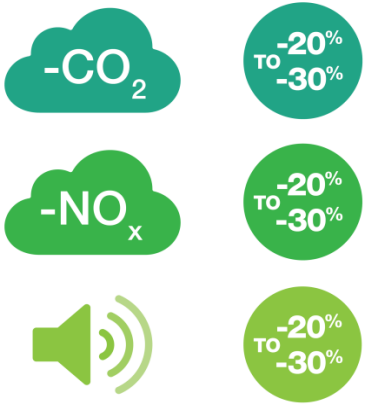
Innovation takes off:
Clean Sky – towards climate-neutral aviation!

Axel Krein
Executive Director, Clean Sky

ATI Conference
19/11/2019

Clean Sky 2: Key facts and figures

Environmental Objectives*



** vs today's best aircraft*

€4 bn Public-Private Partnership Programme

334 INDUSTRY MEMBERS

420 SMES

373 RESEARCH CENTRES

350 UNIVERSITIES

28 COUNTRIES

110 REGIONS

18 MoUs

>466 GRANTS

…while building industrial leadership and ensuring mobility

Clean Sky 2: major demonstrators

Breakthroughs in Propulsion Efficiency


Very High Bypass Ratio (VHBR) Large Turbofan
TRL 6 - 2023


Ultra-High Propulsive Efficiency (UHPE)
TRL 5+ - mid-2022


Advanced Geared Engine Configuration (HPC and LPT technology demonstration)
TRL 5 - 2023


Business aviation / short range Regional Turboprop
TRL 5 - 2022


Light weight and efficient Jet-fuel reciprocating engine [Small Aero-Engine]
TRL 6 - 2019


Reliable and more efficient operation of small turbine engines [Small Aero-Engine]
TRL 6 - 2019


Hybrid Propulsion Ground Test Bench
2020


Novel Aircraft Configuration & Scaled Flight Test
2021

Advances in Wings and Aerodynamics


Adaptive Wing Integrated Demonstrator Flying Test Bed
2022


Integrated Wing Technologies Flying Test Bed
2020 & 2023


Advanced Laminar Flow on Wings and Empennage


Laminar Nacelle Virtual
TRL 5 – 2019

Future Cockpit and Flight Guidance Systems


Disruptive Cockpit Demonstrator (Function preparation test)
2023


Active Regional Cockpit
2020


BizJet Enhanced Cockpit Concept
2022


Avionics for Extended Cockpit Demonstrator -
2020


Affordable SESAR Compliant cockpit for Small Aircraft

Novel Aircraft Configurations


NextGenCTR demonstrator – Next Generation Civil


RACER - Rapid And Cost-Effective Rotorcraft

Optimal Passenger Environment


Full Scale Mock-up of Business Jet Office Centered Cabin
2021


Innovative Cabin & Cargo Systems Technologies
2021

More Electric Aircraft & Systems


Regional Aircraft 'Iron Bird' Systems Integration – 2021


Innovative Electrical Wing - 2021


Electric Drive Landing Gear System [E-LDG]


Advanced Electrical Environmental Control System [E-ECS] Demonstrator


Full Chain demonstration: Electrical power generation, distribution and usage

Innovative Structures and Production Systems


Advanced Rear End Demonstrator
2023


Functional Cabin & Cargo Demonstrator of new integrated systems


Next Generation Multifunctional Fuselage Demonstrator automated cabin assembly & structure integration


Advanced Lower Center Fuselage Demonstrator


Regional Aircraft Fuselage / Pax Cabin Integrated Demonstrator


Affordable aerostructures for Small Air Transport

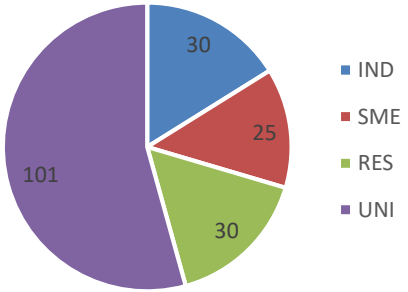

Advanced Small Aircraft Wing Box in Out-of-Autoclave CFRP
2020

UK participation in Clean Sky 2

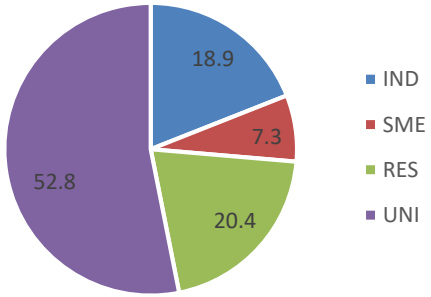
- Total funding for Leaders: >€70 million
- Currently 4th in overall participation in calls and 5th in funding requests
- High academia participation: 5 universities in the top 10

Statistics from Calls for Core Partners 1-4 and Calls for Proposals 1-9

Participation



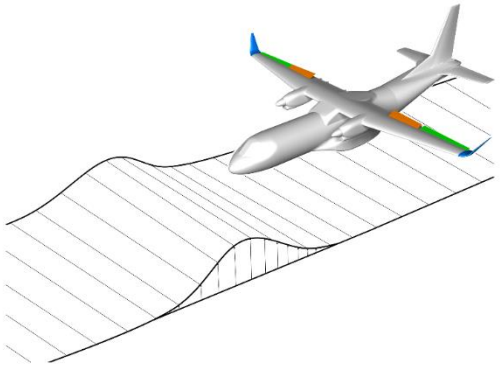
Funding requested (m €)



All information is based on post-evaluation outcome

Spotlight on UK projects in Clean Sky 2 (1/3)

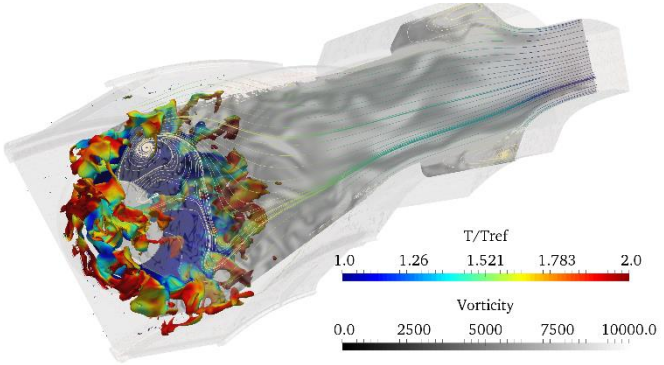
- UHBR engine demonstrator (ENG): aiming at fuel burn reduction of 10%, leading to reduced CO_2, NOx emissions and noise.
  - Performed by Rolls-Royce and flight tested with Airbus



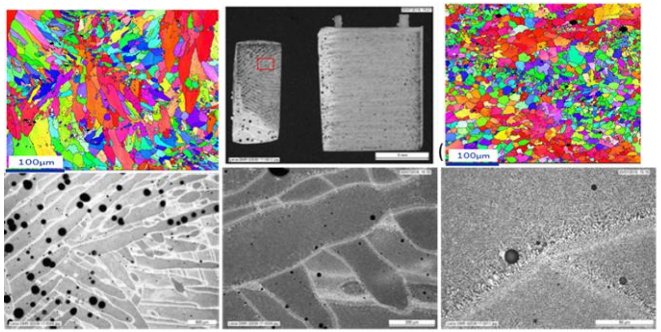
- ReLOAD project (REG): understanding of Load Control and Alleviation technologies to avoid excessive gust and manoeuvre loads, enabling enhanced wing design for weight savings and reduced fuel burn.
  - Coordinated by ARA (Aircraft Research Association Limited)

Spotlight on UK projects in Clean Sky 2 (2/3)

- CORNET project (ENG): improving understanding of engine noise in order to provide industry with new computer-based methods to predict and design quieter engines.
  - Coordinated by University of Cambridge

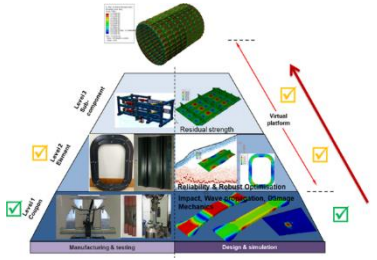


- PASSPORT project (AIR): to enable "right-first-time" additive manufacturing of highly optimised, light-weight parts: more efficient design-to-production cycle.
  - Coordinated by TWI Limited



Spotlight on UK projects in Clean Sky 2 (3/3)

- SHERLOC project (AIR): combining advanced Structural Health Monitoring (SHM) and smart repair technologies in order to develop new maintenance concepts.
  - Coordinated by Imperial College London

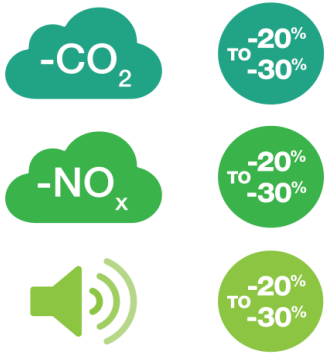


- ASTRAL project (AIR): working on structural design, manufacturing and assembly of a wing for RACER fast rotorcraft.
  - Coordinated by University of Nottingham

- EMINEO project (SYS): aims to provide the technology building blocks to enable the development of More Electric Aircraft
  - Coordinated by University of Nottingham

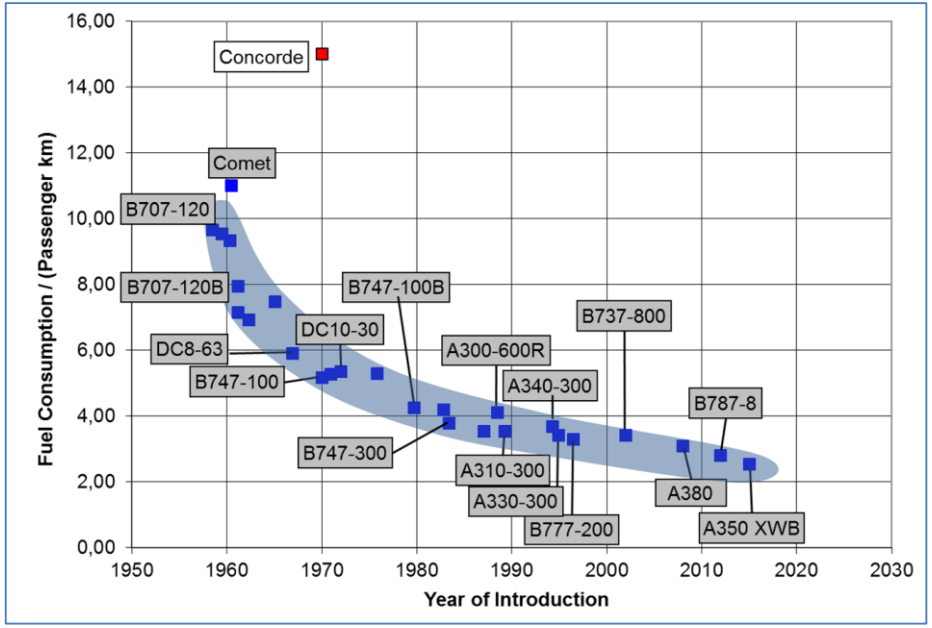
Important gains being made, but this is not enough !

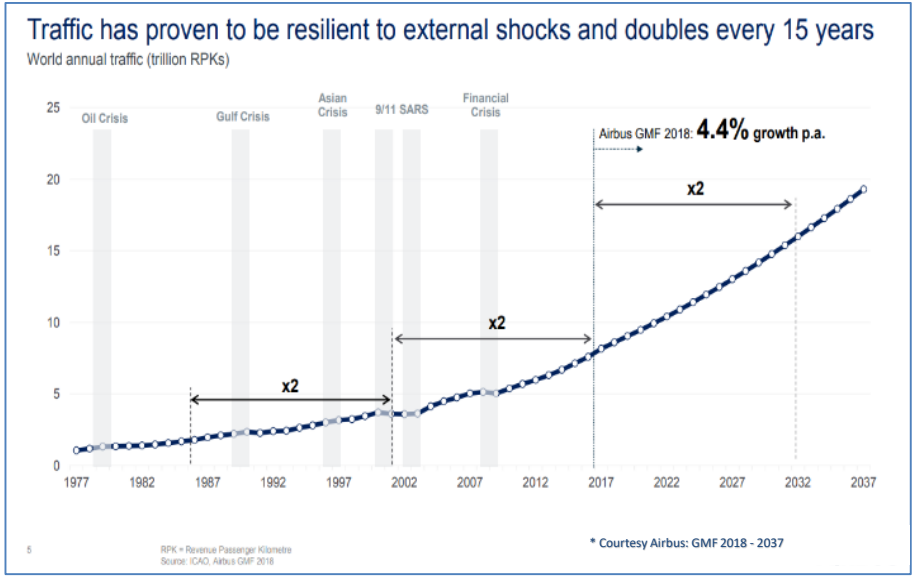
Clean Sky 2 Environmental Objectives



vs. best aircraft in 2014

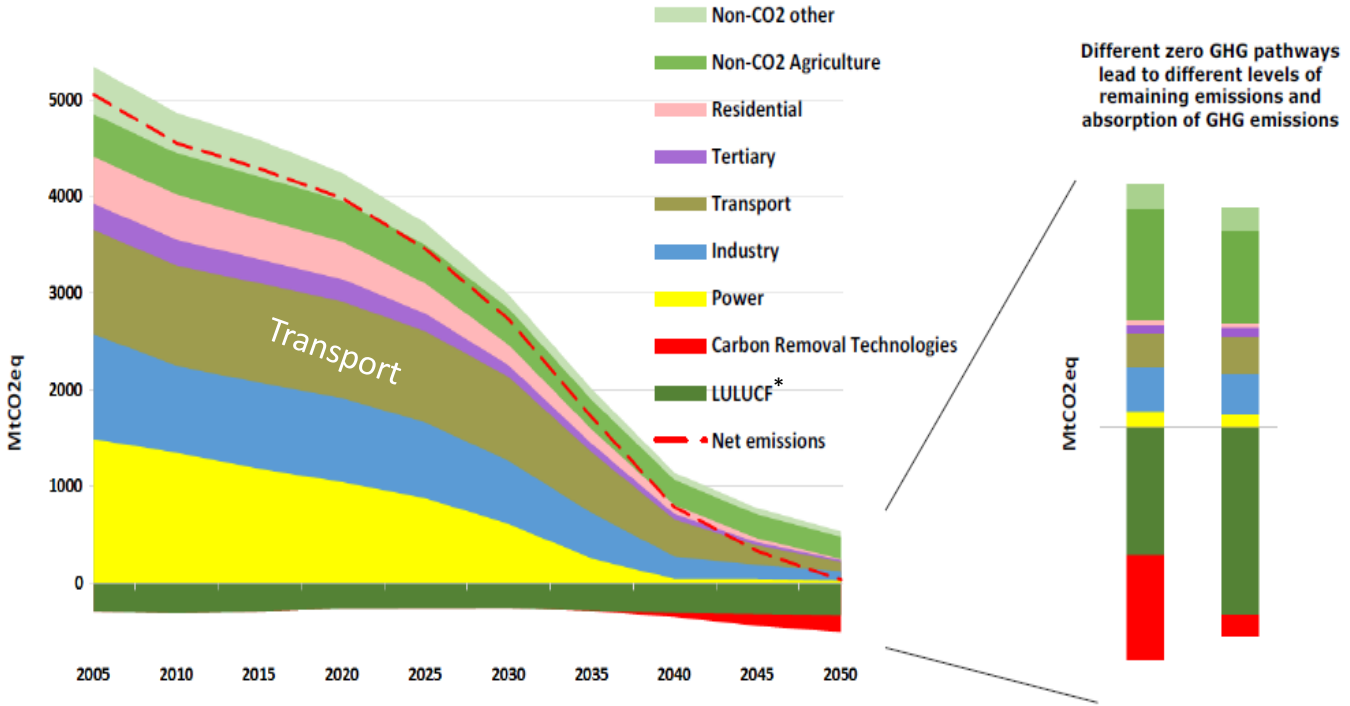
Aviation growth is stronger than CO_2 reduction per RPK *





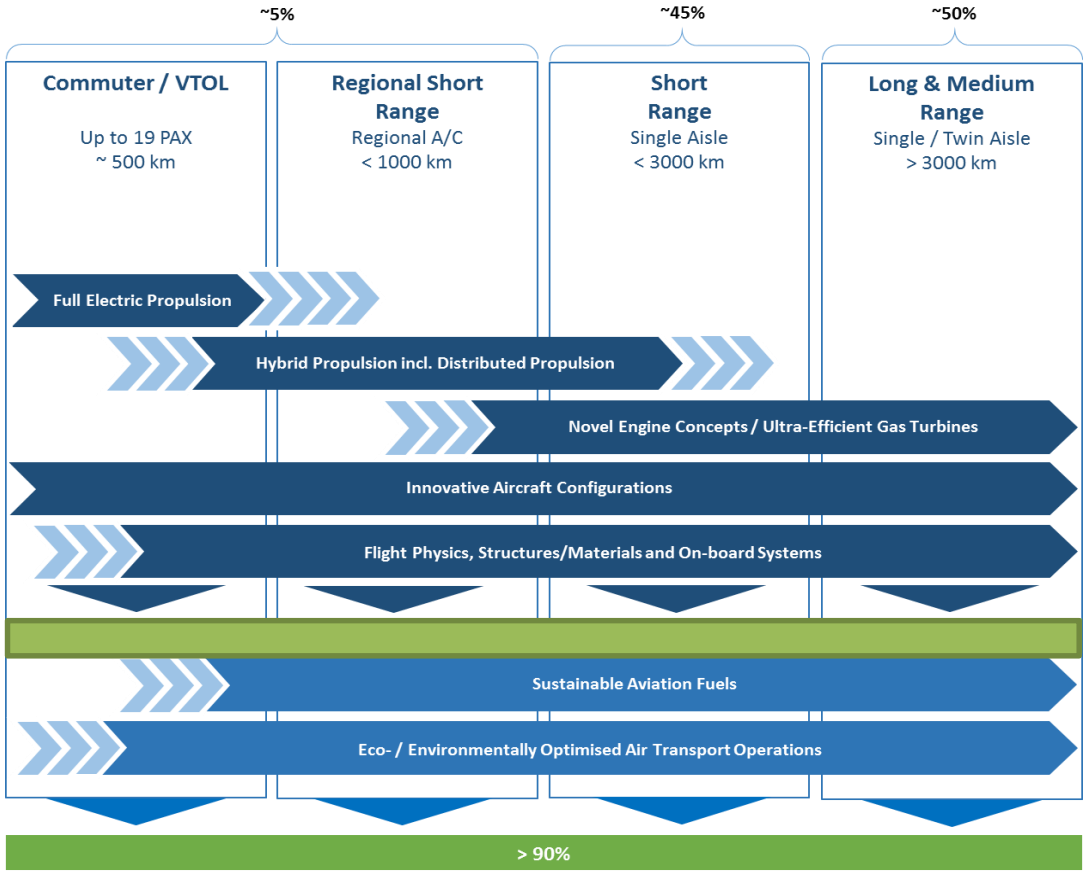
*RPK – revenue passenger kilometre

Europe’s greenhouse gas emissions trajectory



*LULUCF : Land use, land use change and forestry

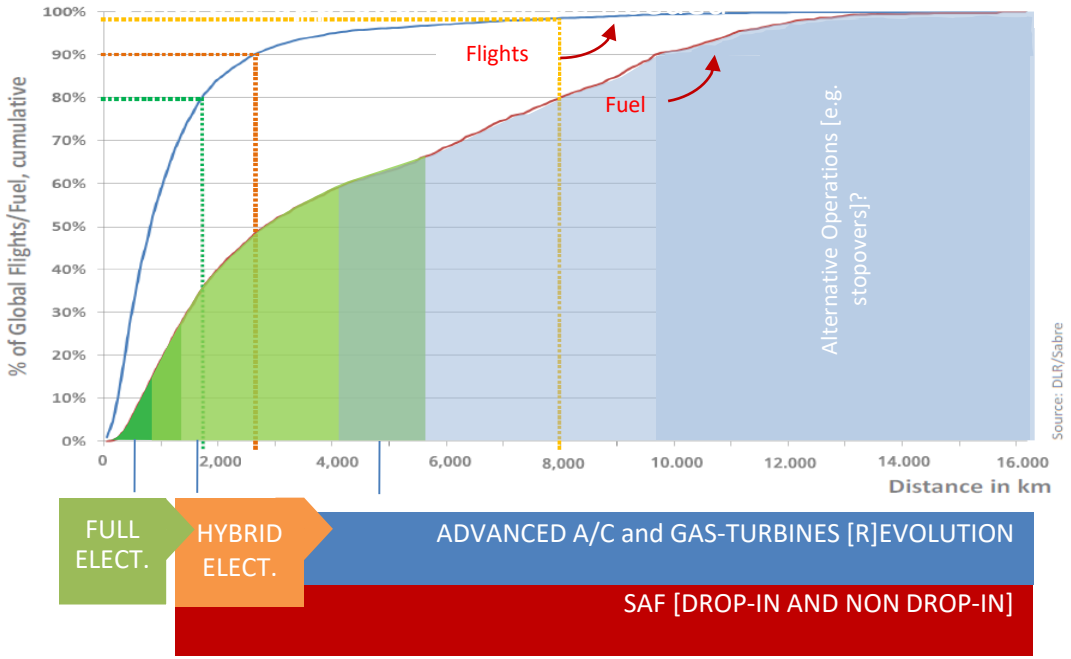
Technology opportunity per product cluster



Fuel and CO_2 share in 2014

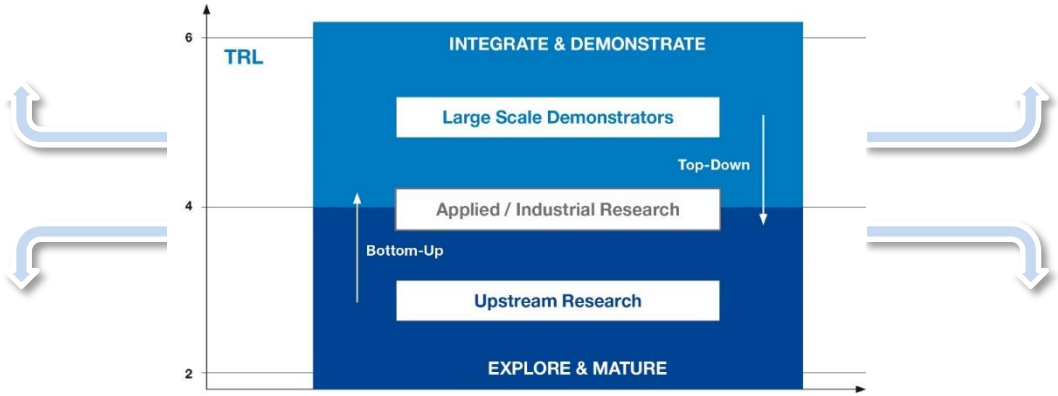
Different approaches per aircraft category needed

90% of flights: < 3000km, = 50% of fuel used
10% of flights: > 3000km, = 50% of fuel used
1% of flights: > 8000km, = 20% of fuel used



Integrated approach to upstream and demo research

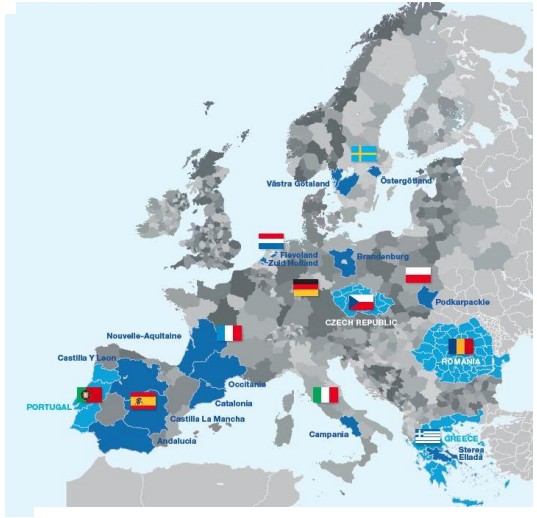
Full electric	Hybrid electric	Advanced a/c configuration & ultra efficient gas turbine	Sustainable alternative fuels enabled aircraft



- *Upstream research in order to fill the pipeline and mature technologies*
- *Large scale demonstrators to rapidly incorporate upstream results into disruptive innovations for maximum impact*

Clean Sky: leveraging synergies across Europe

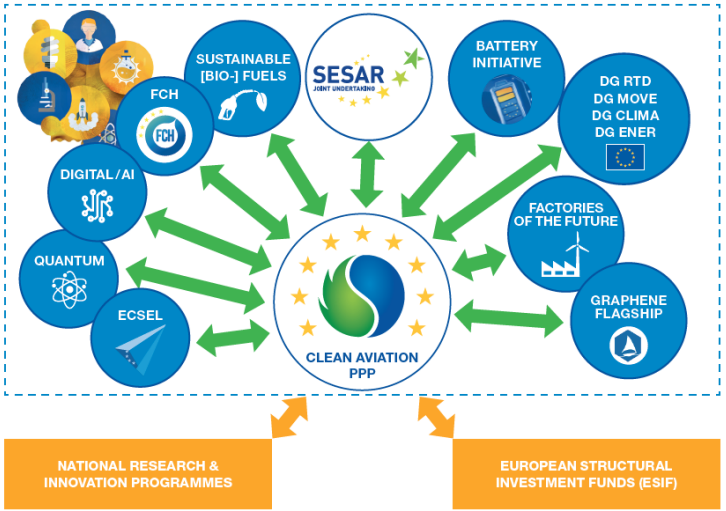
Horizon 2020



CS2 ESIF Synergies: ~ €50 Mil.
(plus projects at national level aligned via CS members)

x10

Horizon Europe



New Horizon Europe partnership synergies level of ambition: ~ €3000 Mil.
(via an Innovation Architecture)

The way forward

- Climate-neutrality is the *Grand Challenge* facing the sector
- We need a revolution in technology development !
- Low TRL *technology push* and high TRL *technology pull* in one programme
- Rapidly maturing, demonstrating and de-risking disruptive architectures
- Innovation Architecture with joint technology roadmaps for all actors
- Teaming up of research and policy will deliver → **impact**
- Impact will assure European aviation is fit for the future


Courtesy DLR


Courtesy ONERA


Courtesy TU Delft / NLR

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