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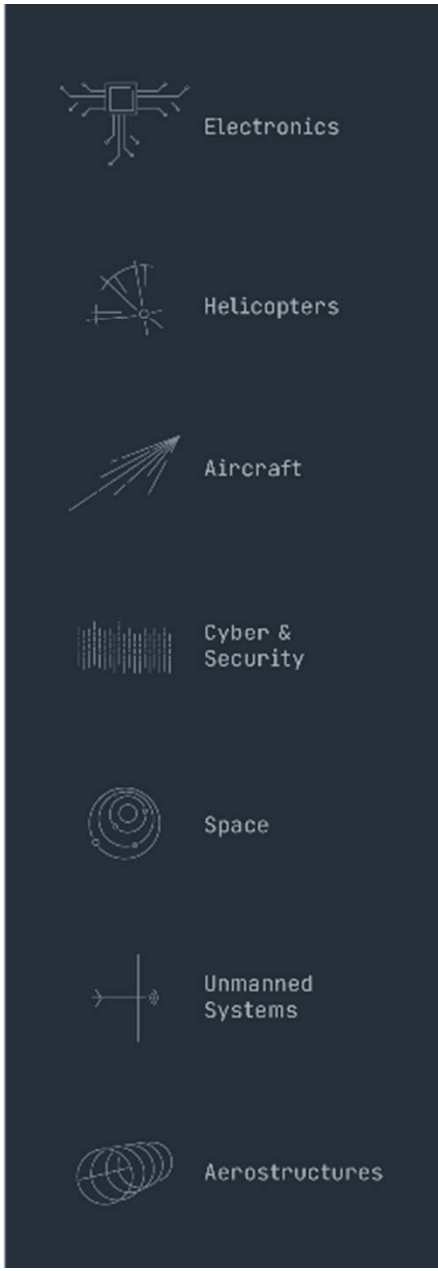
Leonardo Aircraft

Clean Aviation: Hybrid-Electric Regional Thrust

Overview

Clean Aviation French infoday

27.04.2022



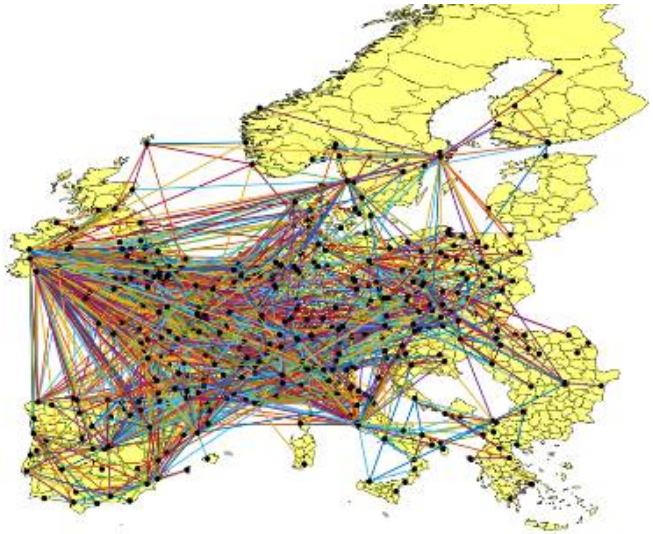
Hybrid-Electric regional vision

- By mid-2030, the mobility of people and goods is expected to undergo progressive changes, especially over distances of less than 500 km (inter-urban regional connections).
- Air vehicles operating in this range and operational environment such as hybrid-electric propulsion are considered the first scheduled air transport system to adopt technologies ready for zero-emission

The regional aircraft will integrate technologies ready for entry into service by 2035, incorporating viable solutions for infrastructure, and certification.

  - The aircraft will include hybrid-electric propulsion supported by 100% drop-in fuels or hydrogen -whether fuel cells or H2 burning- for the thermal power source, to reach up to 90% lower emissions while being fully compliant with ICAO noise rules.

- Regional air transport may be a “first case” for other air vehicle segments:
  - innovative and disruptive technologies
  - opening up new business models for societal demands in terms of people and goods transport: shorter field length and small airports, simplified operations, quick turn-around times, ...
  - ability to operate in a multi-modal mobility frame



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Implemention in Clean Aviation

1. Aircraft integration: regional aircraft as the first commercial platform in the zero-emission pathway with a 2035 EIS by hybrid propulsion and advanced on-board systems
   - Unprecedented challenges for integrating electrical, thermal and propulsive systems with performance challenges 1-2 orders of magnitude bigger in complexity and/or volume/size/weight than current ones
   - Figure out and validate at real scale an aircraft concept and related performance suitable to future societal needs for actual impact
   - Streamline design and qualification/certification processes to meet 2035 EIS and maximize impact
2. Technologies: by developing the bricks enabling an HER A/C a reality
   - Develop and assess hybrid propulsion architecture and related components and systems solving the high power, high voltage electrical network challenges and related thermal management issues
   - Develop digital and sustainable solutions applied to design and manufacturing processes introduced by new HER propulsion, system and integration challenges

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Clean Aviation Call 1 topics

Identification Code	Title	Type of Action	Max Projects Number	Ind. Funding Value in (M€)
Hydrogen-powered aircraft topics				
CLEAN-AVIATION-2022-01-HPA-01	**Direct Combustion of Hydrogen** in Aero-engines	IA	2	115
CLEAN-AVIATION-2022-01-HPA-02	**Multi-MW Fuel Cell Propulsion** System for Hydrogen-Powered Aircraft	IA	2	50
CLEAN-AVIATION-2022-01-HPA-03	Large Scale Lightweight **Liquid Hydrogen Integral Storage** Solutions	IA	1	10
CLEAN-AVIATION-2022-01-HPA-04	Near Term **Disruptive Technologies for Hydrogen-Powered Aircraft**	IA	2	7
Hybrid-electric powered regional aircraft topics				
CLEAN-AVIATION-2022-01-HER-01	**Multi-MW Hybrid-Electric Propulsion** System for Regional Aircraft	IA	2	75
CLEAN-AVIATION-2022-01-HER-02	**Thermal Management** Solutions for Hybrid-Electric Regional Aircraft	IA	1	40
CLEAN-AVIATION-2022-01-HER-03	**Electrical Distribution** Solutions for Hybrid-Electric Regional Aircraft	IA	1	40
CLEAN-AVIATION-2022-01-HER-04	**Innovative Wing Design** for Hybrid-Electric Regional Aircraft	IA	1	20
Short/short-medium range aircraft topics				
CLEAN-AVIATION-2022-01-SMR-01	**Ultra Efficient Propulsion Systems** for Short and Short-Medium Range Aircraft	IA	3	175
CLEAN-AVIATION-2022-01-SMR-02	**Ultra Performance Wing** for Short and Short-medium Range Aircraft	IA	2	55
CLEAN-AVIATION-2022-01-SMR-03	Advanced **Low Weight Integrated Fuselage and Empennage** for Short Range and Short-Medium Range Aircraft	IA	1	40
Transversal activity topics				
CLEAN-AVIATION-2022-01-TRA-01	**Aircraft architectures & technology integration for aircraft concepts ranging from regional to short-medium range applications**	IA	3	90
CLEAN-AVIATION-2022-01-TRA-02	**Novel Certification Methods** and Means of Compliance for Disruptive Technologies	IA	1	18
Coordination and Support Actions				
CLEAN-AVIATION-2022-01-CSA-01	Developing a **European Clean Aviation Regional Ecosystem** (ECARE)	CSA	1	0.72
TOTAL	**14 topics**			**735.72**

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Clean Aviation topics affecting Hybrid-Electric Regional Thrust

Hydrogen Powered Aircraft
H2 Storage
H2 Distribution System
H2 Direct Burn Propulsion System
Fuel Cell Propulsion System
Near Term Disruptive Technologies
Longer Term Disruptive Technologies
Climate assessment

Hybrid Electric Regional Aircraft
Aircraft architecture and configuration
Hybrid-Electric Propulsion
Advanced Electric Distribution
Thermal Management
Airframe Integration Wing
Airframe Integration Fuselage
Digitalisation

Transversal Project
CERTIF 2035

Short & Medium Range Aircraft
Aircraft architecture and integration
Disruptive Propulsion
Ultra Efficient Wing
Integrated Low Weight Fuselage / Empennage
Sustainable Industrialisation

Primary

Secondary

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Hybrid-Electric Regional: highly interconnected and multidisciplinary

HER Project	Links within HER	Links with SMR	Links with H2	Type of links and direction	Links with other EU R&T initiatives
1) Aircraft architecture and configuration	All HER projects – continuous interaction	• Common best practice, certification, standards • Impact monitoring principles and features	• Reference a/c requirements, aircraft integration results, key system features and timeline	• Requirements to the other projects • Results and feedback from the other projects	FHC, BEPA, SESAR 3, Cluster 5 Collaborative Research
2) Hybrid-Electric propulsion	Key interactions with 3, 4, 5 (see HER Phase 1 integrated planning)	• Requirements for Fuel Cell suitable to aeronautical standard at MW scale • Requirements for H2 burning at MW scale	• Impact monitoring principles and features • Fuel cell propulsion architecture and performances • H2 burning performance	• Bidirectional data and solutions with related projects	FHC, BEPA, Cluster 5 Collaborative Research
3) Advanced Electric Distribution	Key interactions with 2, 4, 5, (see HER Phase 1 integrated planning)	• Scalability of all-electric systems to SMR at MW scale per channel	• Fuel cell features (key priority) at MW scale for propulsion	• Bidirectional data and solutions with related projects • Electrical requirements to the other projects	BEPA, FHC, Cluster 5 Collaborative Research
4) Thermal Management	Key interactions with 3, 4, 5 (see HER Phase 1 integrated planning)	• Scalability to SMR size • Standards and certification	• H2 tanks and ancillary systems (key priority)	• Bidirectional data and solutions with related projects	BEPA, FHC, Cluster 5 Collaborative Research
5) Airframe integration Wing	Key interactions with 2, 3, 4, 6 (see HER Phase 1 integrated planning)	• N/A	• H2 burning (lower priority)	• Bidirectional data and solutions with related projects	Made in Europe, Collaborative Research Cluster 4 and 5
6) Airframe Integration Fuselage	Key interactions with 2, 3, 4, 5 (see HER Phase 1 integrated planning)	• Sharing thermal integration of new power sources	• Fuel cell features and constraints	• Bidirectional data and solutions with related projects	Made in Europe, Collaborative Research Cluster 4 and 5
7) Digitalisation	All HER projects –	• Common approach to interface CERTIF 2035 • Shared digital standards and backbone	• N/A	• Digitalization targets to achieve to HER projects • Models and specific tools to integrate	Digital opportunities in EU, Cluster 4 and 5 Collaborative Research, Made in Europe

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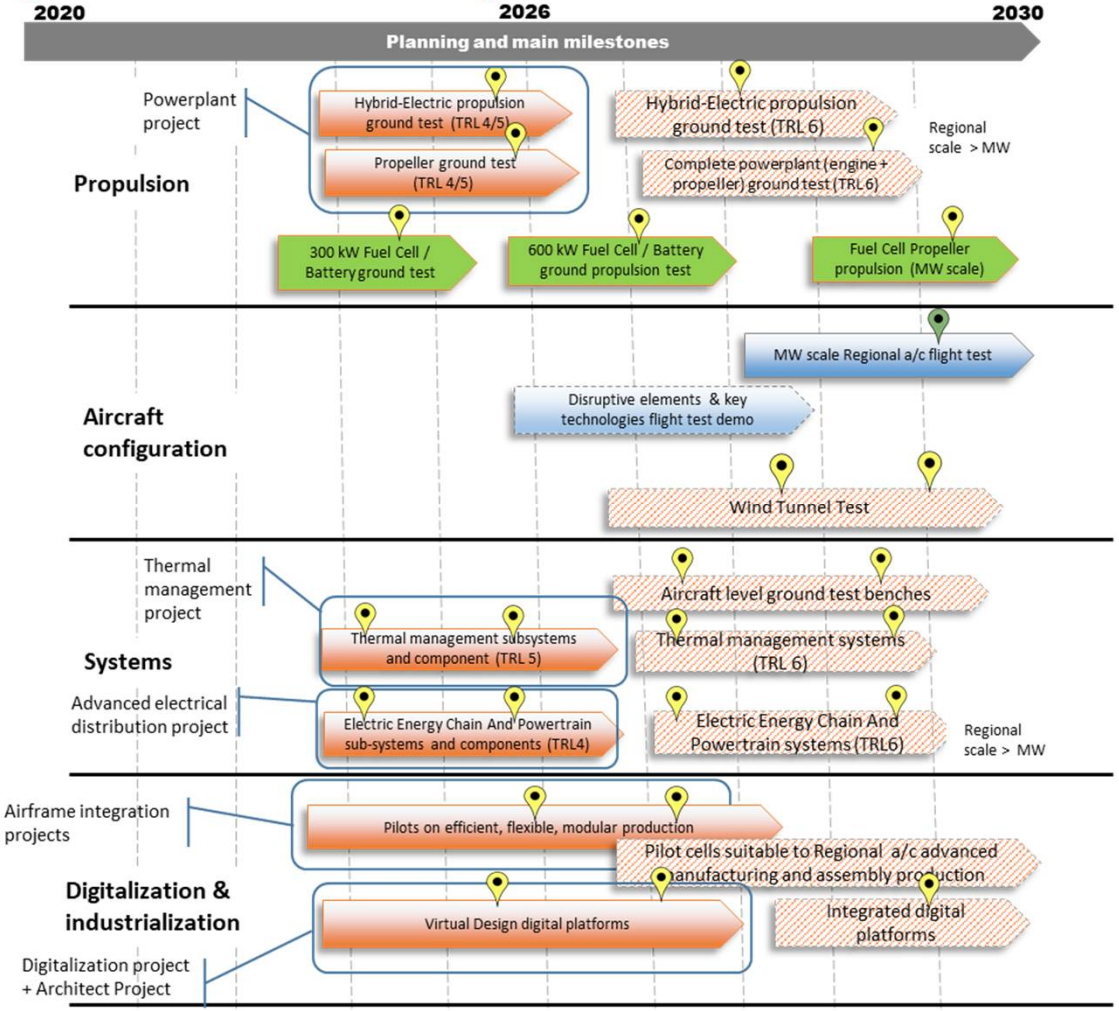
Hybrid-Electric Regional Demonstration Strategy



Phase 1 HER projects

Ground demo

Flight demo

Out of HER

Phase 2 ground demo

Results available

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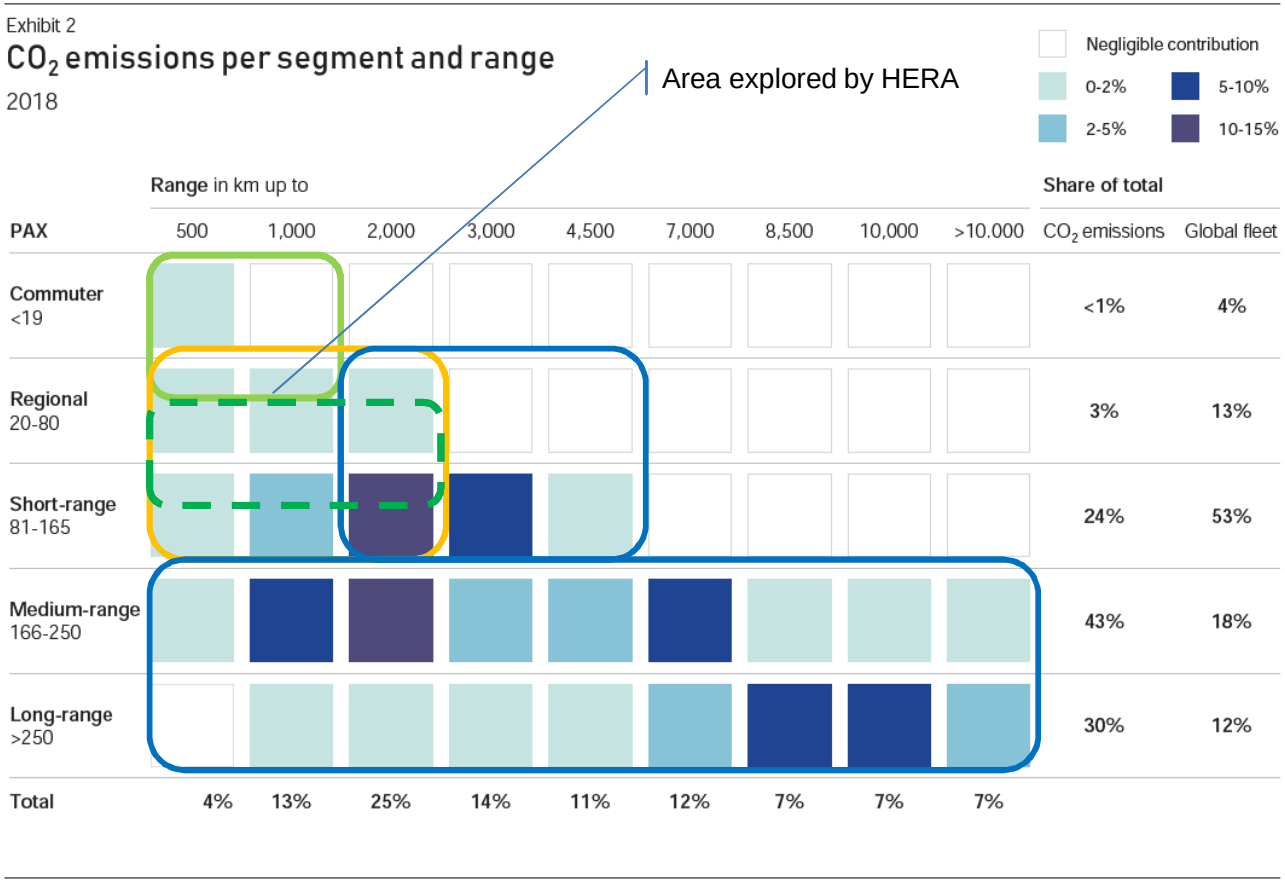
Hybrid-Electric Regional perimeter



Battery

Fuel Cell

Hydrogen Burned

HERA studying regional aircraft with passenger number ranging from 50 to 100 and EIS 2035

HERA GHG target reduction min 30% max 50% vs 2020 aircraft technology

Flight Demo configuration ready in 2025+

Technologies validation at TRL6 by 2030

EIS by 2035

Replacement of 75% of 2020 fleet by 2050

Source
Hydrogen-powered aviation
A fact-based study of hydrogen technology, economics, and climate impact by 2050 (May 2020)

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Regional hybrid-electric aircraft architecture and configuration proposal

What for

- Definition of the potential hybrid-electric regional aircraft concept targeting 2035 EIS
- Definition and assessment of the real-scale demonstrators -in-flight and on-ground- to be performed after 2025

How

- New Aircraft Architecture & Configuration
- Sustainable Industrialisation & Digitalisation
- Processes, Methods and Tools
- Demonstration strategy to mature technologies, anticipate certification and shorten exploitation

What

- key performance, architectures, features and sizing at aircraft level
- certification global approaches and specific rules
- measures promoting the transition to climate neutral aerial mobility
- impact on key operative factors and infrastructures

Phase 1

- Aircraft TLAR
- Aircraft concepts modelling and performance
- Preliminary integration
- V&V plan for HER building blocks
- Technical requirements & systems interfaces
- Models and tools integration
- Impact assessment
- Aircraft certification and operative issues

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FOR YOUR ATTENTION

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