Clean Sky

Challenges and perspectives

EUCASS, Munich, July 3rd, 2013

Eric Dautriat

Clean Sky today:
Unique Public-Private-Partnership in Aeronautics

Focused on environmental goals: CO2, noise, Nox

Europe's largest Aeronautics Research Programme ever

- €1.6B value, split 50/50 between the Commission (cash) and Clean Sky members and partners (in kind)
- Start February 2008; running up to 2017
- Over 50% of the work achieved(end 2012)
- More than 500 participants

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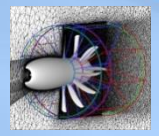
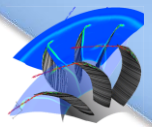
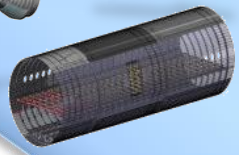
From Technology to Demonstration

Design Studies, Rig Testing, Modelling

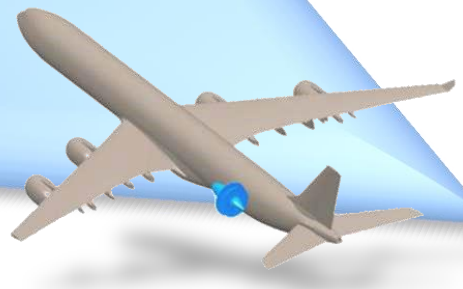






Engine / System Demonstrators

Flying Demonstrators TRL6



Risk Reduction

Integrating breakthrough technologies into full-scale demonstrators…

...preparing the next generation of aircraft

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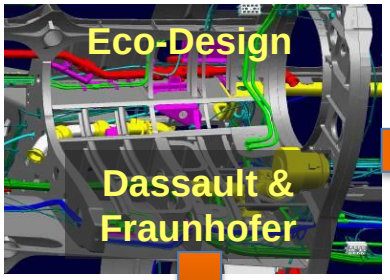
Integrated Program Structure

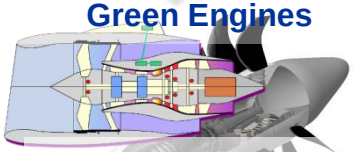
Clean Sky Technology Evaluator
DLR & Thales

Concept

Aircraft



Sustainable and
Green Engines



Rolls-Royce &
Safran

**TECHNOLOGIES &
DEMONSTRATORS**

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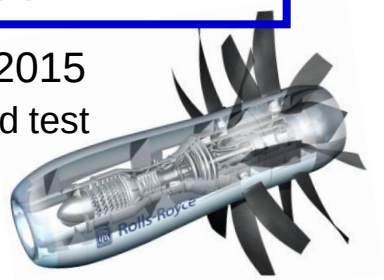
One programme, through diversity of demonstrators

One programme, with
a set of consistent targets,
a common approach,
cross-links between technological platforms,
global management and governance

2012

Large engine, advanced low pressure spool

2015
Ground test



6 platforms
20 large demonstrators
100 key technologies

2015
Regional Aircraft
More electric systems

2015

Diesel powered light helicopter

2014

High Speed Demonstrator for passive laminar-flow wing technologies

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Propulsive efficiency:
Contra-Rotating Open Rotor – Concept Challenges

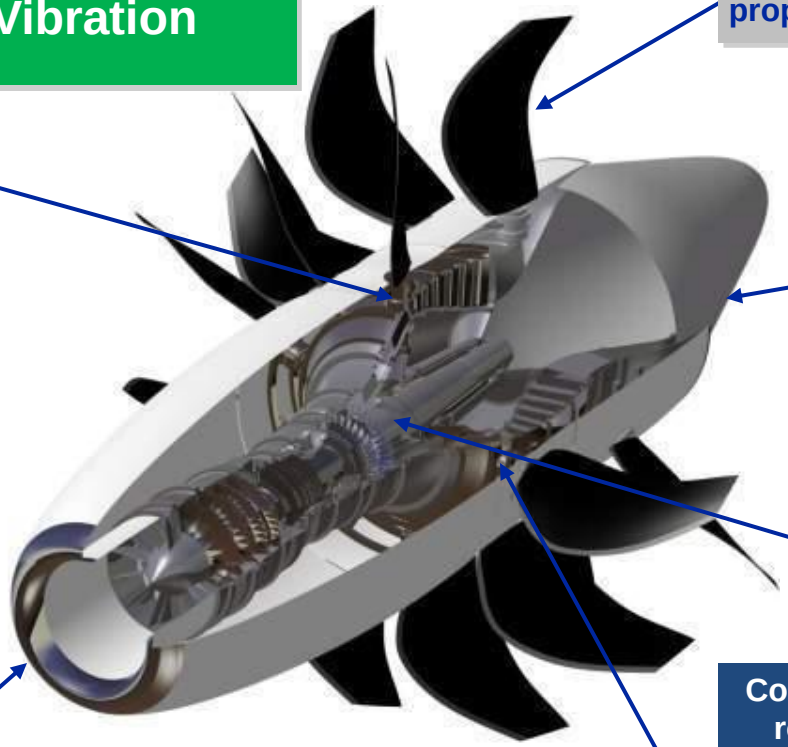
Noise & Vibration

Counter-rotating propellers, noise optimised

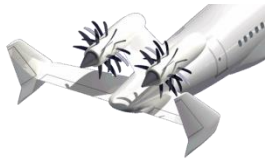
De-icing

Propellers
Pitch Change Control

Rotating Nacelle Parts



A/C Installation and wake interaction



Operability & Power Management

Power gearbox

Communications via rotating systems

Protective Air Intake

Certificability & Reliability

Power Turbine

First ground test before end 2015

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Drag reduction: laminar wing

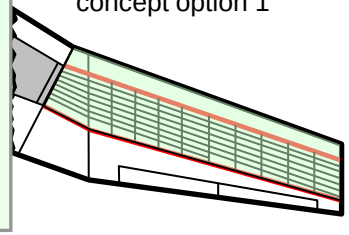
Design of an all new natural laminar wing

- Proof of natural laminar wing concept in wind tunnel tests
- Use of novel materials and structural concepts
- Exploitation of structural and system integration together with tight tolerance / high quality manufacturing methods in a large scale ground test demonstrator
- Large scale flight test demonstration of the laminar wing in operational conditions

Laminar Wing Ground test demonstrator to address structural, system and manufacturing aspects

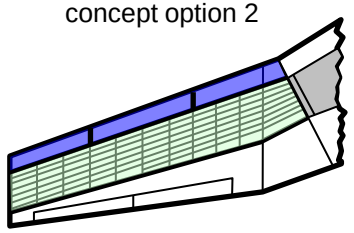
Starboard wing

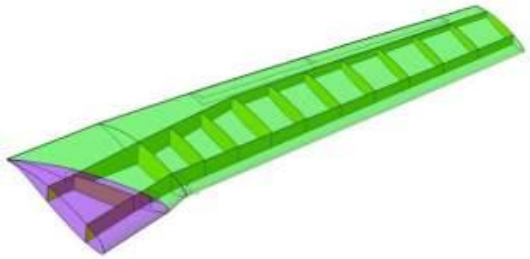
Laminar wing structure concept option 1



Port wing

Laminar wing structure concept option 2





Laminar Wing aerodynamic layout and performance

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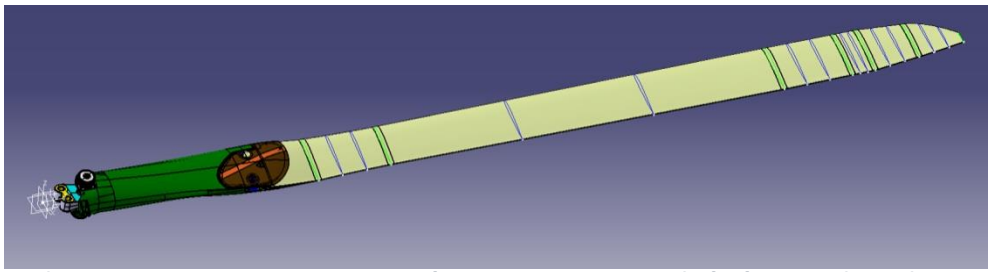
Lift increase:
Smart propeller blades

- **3D-Optimized Blade**

Blade design for improved performances (stall alleviation, increased lift and reduced drag)

✓ TRL 5/6 to completion
(ground test demonstration)

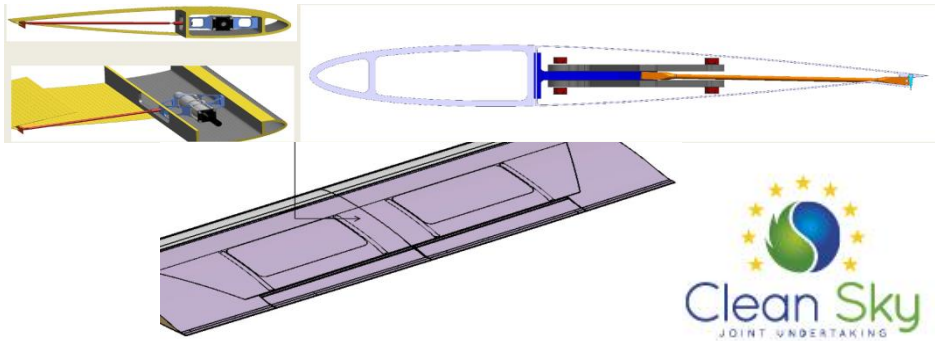


- **Active Gurney Flap rotor**

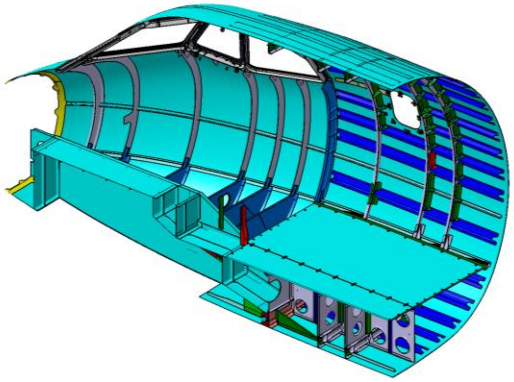
Active device (Gurney Flap) actuated once per revolution and blended into blades: lift increased and reduced power

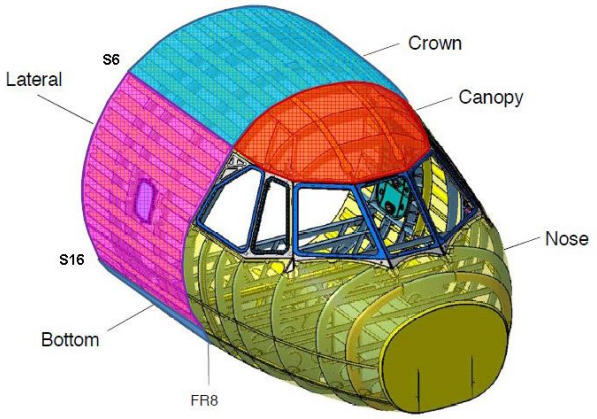
✓ Both model scale & full scale
tests under preparation

✓ Flight test 2014 (TRL6)

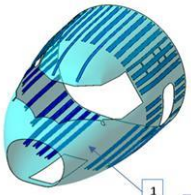


Weight reduction: Composite structures

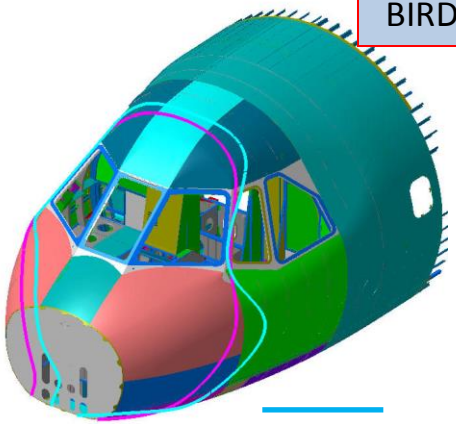


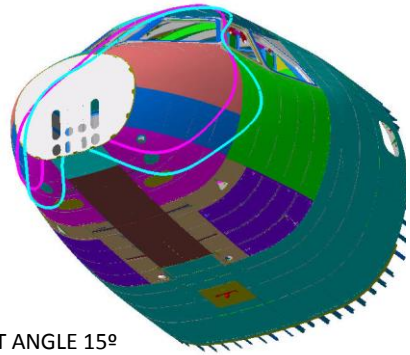


STIFFENED SKIN



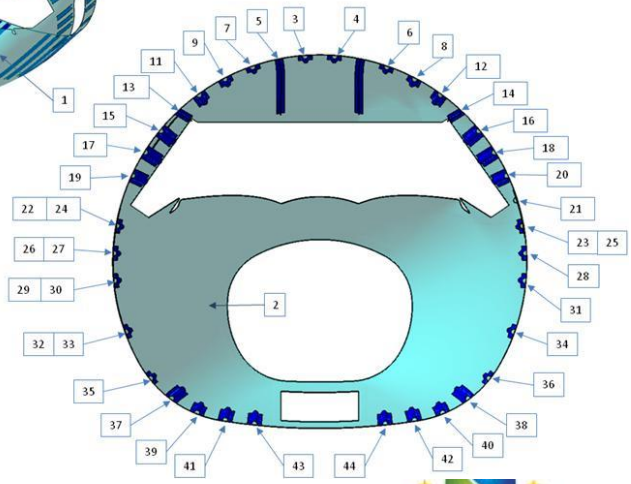
BIRD STRIKE SKIN SENSITIVITY





IMPACT ANGLE 15º

IMPACT ANGLE 20º



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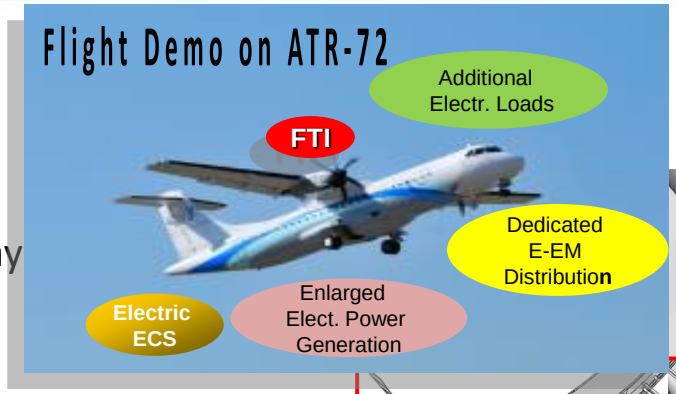
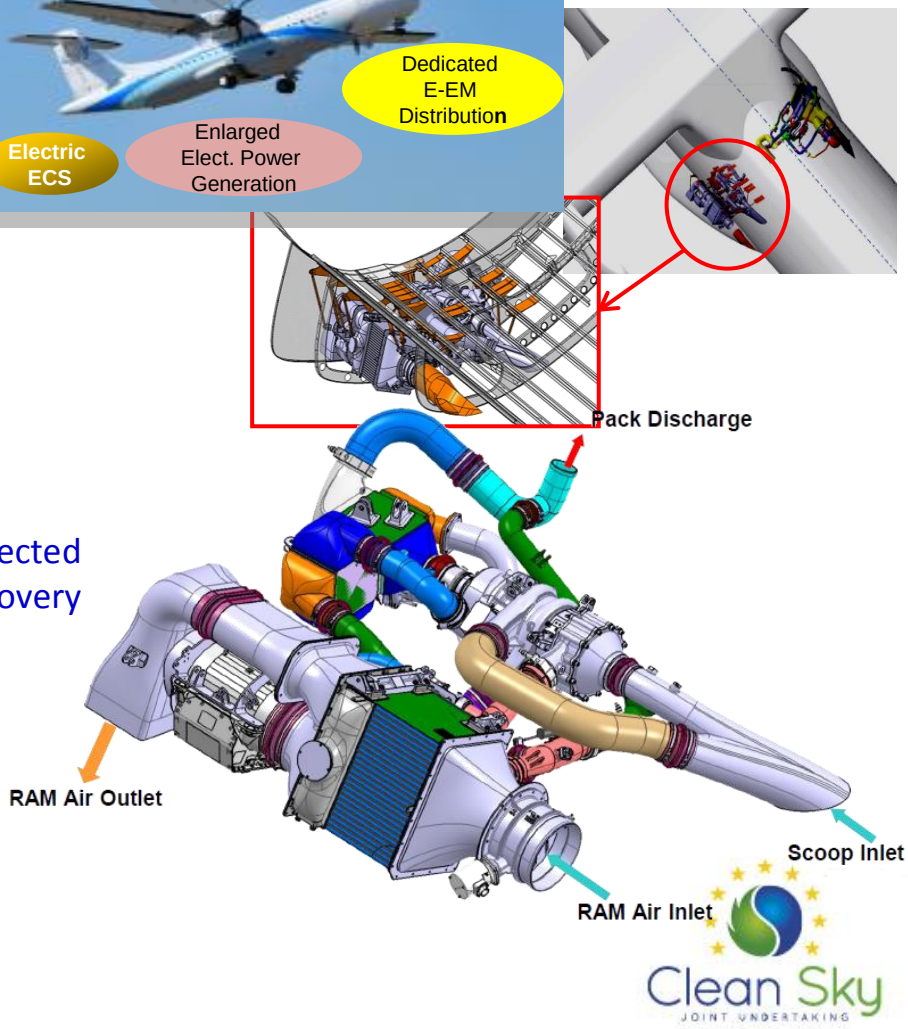
On-board energy management

E-ECS for Regional Aircraft In-Flight Demonstration : Pack installation

❖E-ECS pack will be installed in the RH pack bay replacing the existing pneumatic pack.

❖LH Pneumatic Pack will perform essential functions for SoF





E-ECS pack will have four pneumatic interfaces:

❖New interfaces

- Scoop inlet: a new intake suited to the expected performances will be designed to target high recovery factor (>0,8)

❖Existing interfaces

- Pack discharge (modified distribution)
- Ram Air inlet
- Ram Air Outlet

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Mission optimisation: MultiCriteria Departure Procedure

Objective

Multi-Criteria Departure Procedure (MCDP):

- Consistent with OPS 1.235 ("Noise Abatement Procedures")
- Use of already certified aircraft systems
- Investigate cash operating costs savings and environmental impact mitigation via adequately designed procedure

Concept

Tailor parameters relative to take-off airborne phase

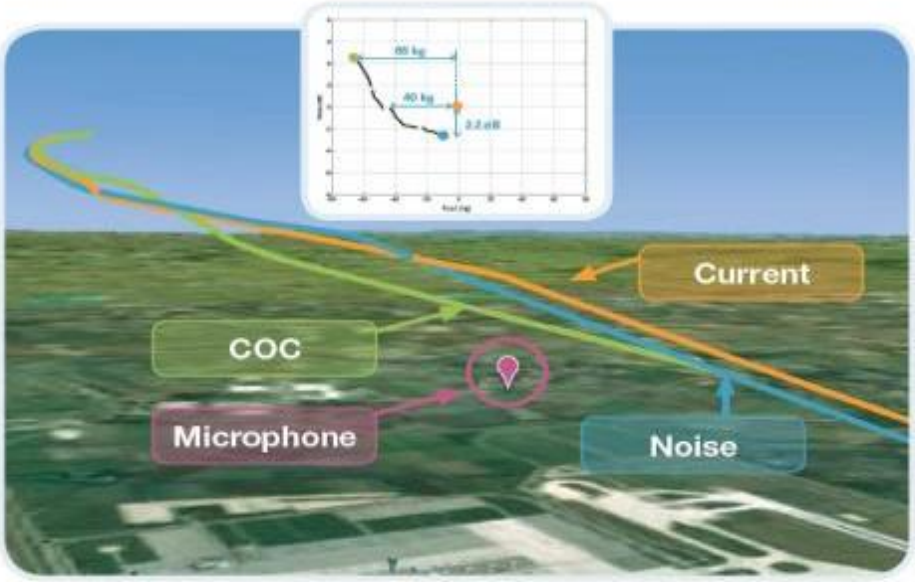
- Regulatory performance (TOW, TFLEX…) remains an input
- Available parameters: Reduction alt, Acceleration alt, CAS, power setting
- Adaptation to TOW, A/C performances, atmospheric conditions…

Benefits

Environmental
Reduction of noise on sensitive area

Economical
Reduction of fuel burn → minimization of COC (Cash Operating Costs)

Airline policy
Fitting to airline policy (cost, green image…)



Applications

- All new aircraft
- New criteria compatibility (engine wear, NOx…)

MCDP : CO2, Nox, Noise reductions in departure phase

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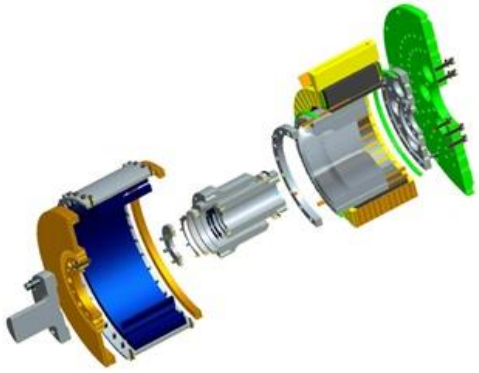
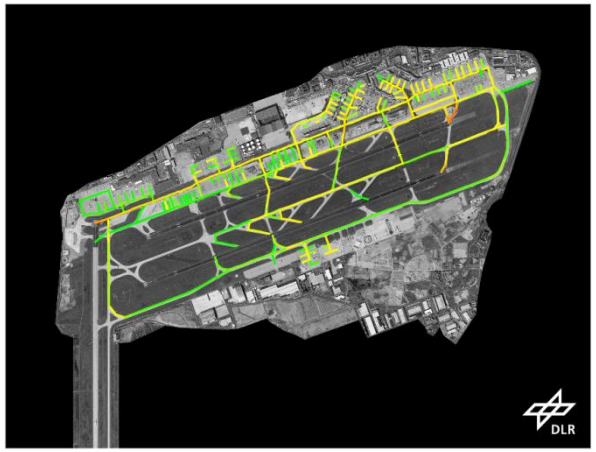
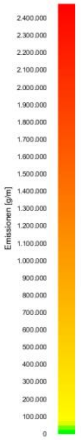
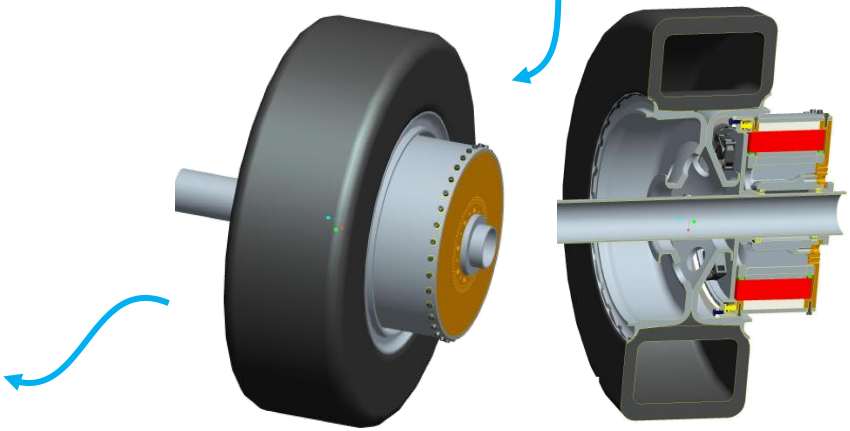
Mission optimisation: Electric taxiing

- **Provide innovative solution for Green Aircraft Operation on Ground**
  - **Autonomous taxi on ground without use of engines to reduce fuel burn**
  - **Low noise brake cooling fan**









Up to 4% fuel burn reduction for short-haul flights with electrical taxiing

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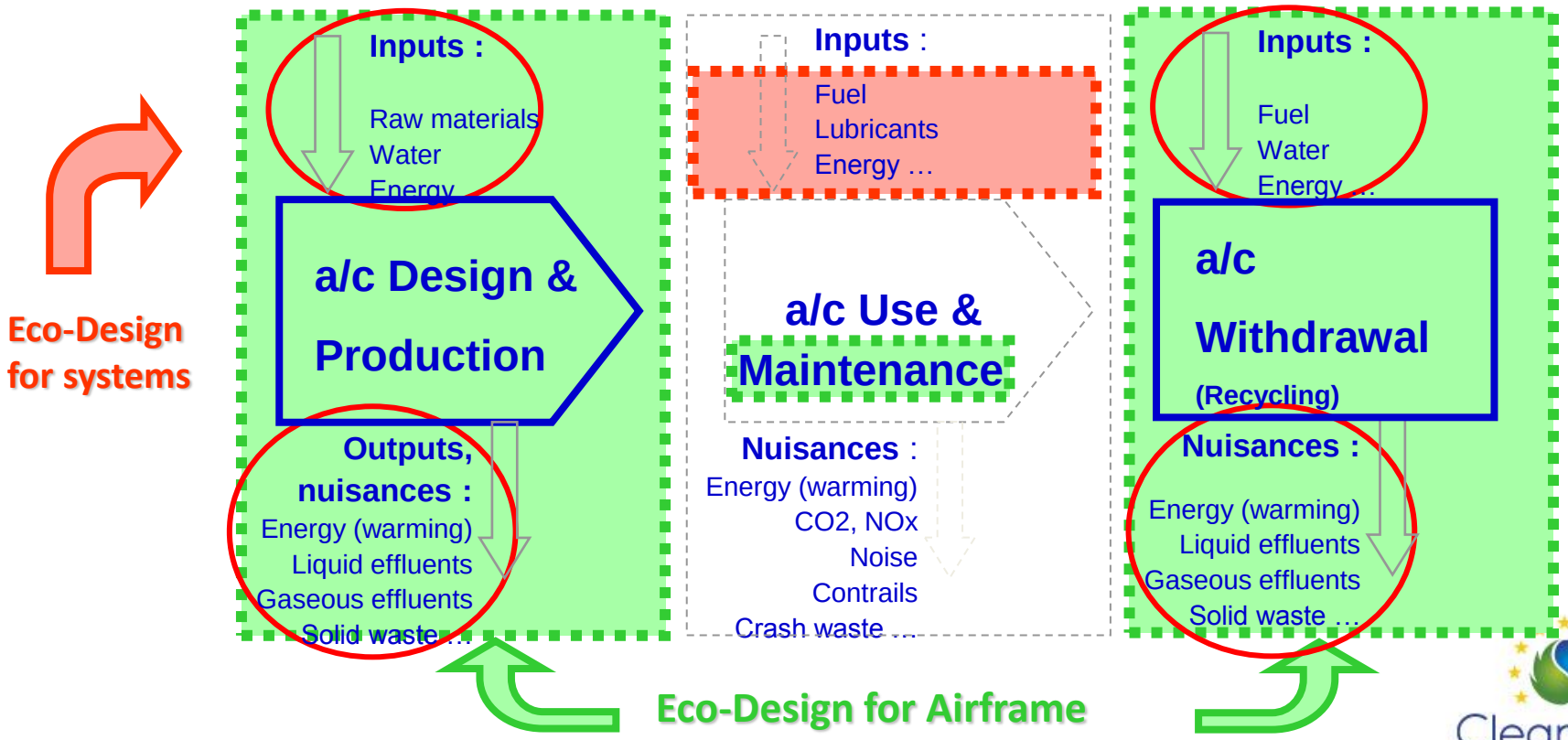
Eco-Design

- To design airframe for decreasing inputs, outputs and nuisances during a/c design & production and withdrawal phases: for Airframe Application (EDA)
- To design architectures of a/c systems, towards the more/all electrical a/c, with the objective of reducing use of non-renewable and noxious fluids/ materials during operations and maintenance: for Systems Application (EDS)



Technology Evaluator 2012
Showing Progress to the goals

Clean Sky Concept Aircraft	Noise area (take off)	CO_2	NO_x
Low Sweep Biz-Jet (Innovative Empennage)	**-68%**	**Up to -32%**	**Up to -28%**
High Sweep Biz-Jet	**-36%**	**-22%**	**-26%**
TP90 (Regional Turbo-prop)	**-48%**	**Up to -23%**	**Up to -43%**
GTF130 (Regional Jet – Geared Turbo-fan)	**-75%**	**Up to -23%**	**Up to -46%**
Short-Medium Range / CROR Engine	**Up to -37%**	**Up to -30%**	**N/A**
Long Range / 3-shaft Advanced Turbo-fan	**Up to -28%**	**Up to -20%**	**Up to -21%[1]**
Single Engine Light	**-47%**	**-30%**	**-76%**
Twin Engine Light	**Up to -53%**	**-26%**	**-74%**

[1] This estimate excludes any SAGE6 'Lean Burn' benefits which should lead to up to 55% NOx reduction in total

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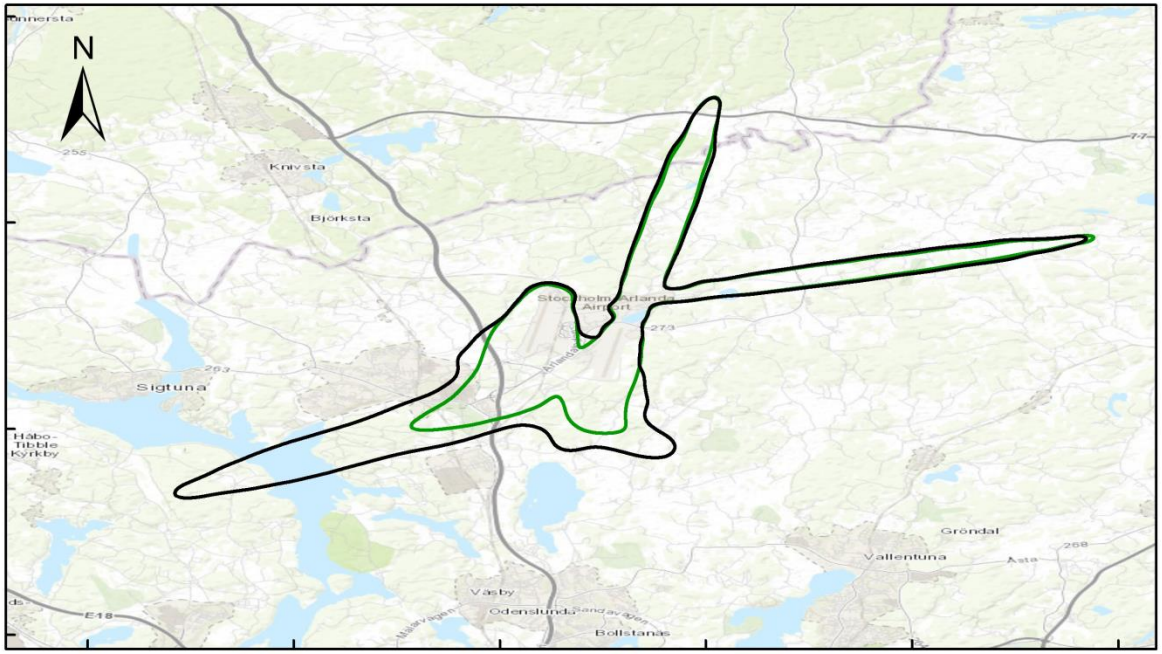
Technology Evaluation: Example of an Airport level Impact

Comparison of 55 dBA Lden contours

Example of a possible 2020 scenario with Clean Sky fleet inserted



Legend

Clean Sky		Reference	
	55.0		55.0

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Meeting the Challenges set in Horizon 2020

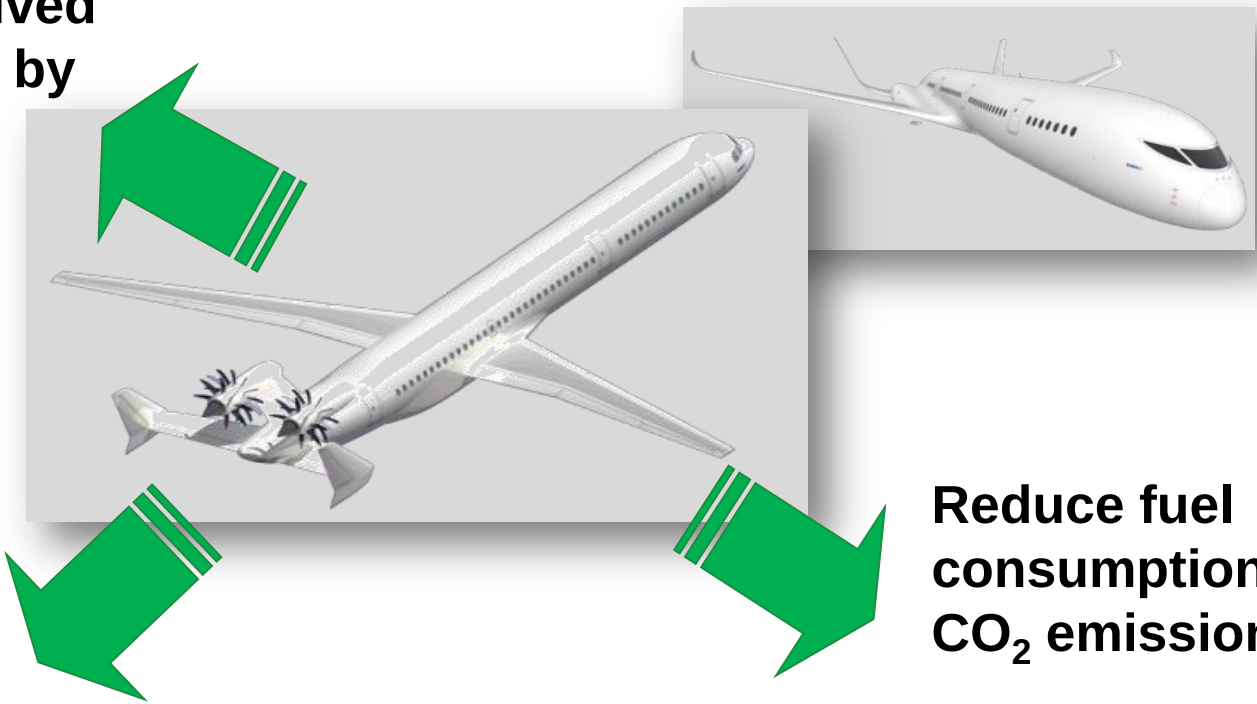
- **Creating resource efficient transport that respects the environment:**
  Finishing the job for reaching ACARE 2020 targets beyond CS1 contribution, and paving the way for the 2035 intermediate step of the new Strategic Research and Innovation Agenda
- **Ensuring safe and seamless mobility:**
  With a global ATS vision, improve the use of small airports, bring new means to the air transport capabilities, provide for faster connections
- **Building industrial leadership in Europe:**
  Facing the new competitors through innovation – strengthening the whole European supply chain.

Enhancing and leveraging innovation capability across Europe, with a strong emphasis on SME participation

Big technical challenges, with bigger ones still ahead

Reduce perceived external noise by

- **50% by 2020**
- **65% by 2050**



Reduce NO_x emissions by

- **80% by 2020**
- **90% by 2050**

Reduce fuel consumption and CO_2 emissions by

- **50% by 2020**
- **75% by 2050**

Vision 2020 and **Flightpath 2050** targets are for new aircraft technology relative to 2000 performance

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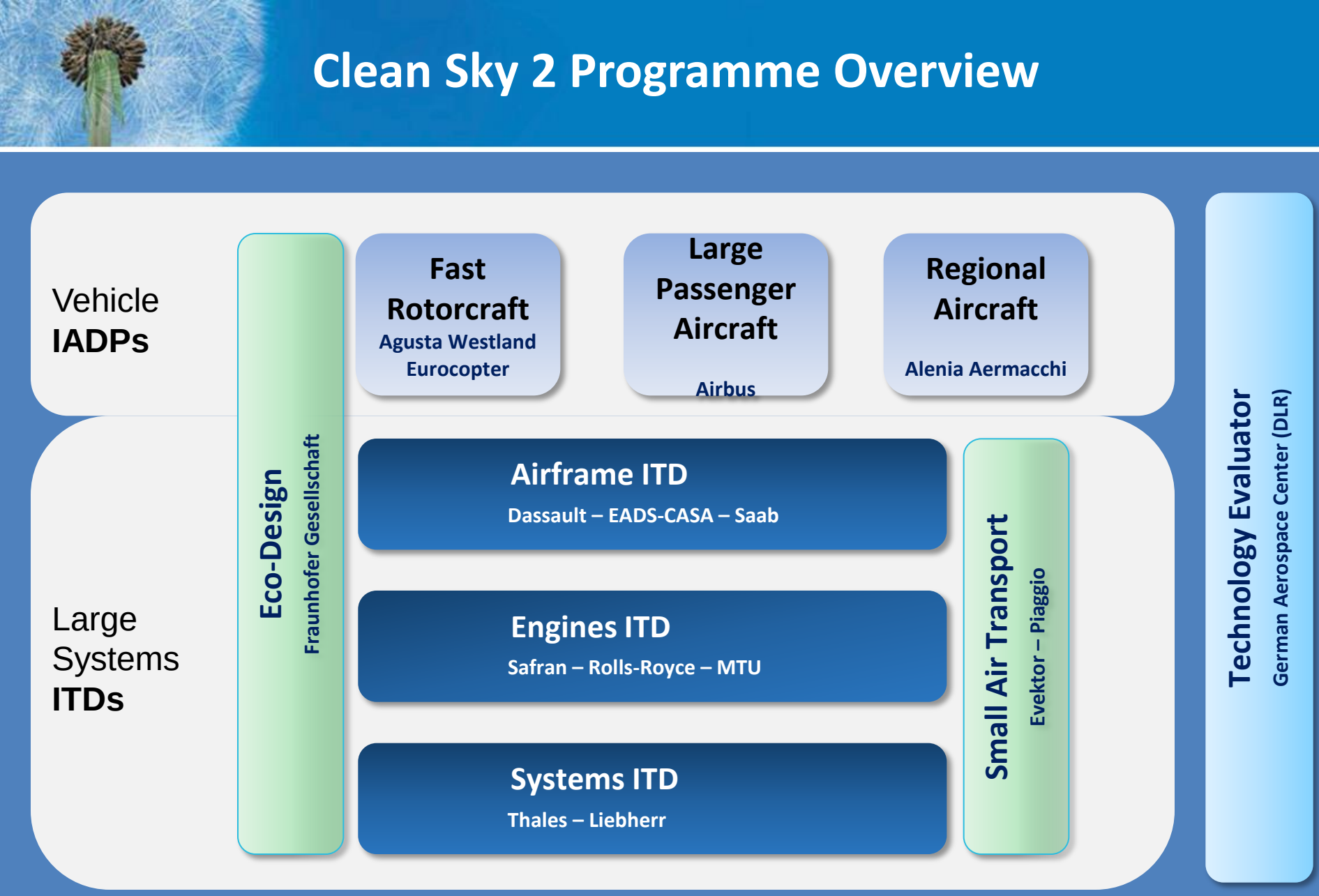
Clean Sky 2 Programme Overview



Building on Clean Sky, going further into integration at full aircraft level
And developing new technology streams for the next generations of aircraft

Going further in aircraft-level integration: High-speed rotorcraft demonstrations

For increased mobility within global ATS, search & rescue, emergency transport...

Tilt-rotor

Compound

Clean Sky 2: up to 800 participants?

Partneships triggered by Clean Sky are essential
Progressively creating a European “Innovation Chain”

>38% of SMEs in Clean Sky Partners
23% academia
24 countries involved
50% of participants are newcomers in European research

Clean Sky 2: larger programme, more open to competition, will need a still wider participation – attracting even more newcomers

It is a Clean Sky JTI ambition to explore routes and create a model for technological innovation in Europe


Lunch time