CLEAN AVIATION

EASA Certification Roadmap on H2

Technology development and certification in a multidimensional ecosystem

Cologne 17 December 2024

Paolo Trinchieri - Team leader H2 projects

Co-funded by the European Union

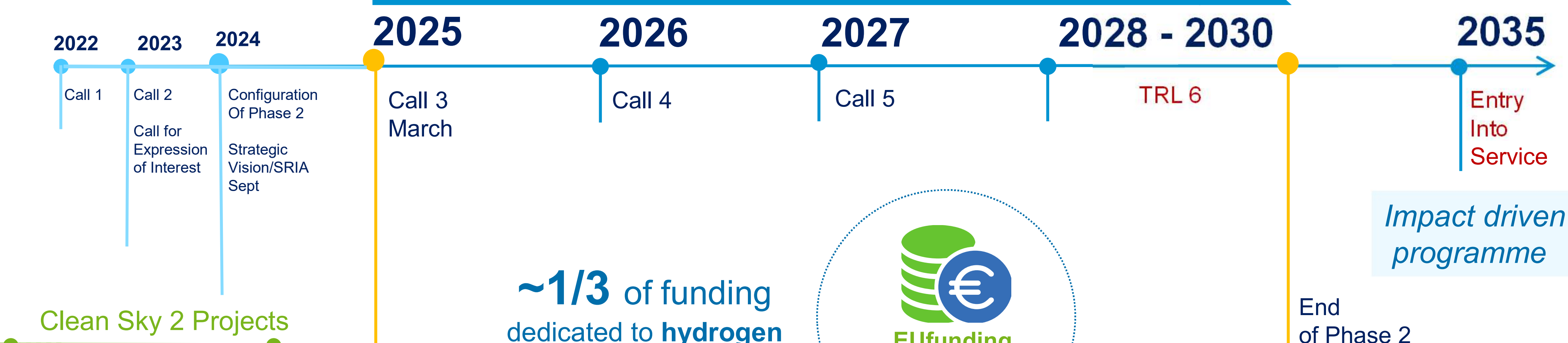
Clean Aviation: 2 Phases

IMPLEMENTATION TIMELINE

Phase 1:
Develop concepts, technology options and trade studies

Phase 2: Accelerate **technology maturation through integrated demonstration**

EU Funding: **€1.7B**
Private Funding: **> €2.4B**



Impact driven programme

~1/3 of funding dedicated to **hydrogen aircraft** development

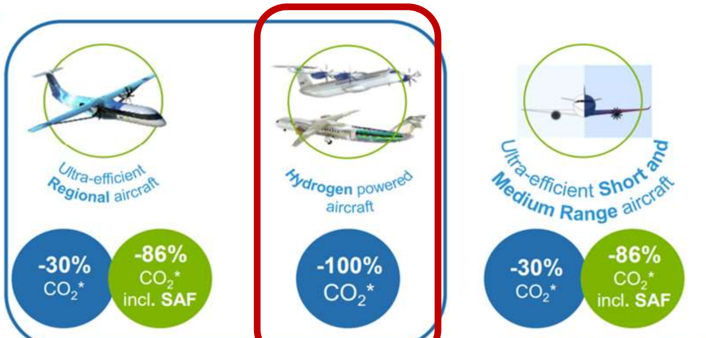
EUfunding
930M

Clean Sky 2 Projects
2014 2024

Clean Sky 2
CLEAN AVIATION

Co-funded by the European Union

Hydrogen Powered Aircraft (HPA) Roadmap and projects



* non-CO_2 effects not yet quantified

- ❑ Phase 1 target: **TRL4 by 2026**
- ❑ Phase 2 target: **TRL6 by 2030** for critical technologies, representative system tests including flight test
- ❑ H2 Combustion vs Fuel Cell propulsion
- ❑ Overall aircraft integration and certification to be reinforced in Phase 2

Detailed roadmap available in the SRIA

Phase 1 projects:
- 4 focus areas
- 7 topics / 9 Grants up to full scale demonstrations
- 120 entities (ca. 40% CAJU total)
- 237 M€ funding
- TRL 3-5

CLEAN AVIATION

Co-funded by the European Union

Hydrogen Aircraft Concepts (SRIA update)

	Gas turbine powered aircraft	Fuel cell powered aircraft
Aircraft concept	Tube and wing	Tube and wing
Range & capacity	Up to **1,400nm & 120/150pax**	**1,000nm & 100 pax**
Propulsion concept	**Gas turbine engine – Hydrogen combustion**	**LT-PEM Fuel cell propulsion**
Installed power	~14,000 SHP (total)	10MW (2,5MW per engine)
Hydrogen storage	Cryogenic (LH2) storage + pump-fed distribution system (liquid/supercritical)	Cryogenic (LH2) storage + pressure-fed distribution system (gaseous)
Advantages	Scalable to larger sizes / longer ranges	No NOx & limited contrails / Competitive at small sizes

Objective of Clean Aviation is to mature Aircraft concept and techno (up to TRL6) to support ~ 2035 Enter in Service

Short haul flights in the case of HPA (< 1500 nm)

Technology integration into aircraft concepts, risks related to technology novelty

CAJU-EASA Cooperative framework

- **Memorandum of Cooperation** agreed in November 2022

- **Phase 1 projects (in progress 2023-2026):**
  Cooperation implemented through **Service Contracts** at project level and documented through deliverables in project grants, aimed to:

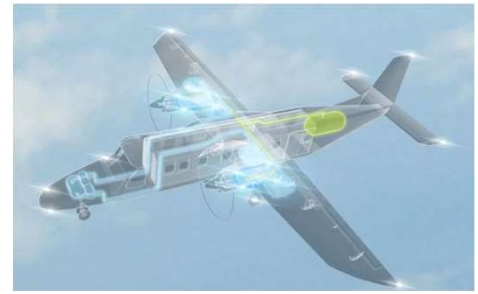
  - Regulator **familiarization** with **H2 technologies** in projects reviewing **baseline regulations, standards,** guidance vs airworthiness requirements and certification basis for new technologies and anticipate special conditions
  - Initial set of **requirements** and **gap analysis** to prepare **certification of H2 technology**
  - Main principle agreed, **safety objectives and operational environment "**concept of operation" for initial rulemaking material preparation

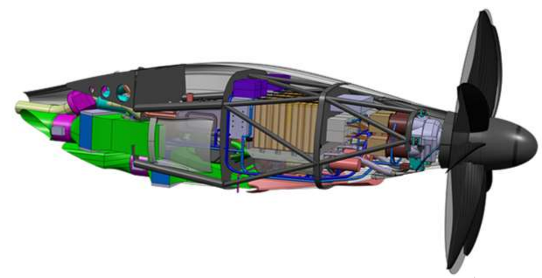
- **Phase 2 projects (2026-2030)** will focus to **certification basis** for **technologies** and **aircraft concepts**

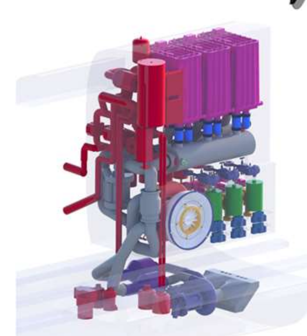
- **Certification Readiness level (CRL)** will be used to assess the progress with a **CRL6 target** (at system level) by the end of Phase 2 for EIS 2035. **TRL / CRL clear articulation**

Cooperation progress in Phase 1 (2023-2026)

- First projects approaching 2nd year of activity
- **Initial design and technology maturation acquired**, demonstration strategy in some case adapted
- CS25 aircraft focus with some CS23 potential step-in
- Cooperation ongoing with projects to advance H2 certification relevant topics:
    - Fuel cell systems (e.g. hybrid scalable system 1 to 2.5 MW)
    - H2 Direct burn (e.g. functional hazard assessment, combustion tests learning)
    - LH2 Storage (e.g. crashworthiness, aircraft integration)
    - Safety analysis, failure modes
    - Systems upscaling, integration in aircraft
    - Some initial test witnessed by EASA staff
- Some difficulty emerged to keep the original ambition for the **end-to-end approach (storage to engine)** in absence of clear aircraft definition
- Opportunity to **reinforce synergies** when same technology is developed in parallel CAJU projects (H2C, FC) and in private effort (e.g. pre-application contracts)
- Continue to ensure EASA involvement in project workshops and reviews to **anticipate issues** including new topics to be considered for future calls







CLEAN AVIATION

Co-funded by the European Union

EU collective effort towards climate-neutral aircraft

Conclusions

- New technologies as H2 require a **new approach** from aircraft operational and safety perspective
- Delivering a competitive, safe and reliable H2 aircraft require a **collective effort** across the **entire eco-system** in an international dimension
- EASA engagement in projects early stages is key to **derisk certification aspects,** involvement of industry airworthiness experts in R&T is a factor of success to prepare future certification
- **Future calls** at technology and integration level are an opportunity to accelerate the **trajectory for Hydrogen Powered Aircraft**
- Continue assessing and mature **H2 technology** is key to overcome current difficulties and prove commercial viability supported by infrastructure and supply currently limiting-delaying large scale implementation in aviation

THANK YOU FOR YOUR ATTENTION

paolo.trinchieri@clean-aviation.eu

Co-funded by
the European Union