



Dedicated to innovation in aerospace

Opportunities in Clean Aviation & Clean Hydrogen

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20-01-2022

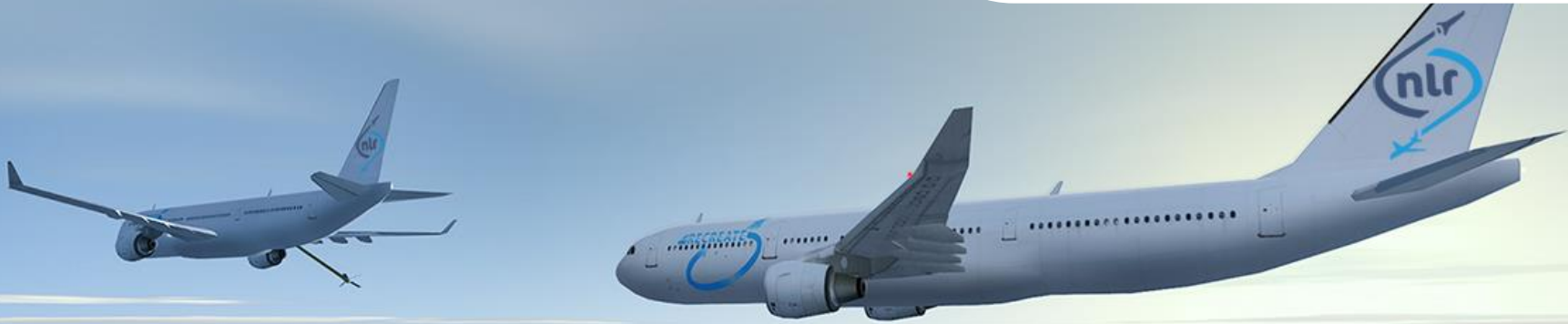


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Aerospace Innovator
More sustainable, safer,
more efficient and
effective



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100+
Royal Netherlands Aerospace Centre
FOUNDED 1919



NOT-FOR-PROFIT APPLIED R&D INSTITUTE



HIGH END FACILITIES



MULTI-DISCIPLINARY



658



ACTIVE GLOBALLY



SCALED INSTRUMENTED (FLIGHT) TESTING



(ACOUSTIC) WINDTUNNELS



(RAPID) PROTOTYPING



HYDROGEN PROPELLED TEST BED



3D Magnesium printing



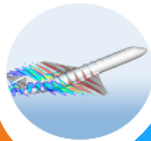
X-LAB ND SHM

Universities

Development & Integration of technologies

Translation to industry

Production & commercialisation



Research



NLR: link between universities and industry

Industrial partners, Spin-offs, Start-ups

TECHNOLOGY READINESS LEVEL (TRL)

9	ACTUAL SYSTEM PROVEN IN OPERATIONAL ENVIRONMENT
8	SYSTEM COMPLETE AND QUALIFIED
7	SYSTEM PROTOTYPE DEMONSTRATION IN OPERATIONAL ENVIRONMENT
6	TECHNOLOGY DEMONSTRATED IN RELEVANT ENVIRONMENT
5	TECHNOLOGY VALIDATED IN RELEVANT ENVIRONMENT
4	TECHNOLOGY VALIDATED IN LAB
3	EXPERIMENTAL PROOF OF CONCEPT
2	TECHNOLOGY CONCEPT FORMULATED
1	BASIC PRINCIPLES OBSERVED

RESEARCH DEPLOYMENT





Three strategic themes



Sustainable aviation



Competitive aerospace



A safe and secure society



Dedicated to innovation in aerospace

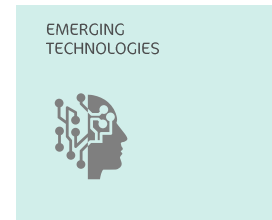
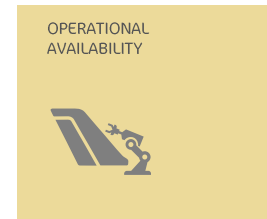
NLR Strategy Plan 2022-2025



Royal NLR – Netherlands Aerospace Centre

Nine programs

1. Climate-neutral aviation
2. The impact on people and society
3. Safe and competitive operations
4. Aerospace vehicle development
5. Operational availability
6. Information-driven operations
7. Future air & space power
8. Unmanned and autonomous
9. Emerging technologies



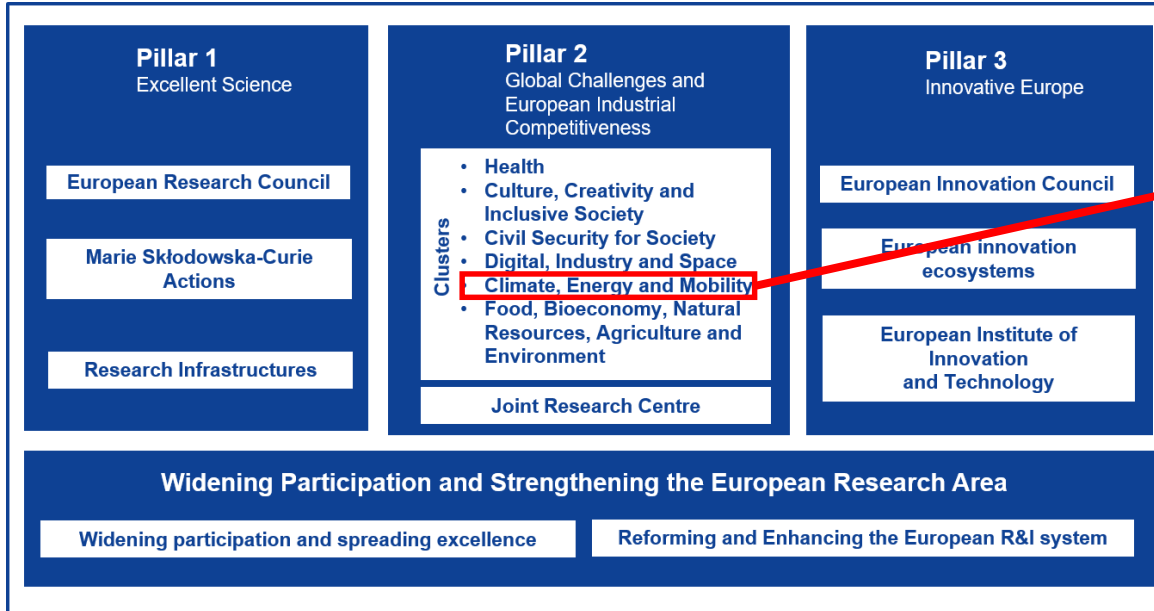
Horizon Europe

THE NEXT EU RESEARCH & INNOVATION
PROGRAMME (2021 – 2027)



Source: European Commission

Horizon Europe



Source: European Commission

Work programme

+

EU-partnerships

- Clean Hydrogen
- Clean Aviation
- SESAR3
- Etc.

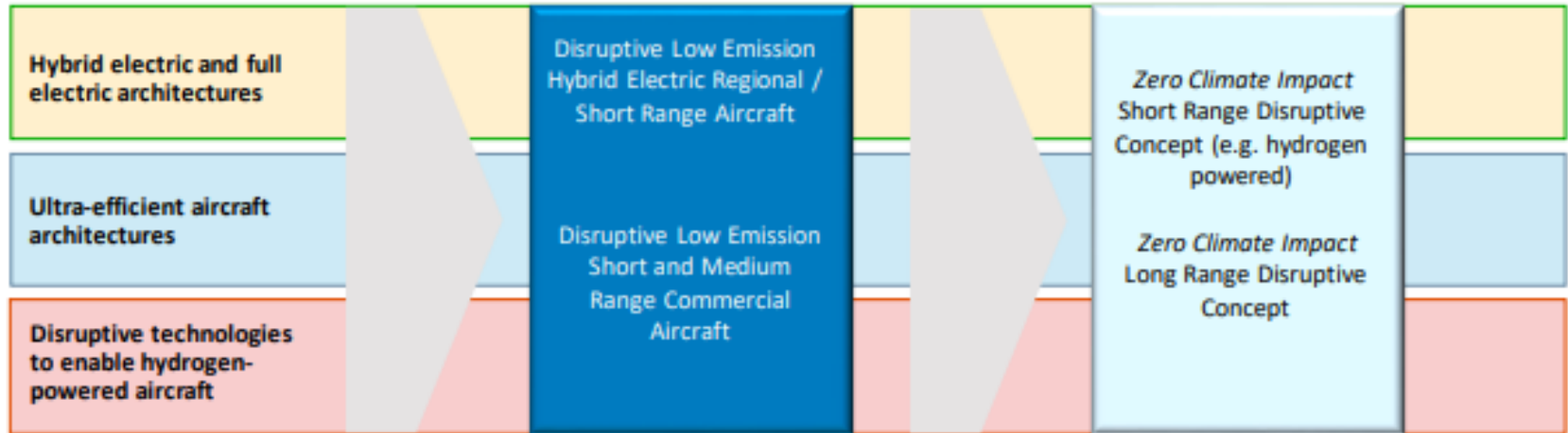
Clean Aviation

- Follow-up to Clean Sky 2
- Duration of 9 years
- Budget:
 - 2.4 G€ private contribution (mainly *in-kind*)
 - 1.7 G€ EU-funding (excl. UK)
- Programme is fully **open**
- Dutch members of the Joint Undertaking:
 - Royal NLR
 - GKN-Fokker
 - TU Delft



Source: Clean Aviation JU
Hyperlink: [SRIA](#)

Clean Aviation: programme structure



Source: European Commission

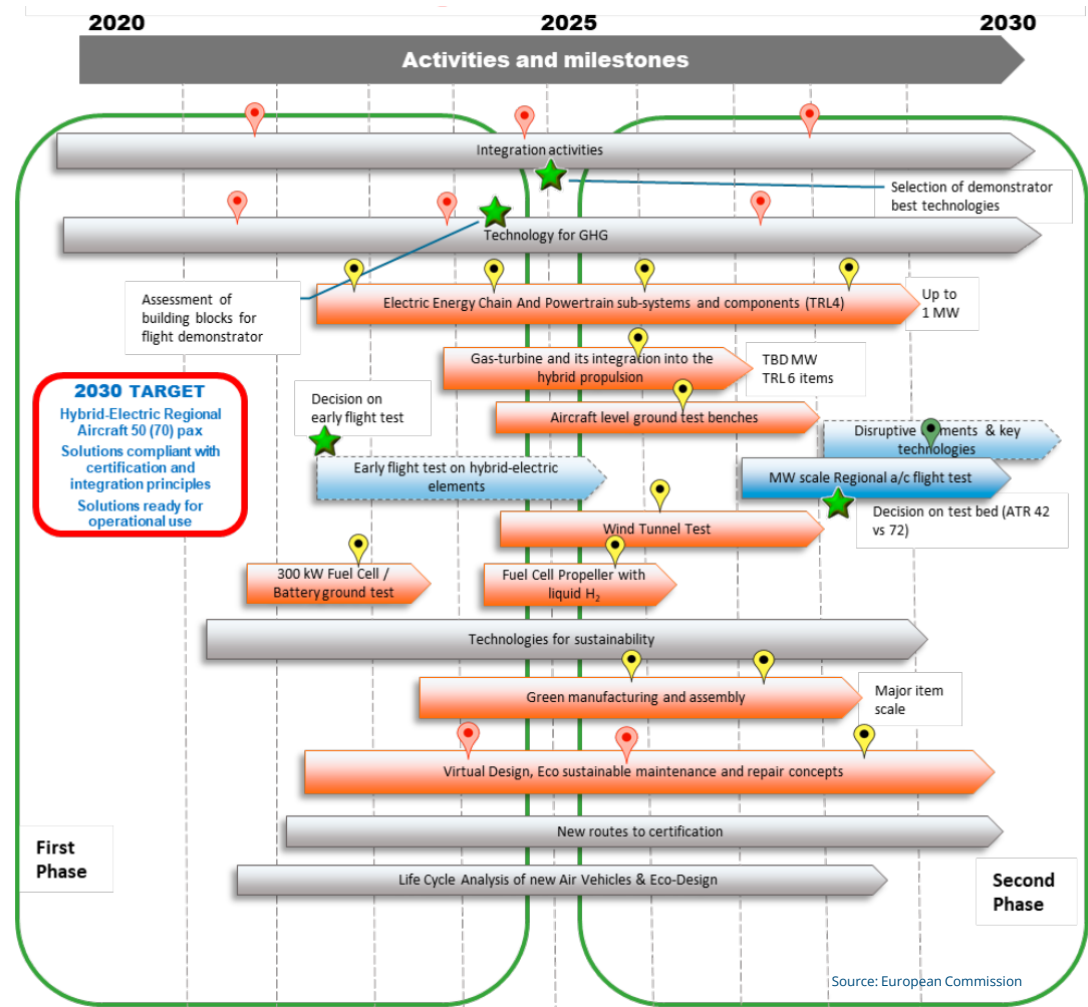
Flight demonstration in Clean Aviation and impact by 2035

Development of disruptive technology options



Clean Aviation Roadmaps

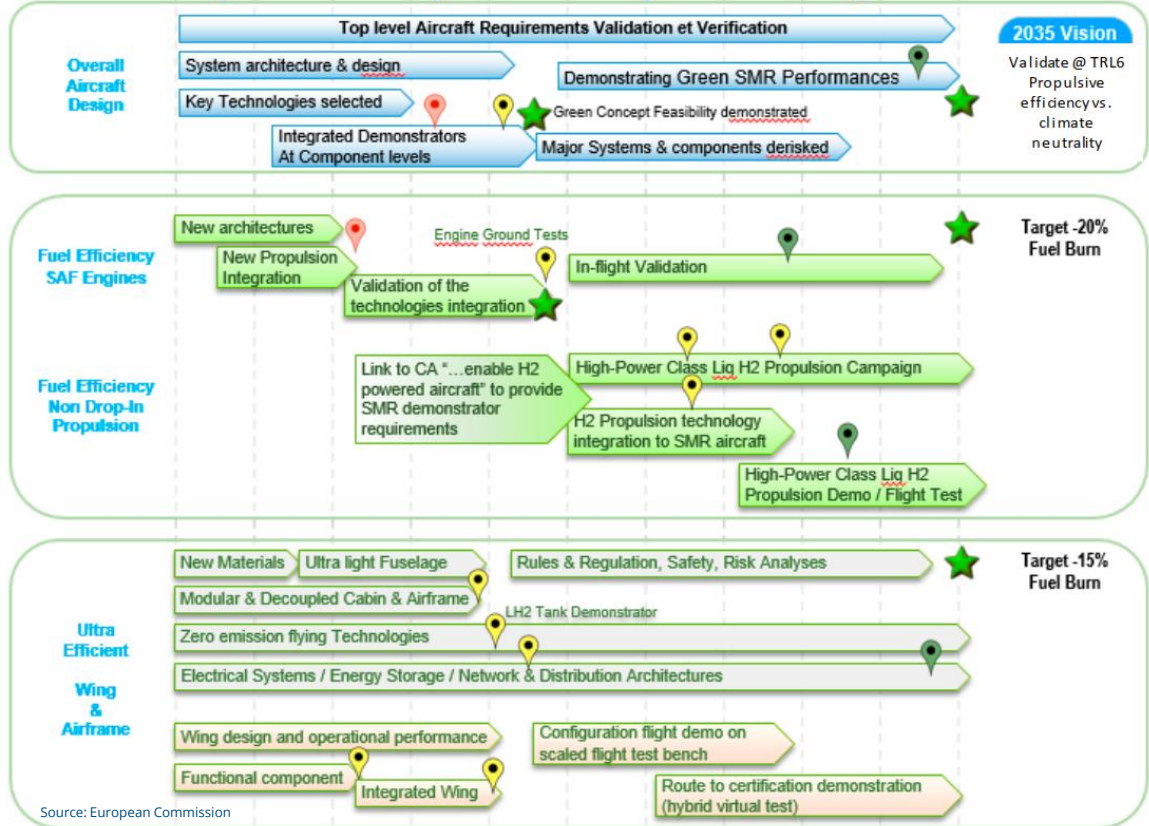
Hybrid Electrical Regional





Clean Aviation Roadmaps

Short Medium Range 1/2

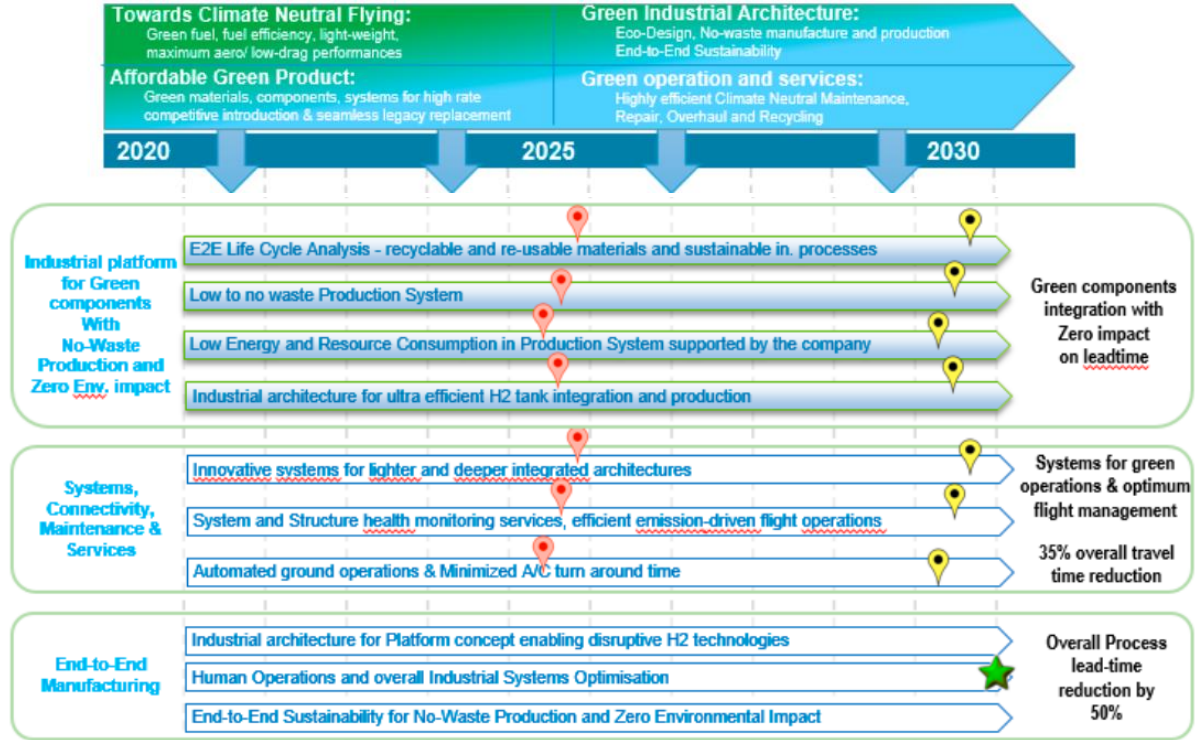


Source: European Commission



Clean Aviation Roadmaps

Short Medium Range 2/2



Source: European Commission



Clean Aviation Roadmaps

Hydrogen

Disruptive tech to enable hydrogen-powered aircraft

- Climate impact assessment
- Propulsion system
 - Storage and fuel distribution
 - Combustion
 - Fuel cells
- Safety and certification
- Demonstrators

Clean Hydrogen

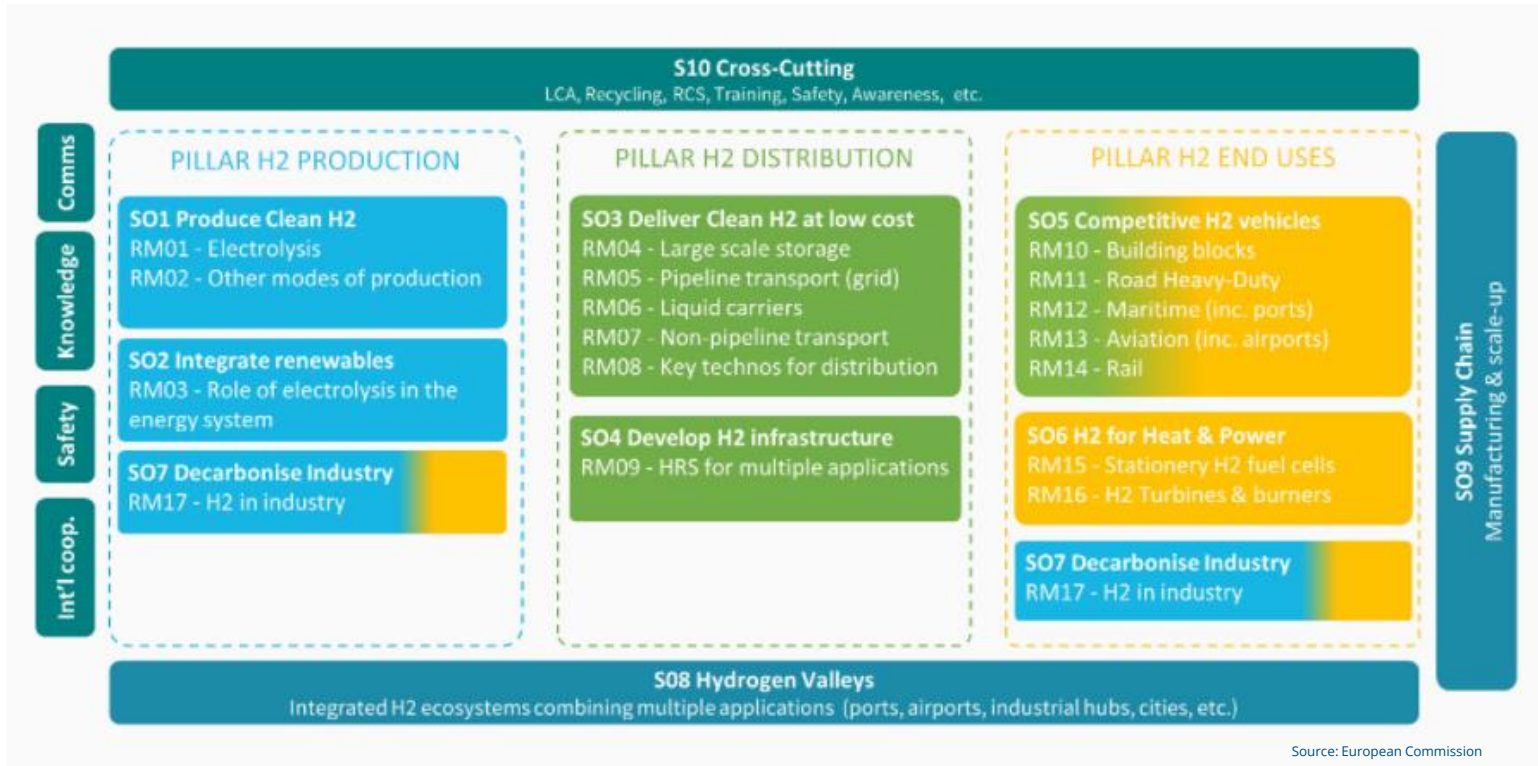
- Follow up to Fuel Cell and Hydrogen (FCH)
- Covers nearly the complete ecosystem
- Budget:
 - 1 G€ EU-funding
 - >1 G€ private contributions
- Programme is fully **open**
- Dutch members a.o.
 - Royal NLR
 - Marin
 - TNO
 - Vopak
 - Etc.



Strategic Research and Innovation Agenda
Final Draft
October 2020

Source: Hydrogen Europe
Hyperlink: [SRIA](#)

Clean Hydrogen: overview



Clean Hydrogen: Aviation



Pillar 3: Hydrogen End-Uses: Transport Applications

3.1.E Aeronautic Applications

OBJECTIVES

1. Improving overall system and stack performance for scalable FC in terms of power density, durability and availability;
2. Reducing NOx emissions of turbines;
3. Addressing Airport infrastructure (of both liquid and compressed hydrogen) and refuelling tech / procedures;
4. Developing aviation dedicated technological bricks, focusing on on-board storage, distribution components and systems of liquid hydrogen.
5. Addressing safety and regulation, specific to hydrogen for aviation applications



**End-use:
Transport Applications**

RHIA Hydrogen Valley?



Horizontal Activities (2)

2. Hydrogen Valleys

MAIN OBJECTIVES

1. Innovation in integrating several technology elements together to improve overall synergies, facilitate sector coupling and improve energy and economic efficiency of the whole system;
2. Improved security and resilience of the energy systems;
3. Demonstration of new markets for hydrogen;
4. Complementarity of the development of hydrogen with RES, integration with other technologies, existing infrastructure, etc;
5. Assessment of the availability and affordability of clean energy provision for industry and city uses.



Horizontal Activities



How can we help?

- NAG and NLR:
 - are available for questions,
 - will actively follow the work programmes and Calls for Proposal and approach Dutch parties in case of possible,
 - can help finding partners (e.g. via EACP, EREA, IMG's, EASN),
 - can be a partner in your consortium.

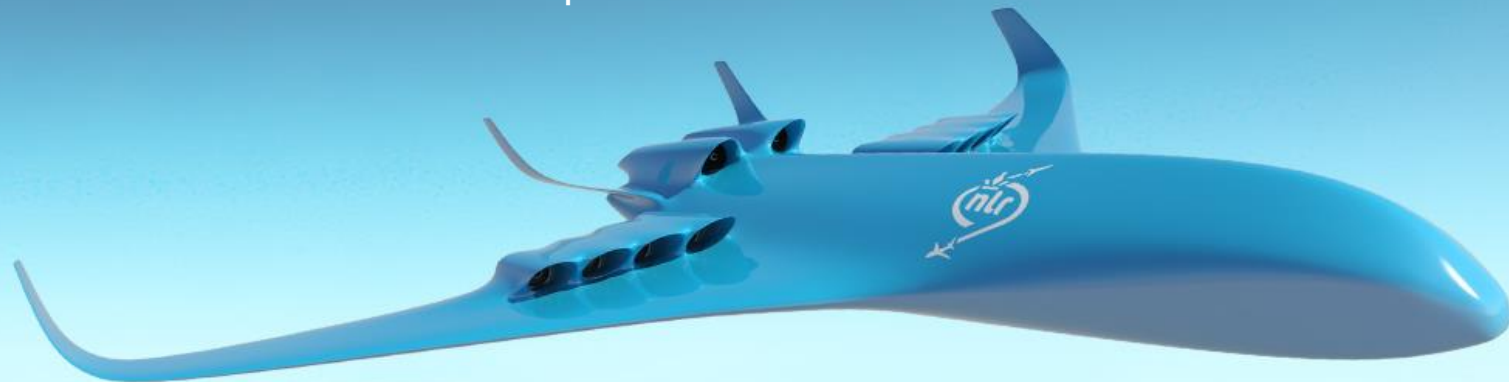
- NLR *MKB-ondersteuningsprogramma*
 - 50% subsidy on project cost.
 - “Engineer 4 a day” consultancy at no cost.



Dedicated to innovation in aerospace

Fully engaged

NLR - Netherlands Aerospace Centre



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