



Co-funded by
the European Union



Clean Aviation: The Ticket to Zero-Emission Flight



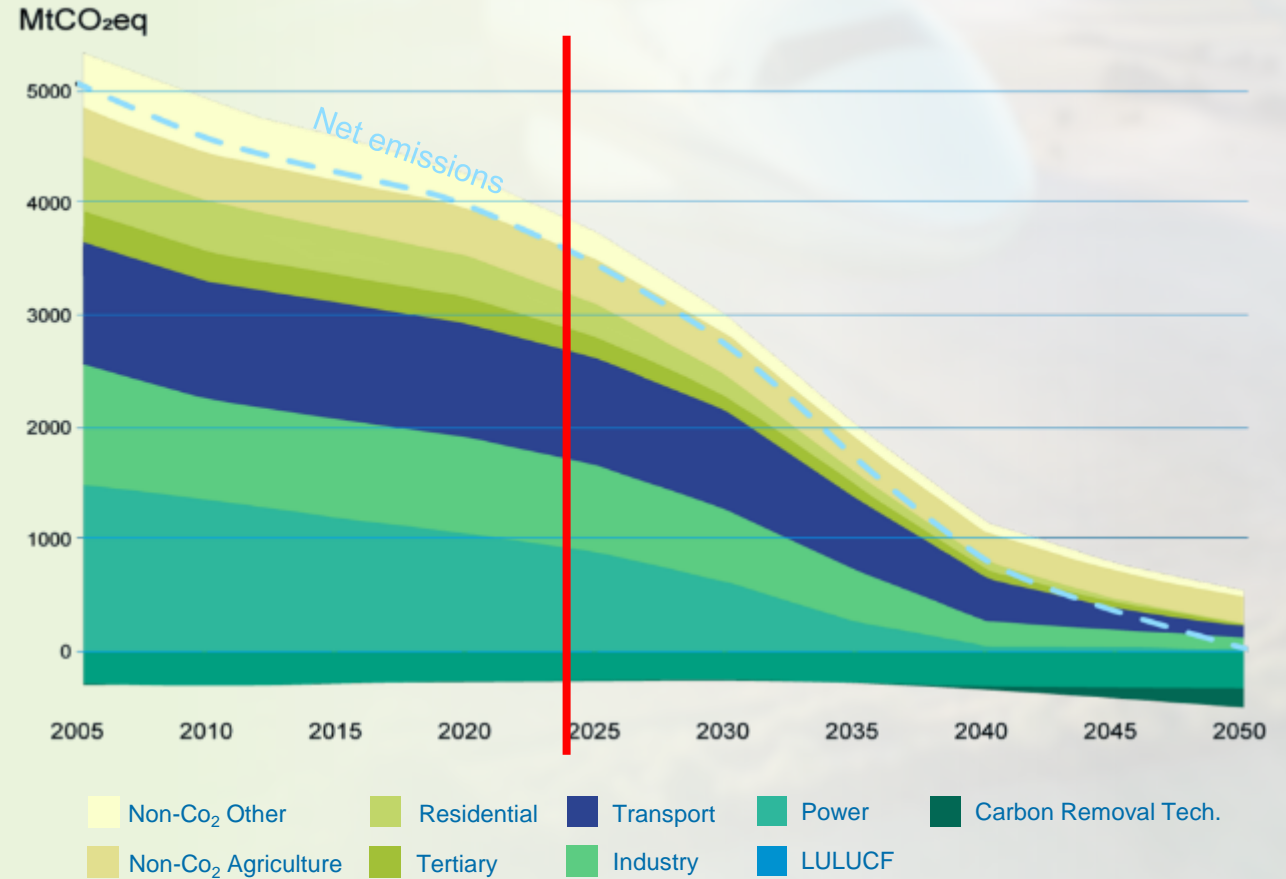
Sébastien **DUBOIS**

50th ANNIVERSARY GARTEUR | 5 OCTOBER 2023 | POZZUOLI, ITALY

*Head of Programme Development
and Communications*

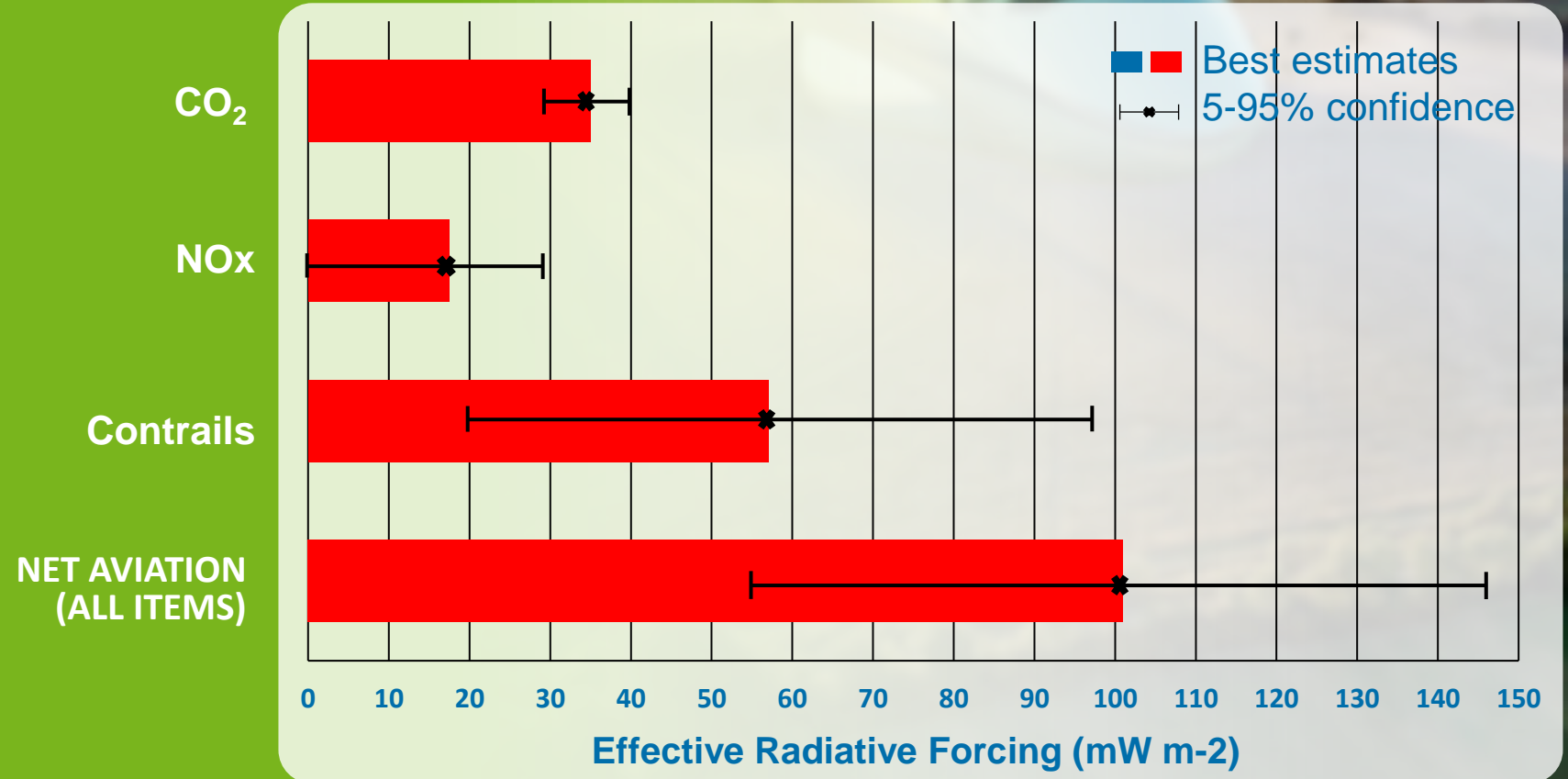
Towards a Net Zero society by 2050!

European commitment to
climate neutrality



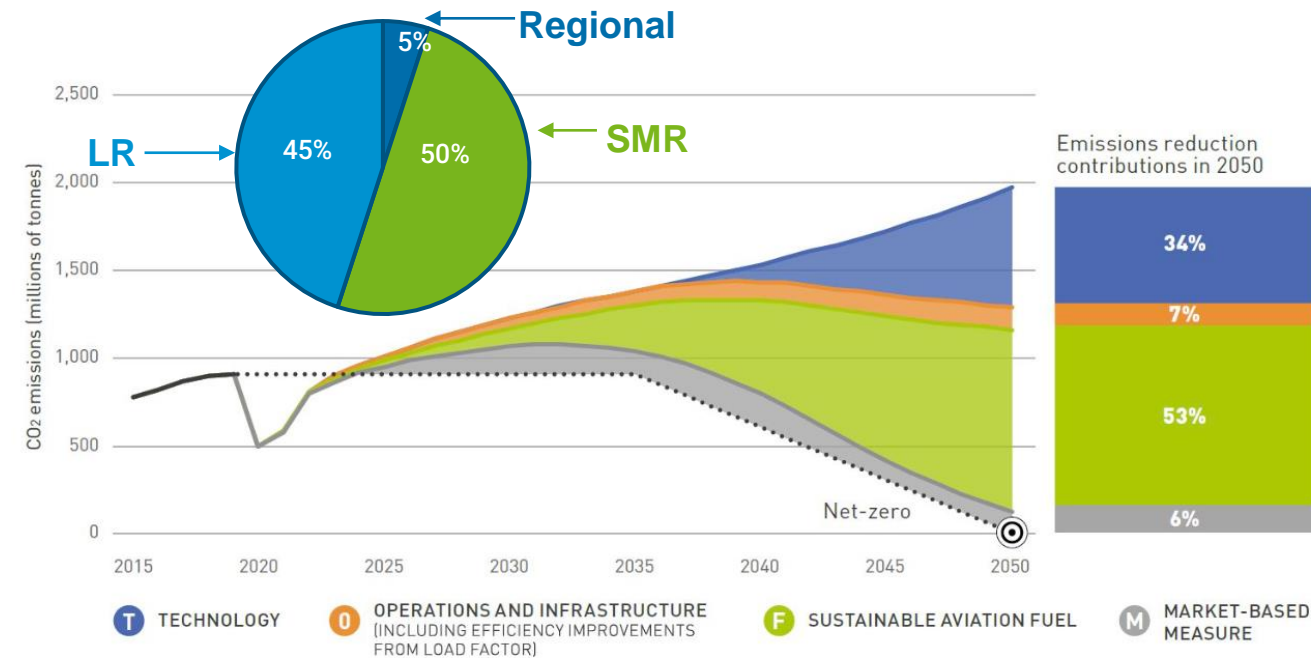
Climate impact is **NOT ONLY** about CO₂

GLOBAL AVIATION EFFECTIVE RADIATIVE FORCING (ERF) TERMS (1940 TO 2018)












Technology & SAF (PtL & H₂) together will trigger disruption

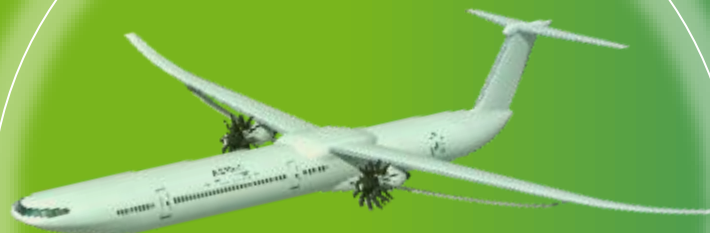
Share of CO₂ emissions in 2019



PtL SAF and H2 vs kerosene

	Environmental IMPACT			Cost		Sust. Energy Demand
	CO ₂ 	NOx 	Contrails 	 Fuel price from 2035	 Aircraft & Airports	
 PtL SAF	Net 0	=	↓	↑	=	↑ ↑
 H2 Direct burn	0	=	?	↓	↑ ↑	↑
 H2 Fuel Cell	0	0	?	↓	↑ ↑	↑

Clean Aviation stands for disruptive technologies & innovations



Short Medium Range
aircraft concept



Hybrid Electric
aircraft concept


-30%
GhG
reduction

Aircraft Entry
into Service
2035

75%
Fleet
replacement
by 2050

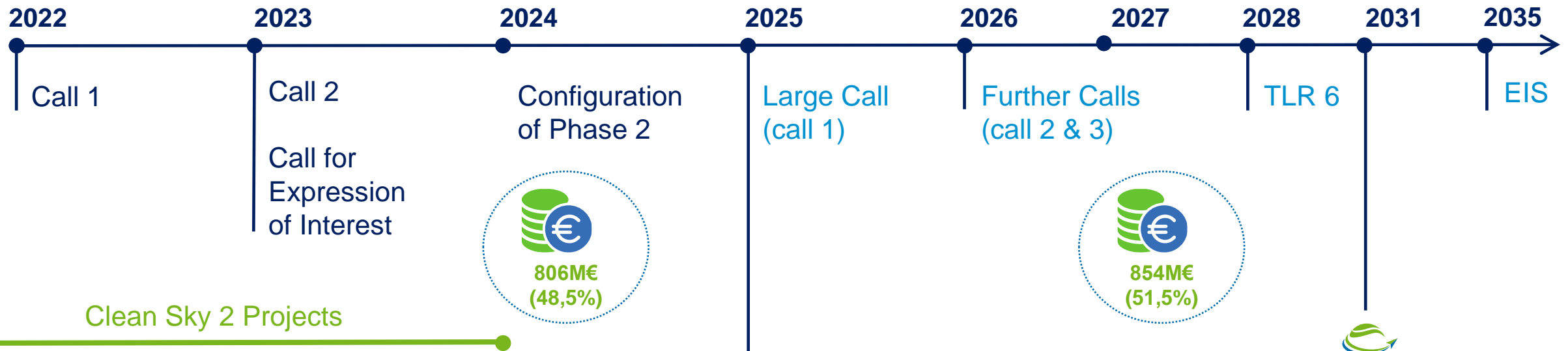
Exploiting
synergies
within Europe

Clean Aviation: 2 Phases


EU Funding:
€1.7bn
Private Funding:
> €2.4bn

Phase 1: Develop **concepts, technology options**
and **trade studies**

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



Clean Sky 2 Projects



Clean Sky 2 Achievements (1 / 2)



Clean Sky 2
Test bed 2
Maiden flight



Tech
Turboprop
Engine



Racer
FRC

Clean Sky 2 Achievements (2 / 2)

MultiFunctional
Fuselage
Demonstrator



Ultra High
Propulsive
Efficiency



UltraFan
Engine



Clean Aviation: 3 thrusts

Driving
**Efficiency
&
Emission
Reduction**

Phase 1: Develop concepts, technology options and trade studies

2022

2023

2024



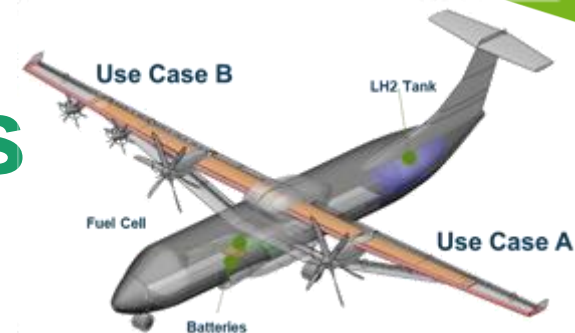
TRANSVERSAL AREAS

HERA Clean Aviation concepts



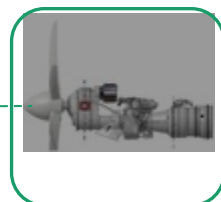
2024
TRL4 by

-50%
Block Fuel

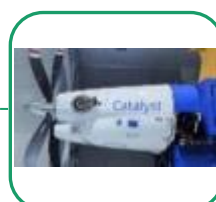


CERTIFICATION &
DIGITALIZATION

PROPULSION



HE-ART



AMBER



NEWBORN

WING



HERWINGT

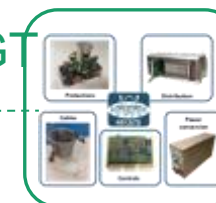
SYSTEMS



THEMA4HERA



H2ELIOS



HECATE



LH2 STORAGE



SMR ACAP Clean Aviation concepts



TRL3 by 2024
TRL4 by 2026



TRL2 by 2024
TRL3 by 2026



CERTIFICATION

PROPULSION



HEAVEN



SWITCH



OFELIA



CAVENDISH



HYDEA

WING



UPWING

FUSELAGE



FASTER H2

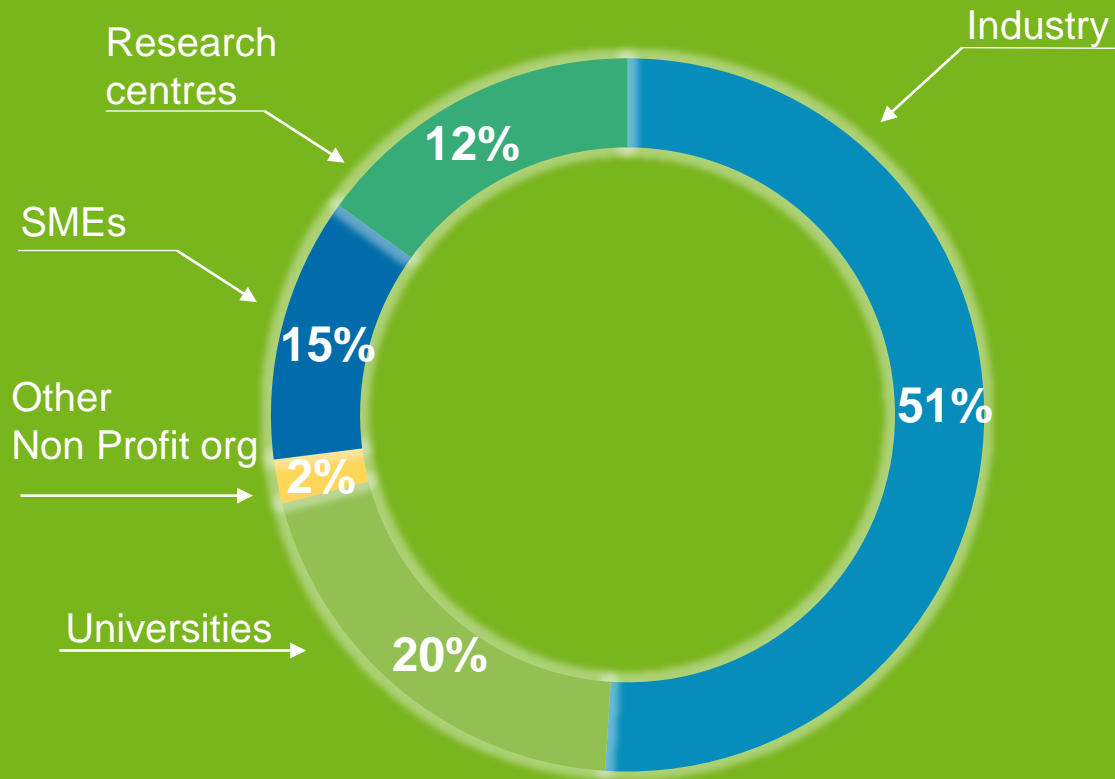


H2ELIOS

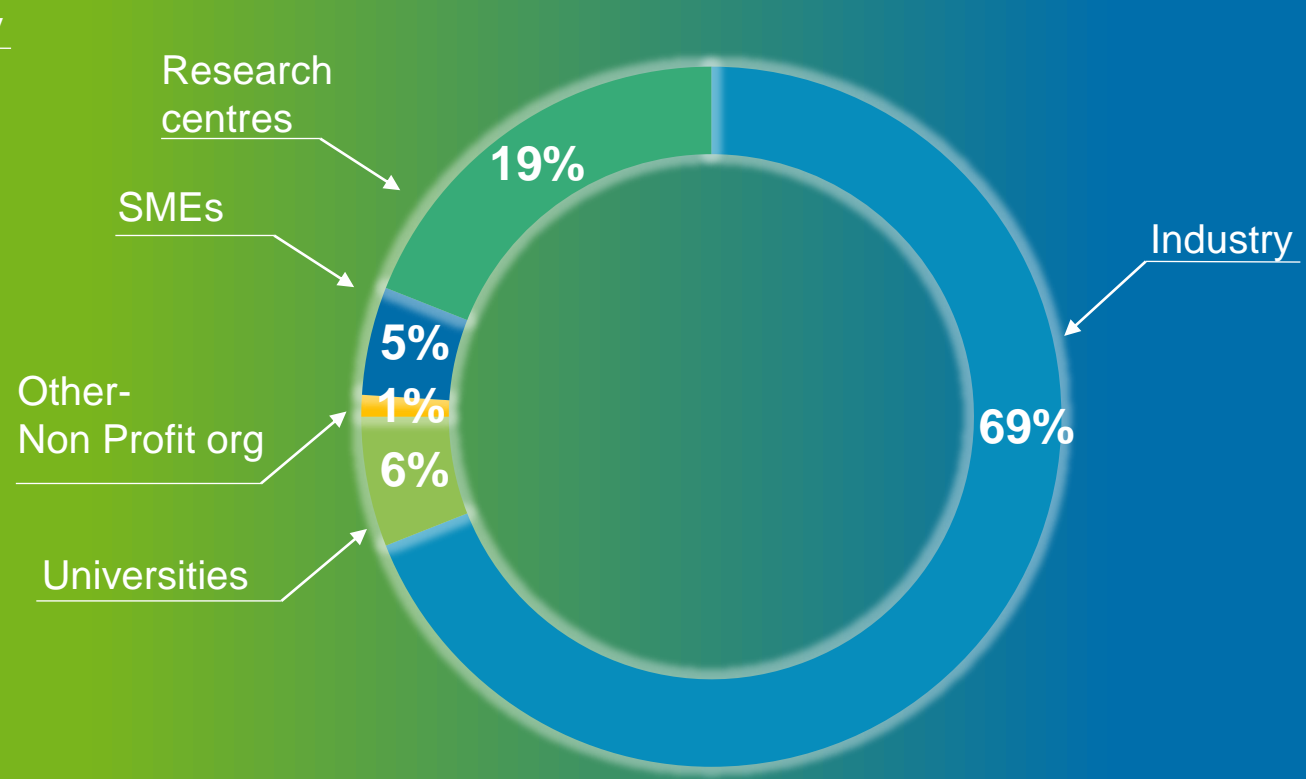
LH2 STORAGE

Participation in Clean Aviation Call 1 & 2

Participation in funded projects
278 participants



Share of budget for all participations
EU Funding **806 millions €**





Hybrid Electric

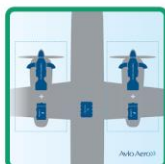
Combining Innovative Airframe,
Novel Systems & HE power train



HE-ART

2.150-2.850 MW Multi Hybrid
Electric propulsion system
for regional Aircraft

ROLLS-ROYCE (*)



AMBER

2250 MW Multi Power train
Innovative for hybrid-Electric
Regional Application

GE AVIO (*)



TheMa4HERA

Thermal Management
Solutions for Hybrid
Electric Regional Aircraft

HONEYWELL (*)



HECATE

Electrical Distribution
Solutions for Hybrid-Electric
Regional Aircraft

COLLINS (*)



HERWINGT

Hybrid Electric Regional Wing
Integration Novel Green
Technologies

AIRBUS (*)



Ultra Efficient / Short Medium Range

Combined powerplant & Airframe efficiency



HEAVEN

Ultrafan – Hydrogen & hybrid
gas turbine design

ROLLS-ROYCE (*)



SWITCH

Sustainable Water-
Enhanced-Turbofan (WET)
Comprising Hybrid-electrics

MTU AERO ENGINES (*)



OFELIA

Open fan engine demonstrator
incl. gas turbine design
hybridisation for Environmental
Low Impact of Aviation

SAFRAN (*)



UP WING

Ultra performance wing

AIRBUS (*)



FASTER-H2

Fuselage H2 integration &
Ultra efficient empennage

AIRBUS (*)



Hydrogen Powered Aircraft

Novel concepts with H2 direct burn &
fuel cell based propulsion



CAVENDISH

Consortium for the AdVent of aero-
Engine Demonstration and aircraft
Integration

ROLLS-ROYCE (*)



HYDEA

Hydrogen DEMonstrator for
Aviation

GE AVIO (*)



NEWBORN

NExt generation high power fuel
cells for airBORNe applications

HONEYWELL (*)



H2ELIOS

HydroEn Lightweight &
Innovative tank for zero-emission
aircraft

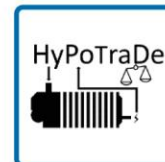
ACITURRI (*)



FLHYing Tank

HydroEn Lightweight &
Innovative tank for zero-emission
aircraft

PIPISTREL (*)



HyPoTraDe

Hydrogen Fuel Cell Electric Power
Train Demonstration

PIPISTREL (*)



EU Funding
€654 mio

Transversal projects



CONCERTO

Construction Of Novel CERTification
methODs and means of compliance
for disruptive technologies

DASSAULT (*)



HERA

Hybrid-Electric Regional
Aircraft Architecture and
technology integration

LEONARDO (*)



SMR ACAP











SMR Aircraft architecture and
technology integration Project

AIRBUS (*)




ECARE

European Clean Aviation
Regional Ecosystem/synergies
with regions

HYBRID ELECTRIC	ULTRA EFFICIENT/ SHORT MEDIUM RANGE	HYDROGEN POWERED AIRCRAFT
<div></div> <div>HERFUSE Hybrid-Electric Regional FUSelage & Empennages <i>LEONARDO</i></div>	<div></div> <div>COMPANION Common Platform and Advanced INstrumentation Readiness for ultra efficient propulsion demonstration <i>AIRBUS</i></div>	<div></div> <div>TROPHY Technological Research On Propulsion by HYdrogen <i>SAFRAN</i></div> <div></div>
<div></div> <div>ODE4HERA Open Digital Environment for Hybrid-Electric Regional Architectures <i>DLR (DEUTSCHES ZENTRUM FUR LUFT – UND RAUMFAHRT)</i></div>	<div></div> <div>AWATAR Advanced Wing MATuration And integration <i>ONERA (OFFICE NATIONAL D'ETUDES ET DE RECHERCHES AEROSPATIALES)</i></div>	<div></div> <div>FAME Fuel cell propulsion system for Aircraft Megawatt Engines <i>AIRBUS</i></div>
		<div></div> <div>HEROPS Hydrogen-Electric ZeRo Emission Propulsion System <i>MTU AERO ENGINES AG</i></div>
SUPPORT ACTION		
<div></div> <div>CLAIM Clean Aviation Support for Impact Monitoring <i>DLR (DEUTSCHES ZENTRUM FUR LUFT – UND RAUMFAHRT)</i></div> <div></div>		

Skip-a-Generation technology leap

- Keep pushing the envelope > ‘traditional’ aeronautical sciences
- Non-traditional sciences > **key enablers**
- Replacing ~75% of the global fleet by 2050
- **Simulation, digital twin and innovative certification**
- **Life-cycle aspects and recyclability**



We are in the
**MOST EXCITING
TECHNOLOGICAL
DECADE** for
AERONAUTICS

3 key action areas to enable the transformation



- Develop and demonstrate **new technologies**
- Shorten aircraft **design cycles**
- Accelerate new **aircraft adoption**



- Implement **appropriate ATM**
- Ensure **dual fuel** infrastructure
- Enable new **network strategies**



- Boost **hydrogen production** (for PtL & LH2)
- Provide sufficient **renewable electricity**



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Thank you

www.clean-aviation.eu

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