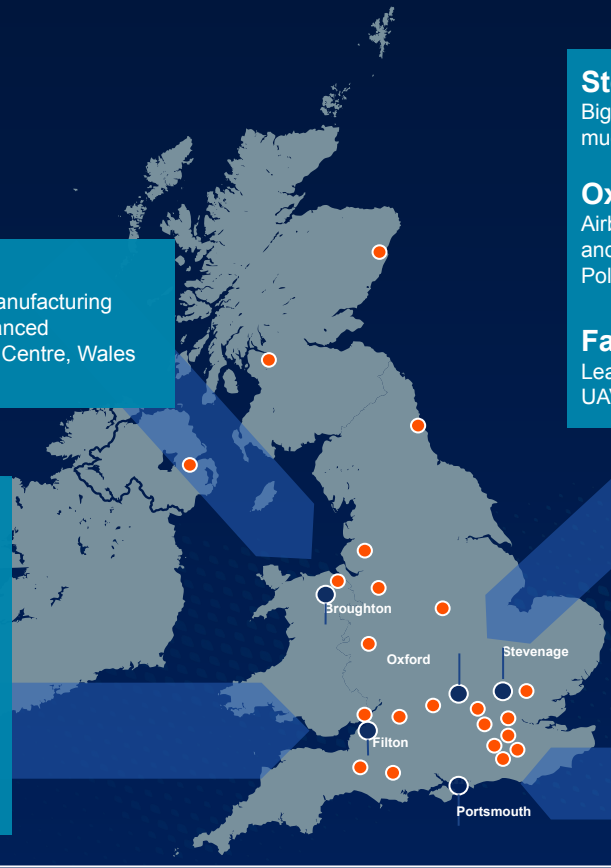
25+
UK sites

£290m*
R&D Spend

Broughton
The world's largest wing manufacturing plant and home to the Advanced Manufacturing & Research Centre, Wales (AMRC Wales).

Filton
World's largest wing design centre with more engineers under one roof than anywhere else in northern Europe. New AIRTeC research centre co funded with BEIS.

Newport
Providing sovereign capability in high grade crypto and world leading offensive and defensive cyber capabilities exported to NSA.



Stevenage
Biggest space industry site in the UK. Home to much of the UK space talent.

Oxford
Airbus Helicopters UK HQ providing training and support for the Airbus helicopters of MoD, Police, Air Ambulance and private customers

Farnborough
Leading the way in solar powered stratospheric UAV's, with the world record holding Zephyr.

Portsmouth
Major space hub. Centre for satellite payloads are assembled in the UK's biggest clean room complex and anechoic chamber.

Guildford
The world leader in small satellite development and manufacture.

* as of Year end 2020

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An extensive supply chain in the UK

UK supply-chain is key for Airbus specialising in the full value chain for Wing Aerostructures, Landing Gears and Engines

Top Suppliers

ROLLS ROYCE

SPIRIT AEROSYSTEMS

GE

BAE SYSTEMS

MAGELLAN AEROSPACE

GKN

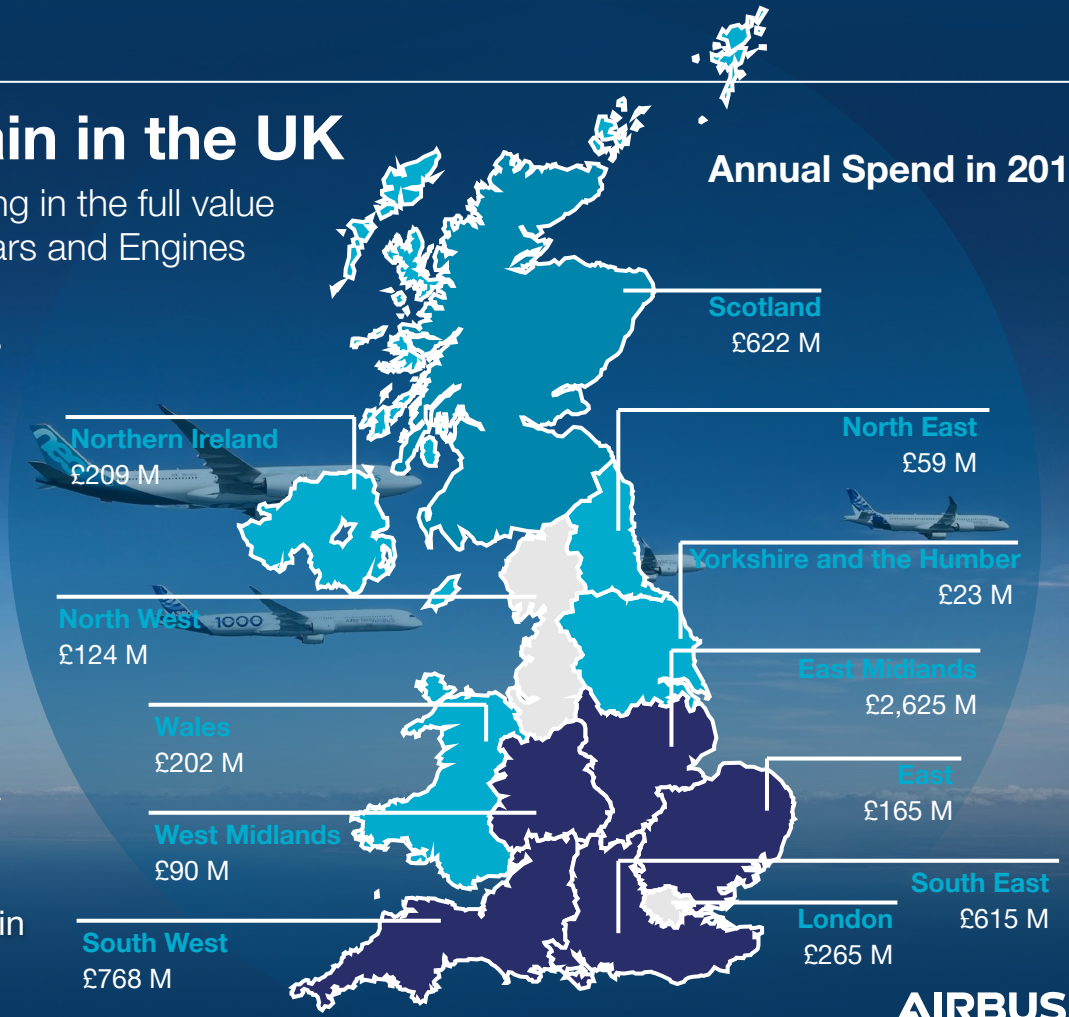
2,445 suppliers

669 SMEs

64,000 + jobs sustained in the aerospace supply chain in 2019

£ 5.8 bn total invoice volume in the UK in 2019

Annual Spend in 2019



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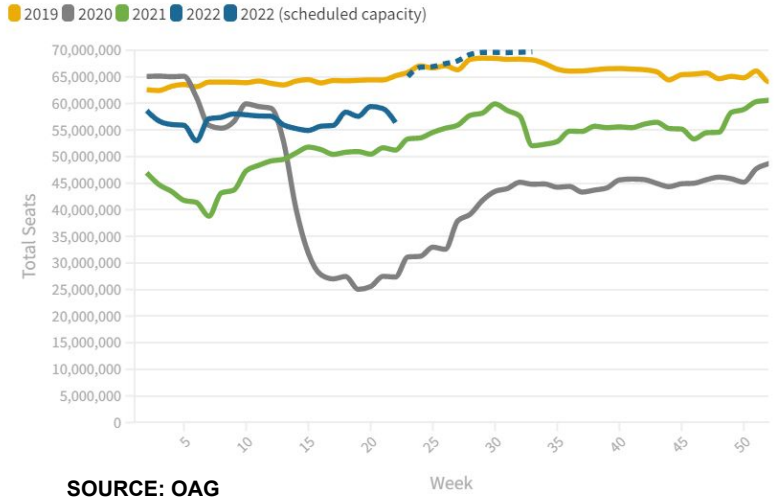
COVID-19 Aviation Industry Challenges & Opportunities

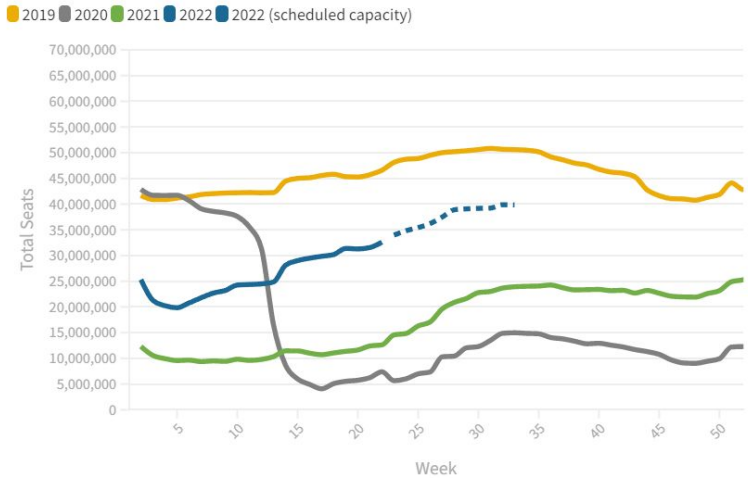
Industry recovery

- Regional initially due to intercountry travel restrictions
  - Short-haul levels well maintained
- International recovering well
- Steep support requirement from airlines as aircraft are returned to use

DOMESTIC SEATS



INTERNATIONAL SEATS



SOURCE: OAG

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Leveraging Digital Skills | Sustainability Drivers

[Airbus Amber]

Design and Manufacturing
Engineering Fundaments
- Productivity and competitiveness
- Hybrid design/stress
- Modelling and simulation digital twin
- Electrical/electronic systems
- Systems engineering

Emerging Technologies
Future Proficiencies
- Automation and autonomy
- Through life services
- Advanced materials
- High value manufacturing
- Electric and hybrid aircraft
- Agile design

Aerospace Sector Digitalisation

Digital Tools
- Artificial Intelligence
- Machine learning
- Internet of Things
- Virtual and Augmented Reality
- Robotics and cobotics

Data Utilisation
- Analytical methods
- Collation
- Verification and Validation
- Problem Solving

Data Management
- Infrastructure and architecture
- Cyber security and compliance
- Communication process and tools
- Data commercialisation

Business Environment
Enablers
- Leadership and entrepreneurship
- Organisation development
- Change management
- Supply change management
- Quality managerment
- Inclusive development
- Health and safety
- Programme management
- Finance
- Job design

Source: AGP 2019 - Skills Needs of our Future Aerospace Workforce

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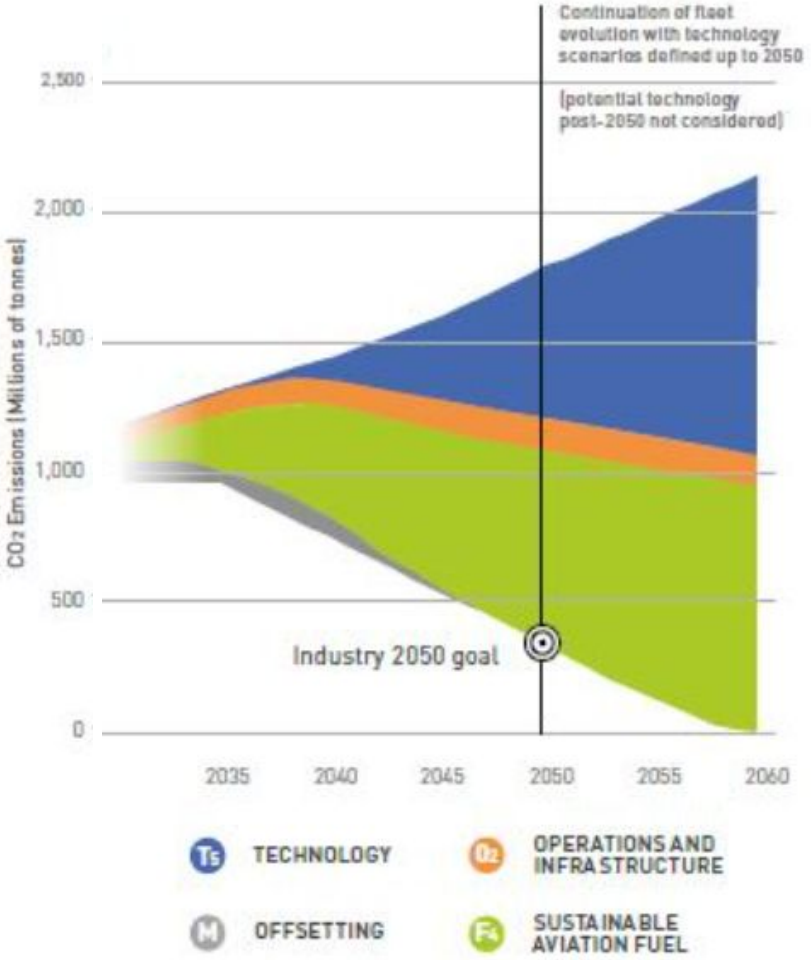


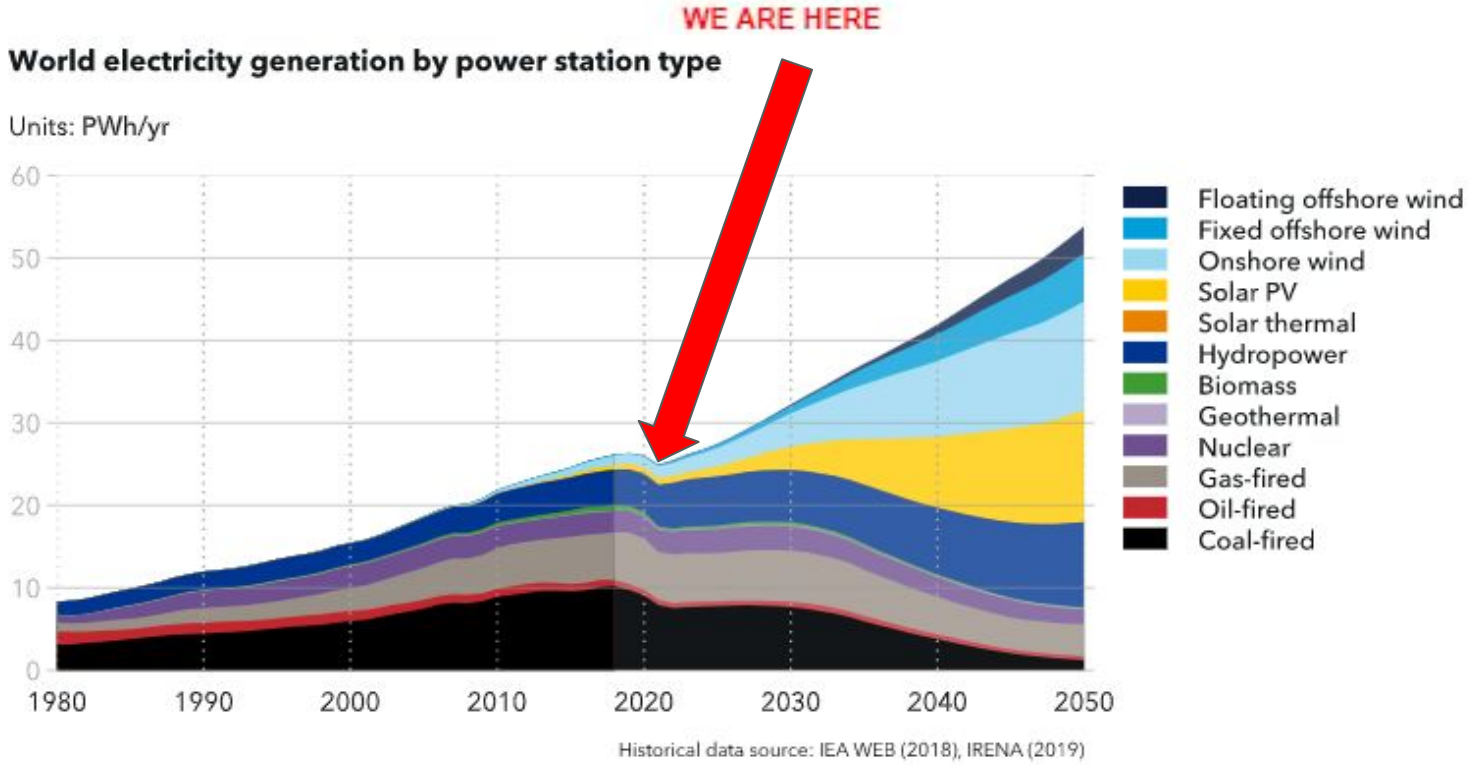
Source: Air Transportation Action Group (ATAG)

Multiple solutions required

Mandatory to leverage multiple pathways in order to reduce aviation's climate impact.

Biofuels are part of the solution.

In addition, we need synthetic fuels based on renewables to allow further scale-up and acceleration



Source: DNV, https://eto.dnv.com/2020/highlights/variable-renewable-energy

We are at the beginning

Massive investment and public policy will encourage the replacement of fossil fuels.

Scale-up will increase availability and bring costs down further.

We must prepare now for the 2030s and beyond.

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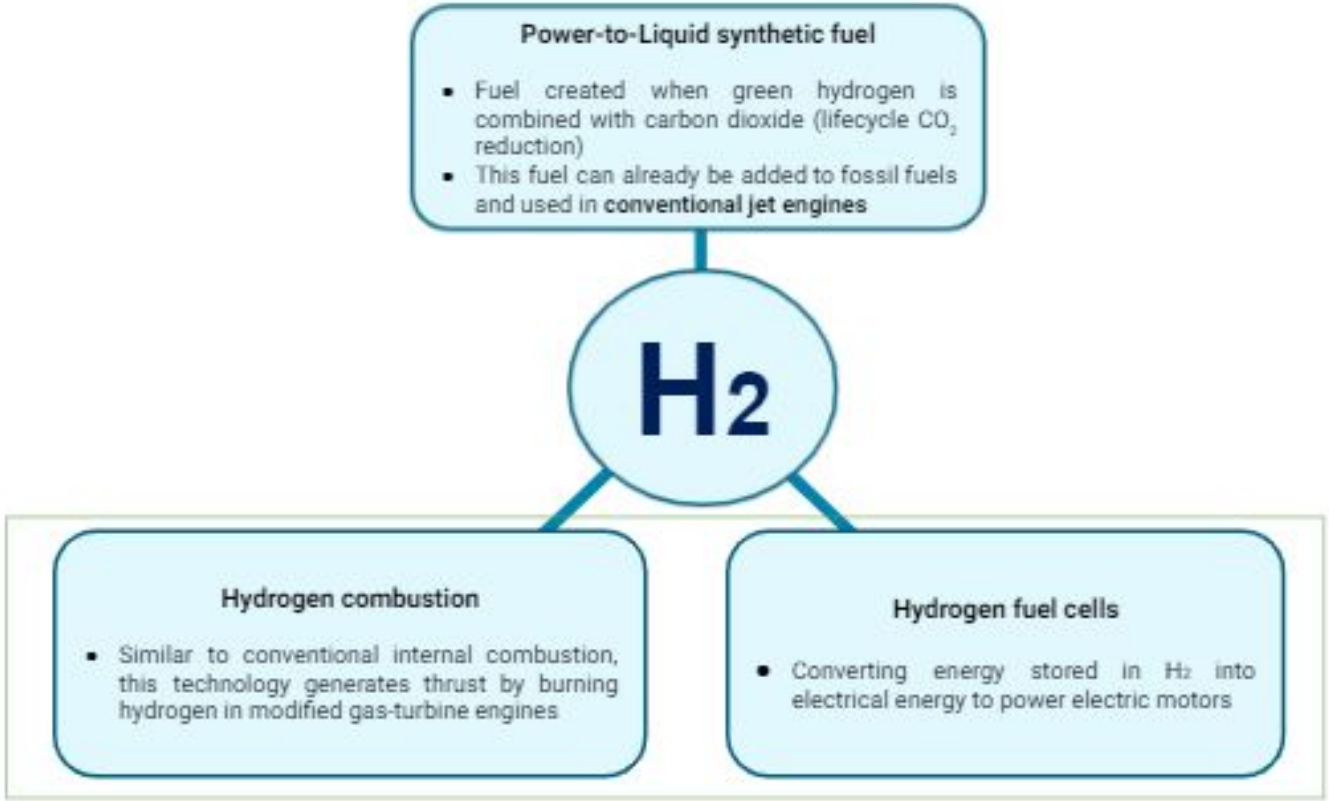

ZEROe:
lowest possible climate impact &
lowest possible cost per tonne of CO_2 avoided

Hydrogen for aviation

A key enabler to achieve aviation's targets

Green hydrogen emits no CO_2 and has the potential to reduce non-CO_2 emissions as well as persistent contrails

Airbus intends to power aviation with renewable energy - using H_2 as a surrogate

Green hydrogen is hydrogen produced via renewable electricity

Today

All Airbus aircraft fuelled with Jet A1

SAF approved up to 50% blends

2025-2030

Airbus fleet certified for 100% SAF

2035

Entry into service of ZEROe Hydrogen powered aircraft

2050

Entire fleet powered by Hydrogen and SAF

Development of H2 technologies

LH2 tank and fuel systems
Electric motors
Refuel ground operations

Ramp up in production of green aviation fuels

Domestic production of green hydrogen, biofuels and Power-to-Liquid

Decarbonisation Roadmap

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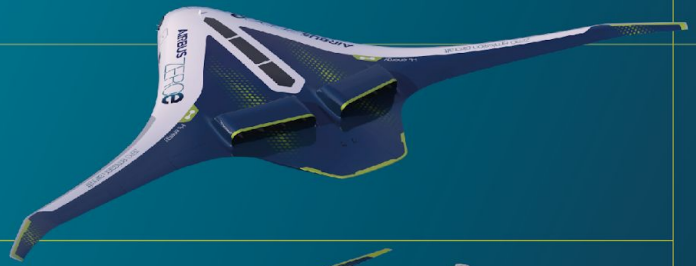
Introducing Airbus ZEROe

Reducing the climate impact of flying

Turboprop

- **<100** Passengers
- Hydrogen Hybrid Turboprop Engines (x 2)
- **1,000+nm** Range
- Liquid Hydrogen Storage & Distribution System

Blended-Wing Body



- **<200** Passengers
- Hydrogen Hybrid Turbofan Engines (x 2)
- **2,000+nm** Range
- Liquid Hydrogen Storage & Distribution System

Turbofan

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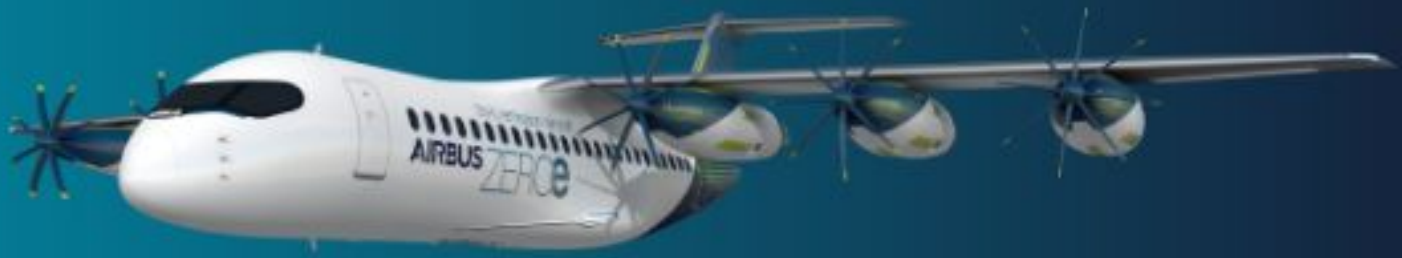
ZEROe The "Pod" configuration



6 "pods"
that act as standalone turboprop motors

8-bladed propellers
made of composite materials

Distributed hydrogen
fuel cell propulsion system

Removable fixtures
along wing for quick pod assembly & disassembly

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ZEROe Hydrogen combustion demonstrator

A380 multimodal test platform
with its capacity to store large hydrogen tanks

Hydrogen combustion engine
located along the rear fuselage

4 liquid hydrogen tanks
stored in a caudal position

Liquid hydrogen distribution system

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ZEROe Technologies

Hydrogen Powered Gas Turbines
(Gas turbines with modified combustion chamber, fuel injectors and fuel system)

Liquid Hydrogen Storage
(in non-pressurised zone behind rear pressure bulkhead)

Fuel Cell
(megawatt scale, supplementing the gas turbines with electrical power at very high levels of efficiency)

Power Electronics & Electric Motors
(powered by the fuel cells and injecting energy onto the turbofan shaft)

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Hydrogen Hub at Airports by Airbus

This concept involves collaborating with airports to develop a stepped approach to decarbonise airport facilities, ground operations and transportation using hydrogen

2020
Launch of preliminary studies into airport infrastructure and energy production needs

2023
Start of concept deployment at airports worldwide

2030
Ramp up of hydrogen infrastructure deployment worldwide

2035
Entry-into-service of ZEROe hydrogen aircraft at airports

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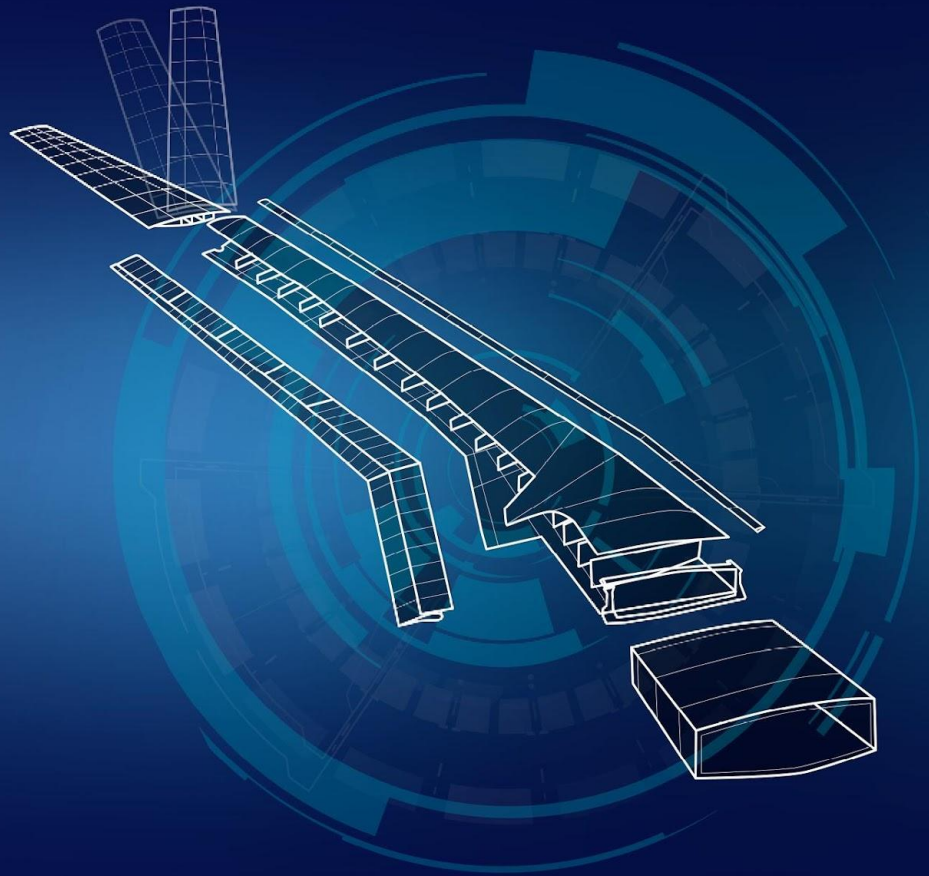

Wing of Tomorrow

Integrated engineering
for manufacture

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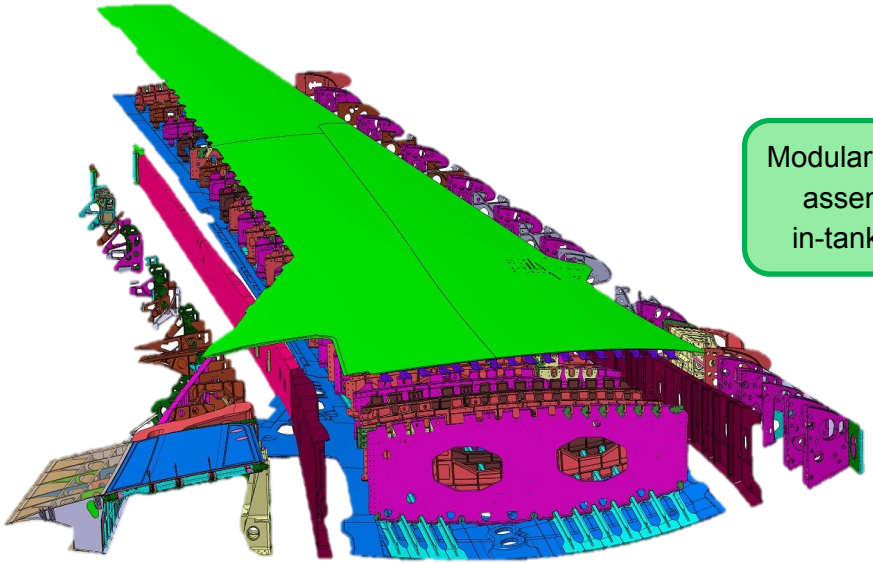
Wing of Tomorrow

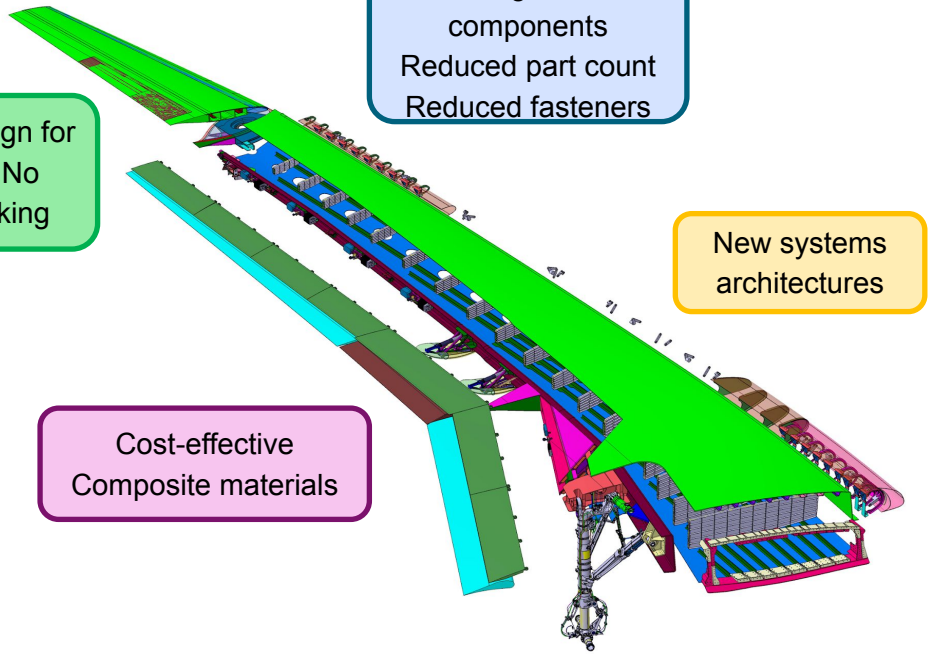
Wing of Tomorrow Programme launched in 2015 '**Fast market response' - Single Aisle New Wing**

Out of cycle development to prepare the future

Wing of Tomorrow will capture **knowledge** from Demonstrators, understand **scalability and limitations** and ensure engineering and industrial capability for any expected future wing design

New Wing Architecture optimised for industrialisation





Integrated components
Reduced part count
Reduced fasteners

Modular Design for assembly. No in-tank working

New systems architectures

Cost-effective Composite materials

Existing Single Aisle Wing
Multi-part, Multi-Assembly.
Non-integrated Systems & High Lift Installation
Design Solution challenging for Industrialisation

ESSENTIAL to design for RC and Rate targets with Performance

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UK Ecosystem supporting UK R&T Strategy

GKN Global Technology Centre, Bristol

Advanced Manufacturing Research Centre Cymru

Aerospace Integration Research Centre, Cranfield

National Composites Centre – Bristol

Spirit Aerospace Innovation Centre, Prestwick

Wing of Tomorrow Plateau, Filton

Aerospace Integrated Research and Test Centre, Filton

Manufacturing Technology Centre, Coventry

UNIVERSITY NETWORK

University of BRISTOL · Cranfield University · Imperial College London · Loughborough University · MANCHESTER 1824 The University of Manchester · University of Nottingham · The University Of Sheffield. · CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD · University of Southampton

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Collaboration is key:

AIRBUS Filton commercial opportunities

Filton site, the history

More than 100 years of aviation history

Bristol Aircraft Company founded

1910

Prototype Concorde flew from Filton on 9th April for the first time

1969

Pegasus House opened

1936

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AIRTeC - Aerospace Integrated Research and Test Centre

Flexible lab space

Strong wall

Skilled researchers and engineers under one roof

x250

Additive manufacturing

Testing the **Wing of Tomorrow**

X10

Testing 10 times faster

£40m

Investment

250

Employees based in facility

2018

Facility opened

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Liquid Energy Testing

36,000 l

Fuel tank

-50 to +55˚C

Fuel temperature range

600

Different aircraft parts

Developing Sustainable Skills and capability: SAF and Hydrogen

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Additive Manufacture

Latest Generation Machines

AIRBUS Chamber of Reference for Powder Bed Fusion

Qualified Flying AM Parts

Direct Energy Deposition Capability

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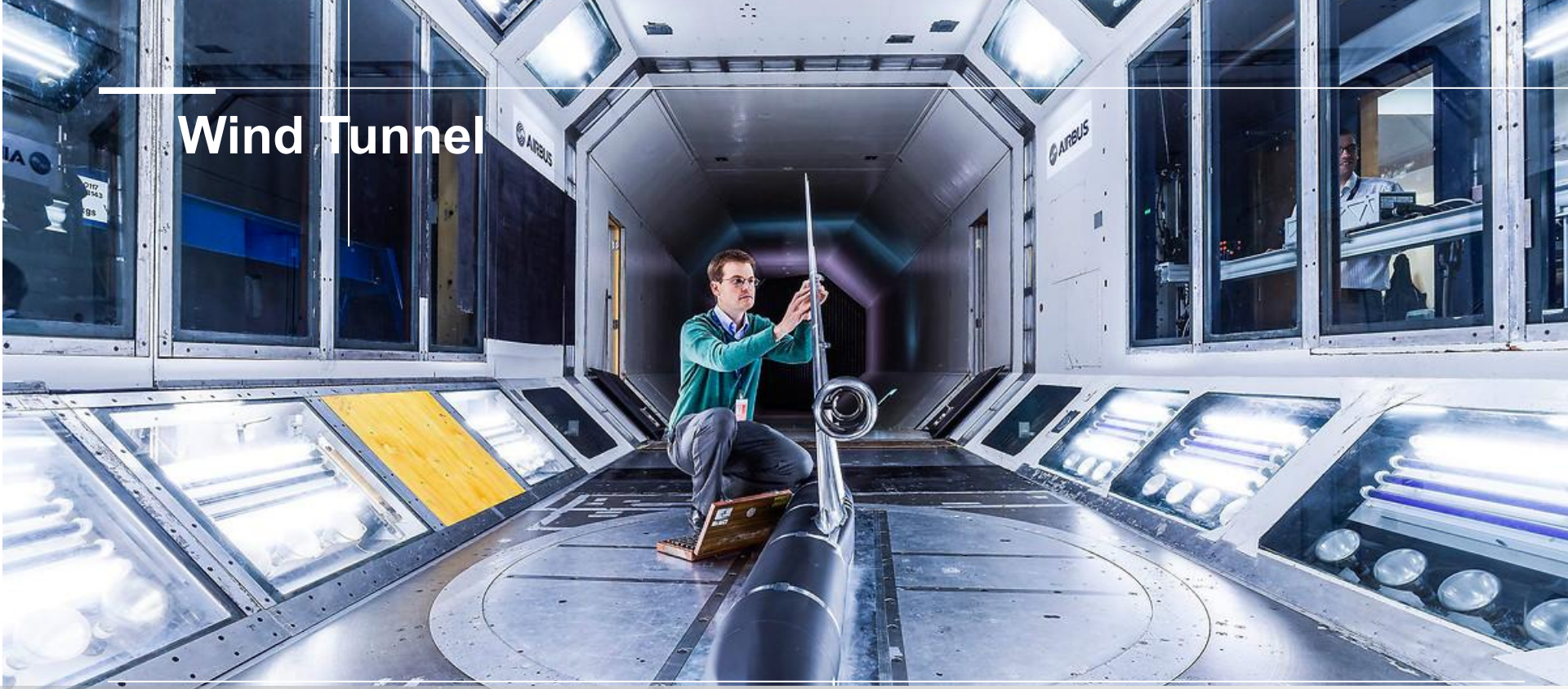
Wind Tunnel



200mph

Maximum speed

1.6Mw

Electric motor to power fan

6.7m

Seven bladed carbon fibre fan

Complete 3D printed services

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Heritage and Modern office & Industrial space

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Interested in discussing potential collaboration opportunities?

Please contact:

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Thank you

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