UK AEROSPACE RESEARCH CONSORTIUM

Maximising value from UK academic research – the UK-Aerospace Research Consortium theme approach

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ICAS 2022, Stockholm
Roger Gardner, Network Manager,
UK Aerospace Research Consortium

The 11 founding member universities:

University of Bristol
University of Cambridge
Cranfield University
Imperial College London
Manchester 1824 The University of Manchester
University of Nottingham UK | CHINA | MALAYSIA
Queen's University Belfast
The University Of Sheffield.
University of Southampton
University of Strathclyde Glasgow
Prifysgol Abertawe Swansea University

Rationale

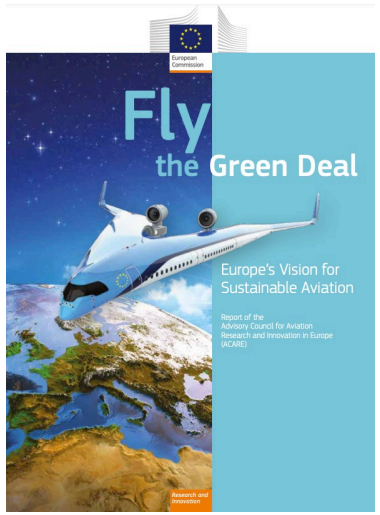
- Responding to urgent climate change stimulus for research
- Getting better alignment with industry on priorities and impact route
- Comparing notes with like-minded researchers internationally
- Leveraging multi-institute and multi-discipline views
- Taking a system view
- Undertake excellent research

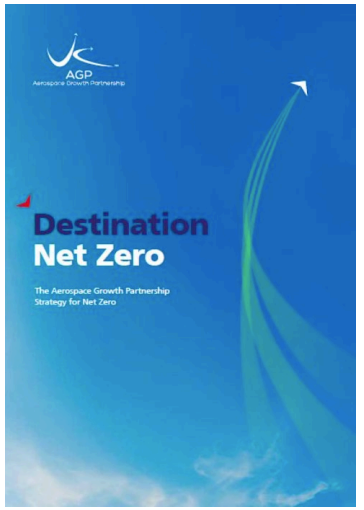
Engineering and Physical Sciences Research Council

Natural Environment Research Council

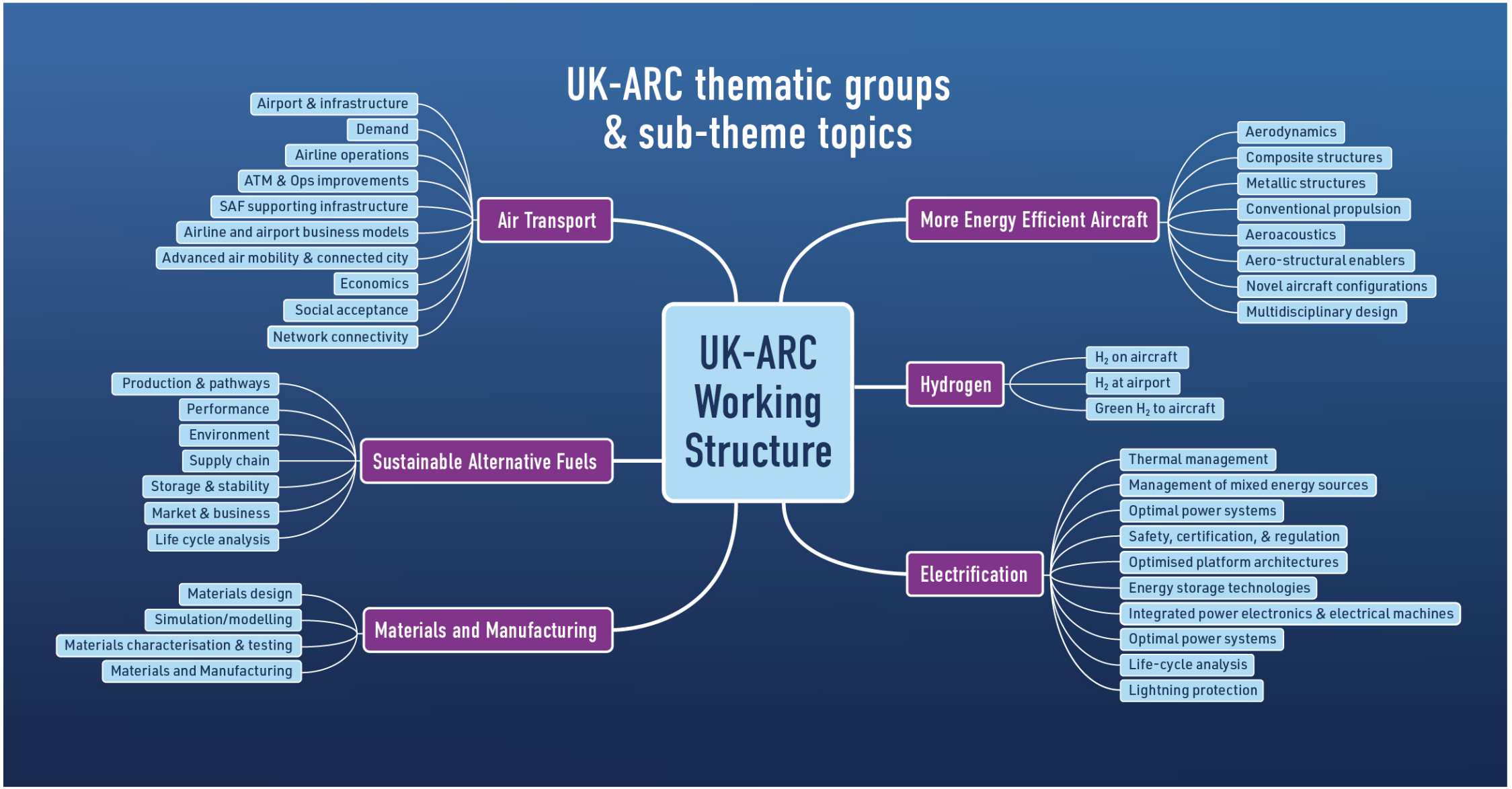
AEROSPACE TECHNOLOGY INSTITUTE

CLEAN AVIATION





A strong net zero focus, linking with industry



More Energy Efficient Aircraft

- Concentrating upon technologies, structural enablers and tools that enable less environmental impact
- More accurate aero-acoustic prediction software and mechanisms to control noise generation
- Importance of improving multi-disciplinary design capabilities
- Integration perspective
- Considering facility development needs

Topic	Top research priorities
Aerodynamics	Aerodynamic testing and correlation with numerical models High and low fidelity aerodynamic modelling methods Aerodynamic shape optimisation
Structural Enablers	Alternative fuel storage Morphing and multifunctional structures Composites for aeroelastic tailoring Loads alleviation Folding wing tips
Propulsion	Hybrid Powered aircraft All-electric aircraft Hydrogen fuel cells
Novel configurations	Fast evaluation of different concepts at conceptual stage Distributed propulsion designs Pathways to certification for novel configurations

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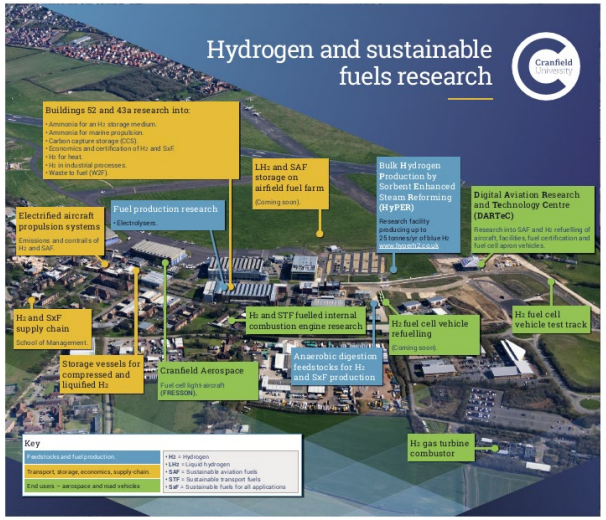
H2



- Building on the thrust of the ATI FlyZero project
- Importance of links with other groups and sector interests
- Main progress in the ‘H2 in the aircraft’ sub-theme – challenge areas: tanks and cryogenics
- Leverage knowledge from projects such as EU ENABLE H2
- Awareness of certification hurdles
- Importance of international programme context
- Building capability and identifying research facility needs

H2 in the Aircraft
H2 aircraft design and performance analysis
H2 propulsion system design, integration, and performance analysis (gas turbines (including advanced cycles – intercooling, recuperation, pressure rise combustion etc.), fuel cells, hybrid and turboelectric + distributed propulsion).
LH2 tank design, manufacturing, and aircraft integration
LH2 tank fluid movement modelling (sloshing), sensors and gauging
LH2 fuel system thermal management and control (fuel supply system from tanks to “consumer” (either fuel cell or gas turbine))
Aircraft engine and combustion noise
Low NOx H2 Combustion
Contrails modelling and aircraft trajectory optimisation for contrail avoidance (incl. trade-offs with mission fuel burn).
Dual-fuel aircraft (H2 and other (e.g., Jet A-1 or Natural Gas))
Technoeconomic Environmental Risk Assessments (TERA) (Mission level and over the life cycle)
Materials and Manufacturing

H2 in the Airport
H2 aircraft ground operations and airport infrastructure
H2 safety (airport, storage, aircraft, refuelling)

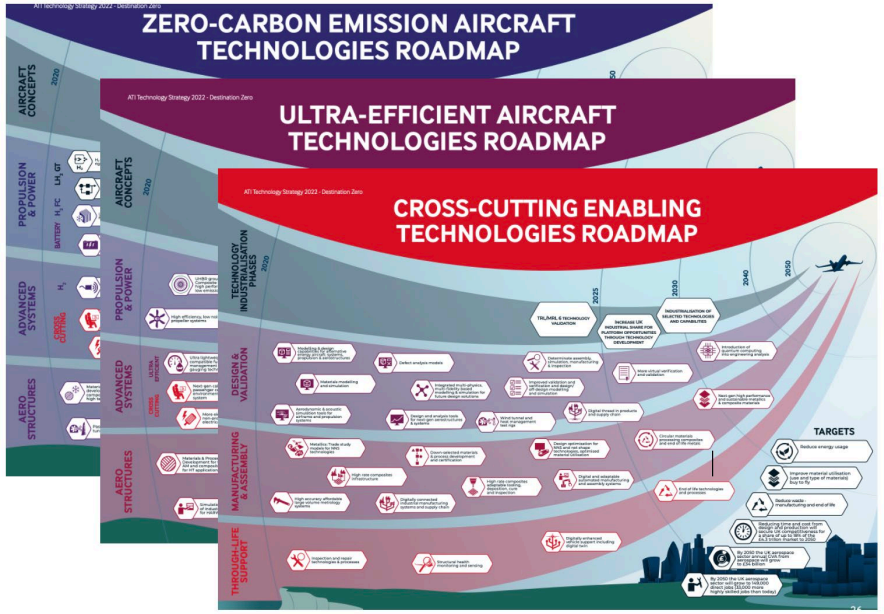
H2 to the Airport
H2, NG and nuclear gas turbines and rotating equipment for land and marine
H2 from renewables
H2 from fossil fuels and CCS
Seawater electrolysis (necessary to protect freshwater supplies)
Automotive and FCs and ICEs for marine

Electrification

Theme workshop focus:

- Propulsion research
- On-board systems
- Energy storage and management

- Viewed at the component, system and aircraft level
- Understand ATI system roadmaps
- Considering test facilities
- Links to other theme groups



Scope

- Thermal management
- Management of mixed energy sources
- Optimal power systems
- Safety, certification, and regulation
- Optimised platform architectures
- Energy storage technologies
- Integrated power electronics and electrical machines
- Optimal power systems
- Life-cycle analysis
- Lightning protection

Connections with University of Nottingham, **S**olutions for **A**erospace **E**lectrification **L**eadership (SAEL) – an independent and international academic and industry collaboration

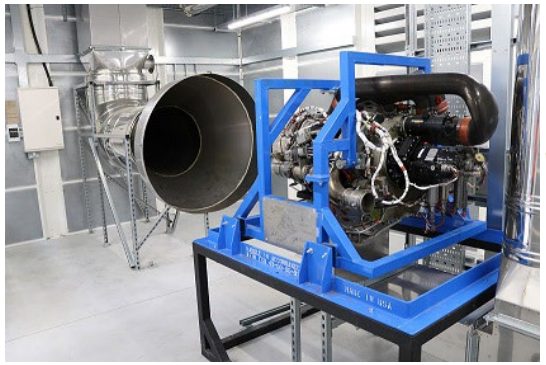
Sustainable Alternative Fuels

- System level view
- Linking to the thrust of the UK Government Jet Zero initiative
  - Pathways for production
  - Emissions
  - Market & economics
- ‘Fit for purpose’ testing

Sustainable Aviation Fuel Supply Chain
A Large Ecosystem – Opportunities beyond fuel production

Fuel	• Production (equipment) • Quality control instrumentation and systems • Process control • Energy source & Feedstock (e.g. H2, syngas)
Transport	• Shipping • Refueling vehicles • Pipelines
Operations & Maintenance	• Refueling and maintenance companies • Storage systems
Utilization	• Aircraft engine manufacturers • Specialist components manufacturers • Control systems • Aircraft OEMs • Airlines • Airports
Specialist Workforce	• Fuel Production • Operations and Maintenance • Courses/Training centre

Opportunities for Development and Innovation

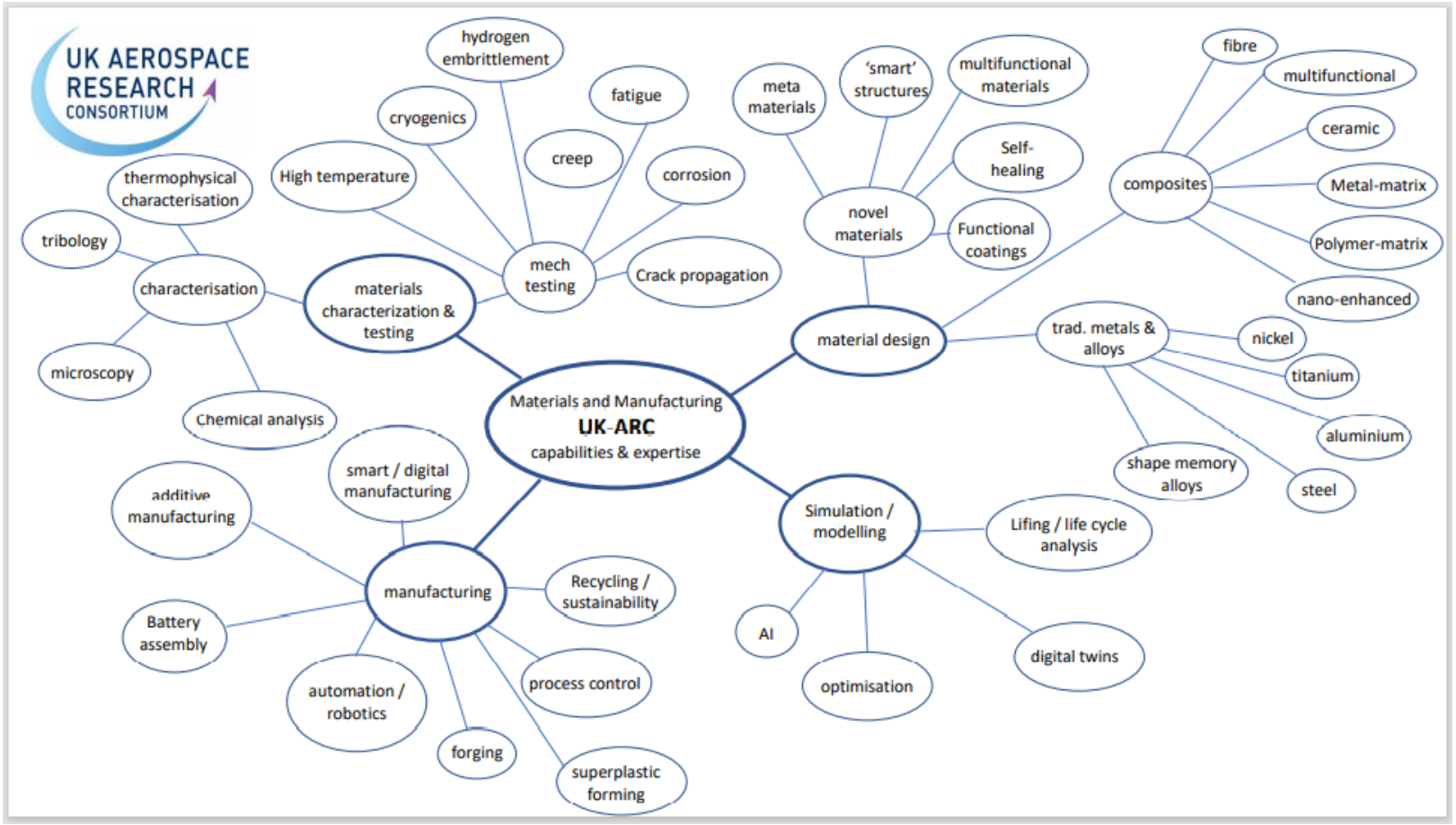


University of Sheffield Translational Energy Research Centre

Material and Manufacturing

Considering the challenges, e.g. :

- Hydrogen – cryogenics/embrittlement
- Composite/multi-materials
- Electrification – thermal management
- Structures – weight saving – bio-based materials
- AM implementation



Air Transport

Approach

- System level view
- Impacts as well as technology and operational solutions
- Account for emerging technologies – Advanced Air Mobility (AAM)

Topics

- Airport and infrastructure
- Demand
- Airline operations
- Air Traffic Management modernisation and operational improvements
- The infrastructure and logistics in widespread adoption of SAFs
- Airline and Airport business models
- Advanced Air Mobility and the connected city
- Economics
- Social acceptance of change including new technologies

Additional themes?

- Noise – perhaps needs to be considered separately as new technologies emerge
- System modelling, economics and scenarios – part of the systems approach
- Atmospheric science – importance of connections with scientists on non-CO2 emissions
- Links with other groups – UK Vertical Lift Network (VLN) and other sector groups (e.g. on hydrogen)

Approach on validation

- Internal inter-theme connection
- Sharing perspectives with ATI and industry
- Checking against UK and international initiatives
- Fitting with UK strategic ambitions (net zero, digitization, etc)
- Towards ….building value-added collaborative projects

Aerospace Growth Partnership

Advisory Council for Aeronautics Research in Europe

Department for Business, Energy & Industrial Strategy

UK AEROSPACE RESEARCH CONSORTIUM

UKRI Engineering and Physical Sciences Research Council

Advancing UK Aerospace Research through University Collaboration

UK-ARC facilitates and promotes value-added aerospace research projects across university boundaries and with the sector. As a growing community with a net zero focus, UK-ARC connects experts and stakeholders, expands use of university research facilities and builds international collaborations.

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Thank you for your attention

Any questions?