

Clean Sky Activities on Rotorcraft

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EU Clean Sky JU



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www.cleansky.eu www.easa.europa.eu



AGENDA

- Introduction to Clean Sky – EASA Cooperation
- What is Clean Sky JU
- Difference between CS and CS2
- About CS1 achievements

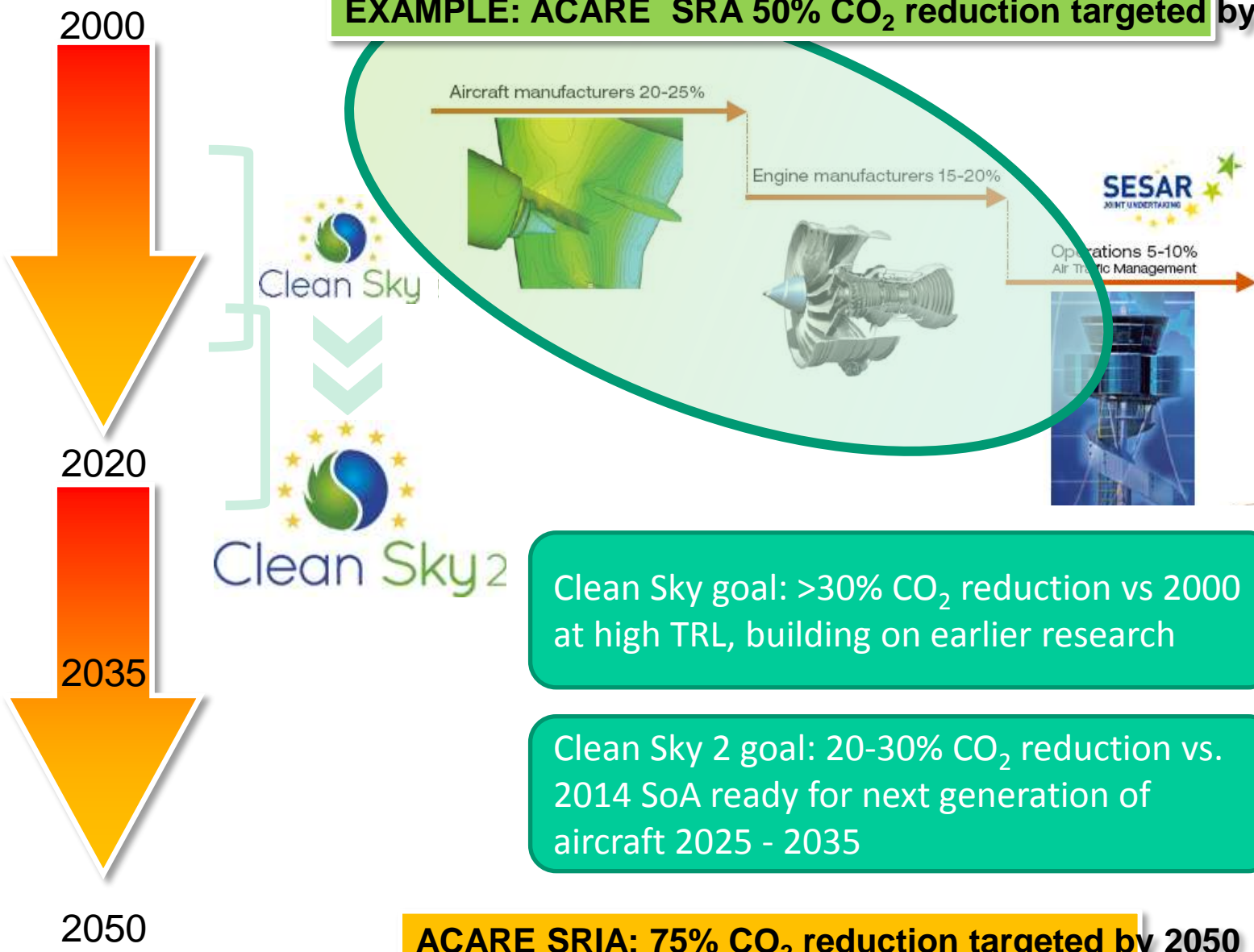
A **Memorandum of Cooperation** has been prepared by the two European institutions.

The formal signature took place in Warsaw on Tuesday 22 November together with the parallel agreement between EASA and SESAR.

Clean Sky JTI – response to challenges

Extended and Enhanced efforts in CS2 / H2020

EXAMPLE: ACARE SRA 50% CO₂ reduction targeted by 2020



Clean Sky organization

Integrated Technology Demonstrators



Smart Fixed Wing Aircraft
Airbus (F, D, UK, E)
SAAB (SE)
Green Regional Aircraft
Alenia Aeronautica (I)
EADS CASA (E)
Green Rotorcraft
AgustaWestland (I, UK)
Eurocopter (F, D)
Sustainable and Green Engines
Rolls-Royce (UK, D)
Safran (F)
Systems for Green Operation
Thales (F)
Liebherr (D)
Ecodesign
Dassault Aviation (F)
Fraunhofer Gesellschaft (D)

Technology Evaluator
 Thales
 DLR



Addressing H2020 Transport Challenge Areas

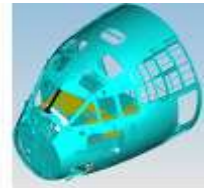
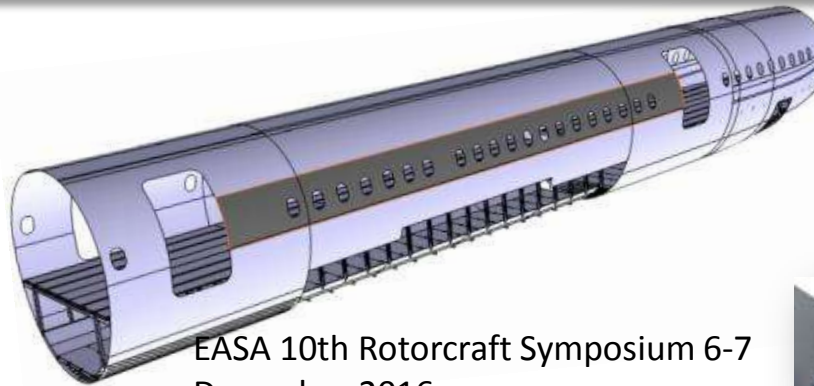
Energy Efficiency & Environment



Enabling Safe & Seamless Mobility



Building industrial leadership in Europe



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Clean Sky 2 Programme

EU Funding: ~1.8bn€
Private Members: ~2.2bn€

Vehicle
IADPs

**Fast
Rotorcraft**
Leonardo
Helicopters
Airbus
Helicopters

**Large
Passenger
Aircraft**
Airbus

**Regional
Aircraft**
Leonardo
Aircraft

Large
Systems
ITDs

Eco-Design
Fraunhofer Gesellschaft

Airframe ITD
Dassault – EADS-CASA – Saab

Engines ITD
Safran – Rolls-Royce – MTU

Systems ITD
Thales – Liebherr

Small Air Transport
Evektor – Piaggio

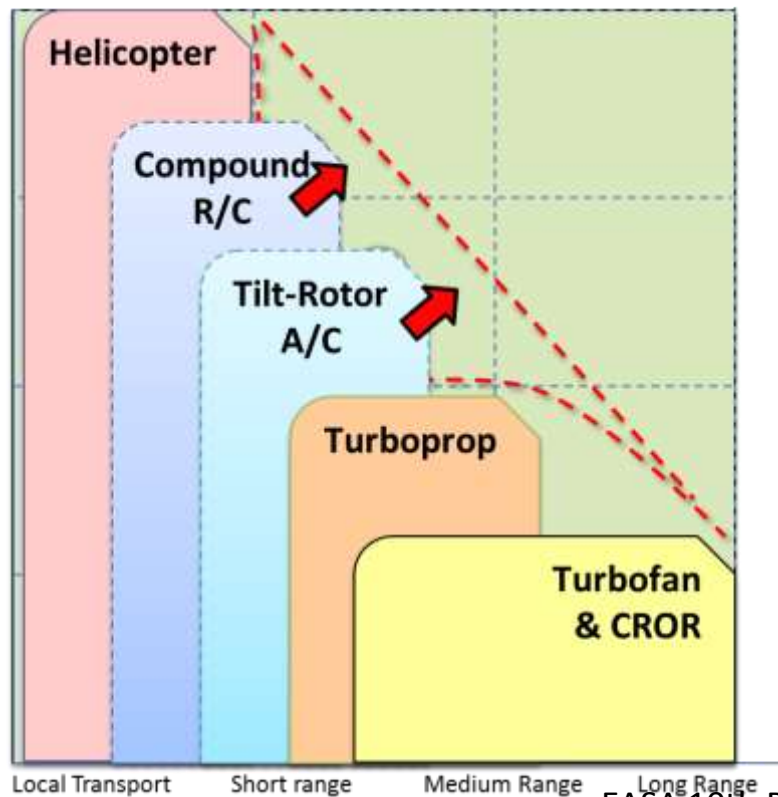
Technology Evaluator (TE)
German Aerospace Center (DLR)

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

EU Rotorcraft: difference between CS and CS2

CS : addressing technology streams

CS2 => “in-flight” demonstration of integrated technologies on entire vehicle level



Clean Sky – Main Achievements

Main Demonstrators achieved (date and Technology Readiness Level (TRL) reached)



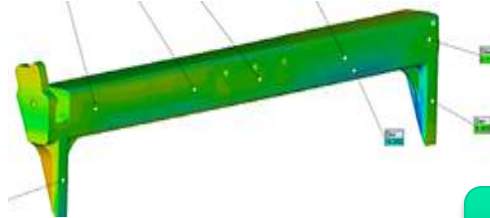
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Clean Sky/GRC – Main Achievements

GRC-1 Innovative Rotor Blades

Active Gurney Flap (TRL 6?)



Maiden flight in December 2016?

Active Twist (TRL 4)



Passive Optimized Blade (TRL 6)

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Clean Sky/GRC – Main Achievements

GRC-2 Drag Reduction of airframe and non-lifting systems



Hub cap & mast fairing (TRL 6)



Separation control on blunt airframe rear part (TRL 4)



(TRL 6)
Optimised turboshaft installation



(TRL 4 TETRA)



Bluecopter demonstrator in flight

TRL 6










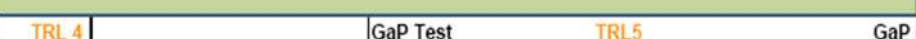





Numerical optimization to reduce drag on selected components
(TRL 4)



Clean Sky/GRC – Main Achievements

GRC-3 More Electrical Rotorcraft

Nr.	Demonstration / Technology Product	Owner	2015	2016											
			O	N	D	J	F	M	A	M	J	J	A	S	O
3.4.1	Brushless Starter Generator	(AH-S)	 TRL4/5	CLOSED											
3.4.2	Power Converter REGENESYS	(AWL)	 TRL5	GaP Closed									Joint Report		
3.4.3	Energy Storage REGENESYS	(AWL)	 TRL5	GaP Closed											
3.4.6	Energy Recovery System	(AH-S)	 TRL4/5	CLOSED											
3.5.2	EMA for Flight Control System	(AH-S)	 TRL3				Replanned Test			TRL4/5			Report		
3.5.3.1	EMA For Landing Gear	(AH-S)	 TRL4	CLOSED											
3.5.3.1	EMA for Rotor Brake HERRB	(AWL)	 TRL5				GaP Report						Report		
3.6.1	Electric Tail Rotor (Open Rotor) ELETAD	(AWL)	 TRL4				GaP Test			TRL5			GaP closure & Report		
3.6.2	Electric Tail Rotor (Fenestron)	(AH-D)	 TRL3	CLOSED											
3.6.3	Electric Tail Demonstrator	(AWL)	 TRL4				Manufacture			Test			Demo		
3.7	Energy for Piezo Actuators	(AH-D)	 TRL3	CLOSED											
3.8	Ground Demonstration (ED Common Bench)	(AH-L)	 HEMAS	CLOSED											
				Revised location replanned HEMAS Test now at AH											





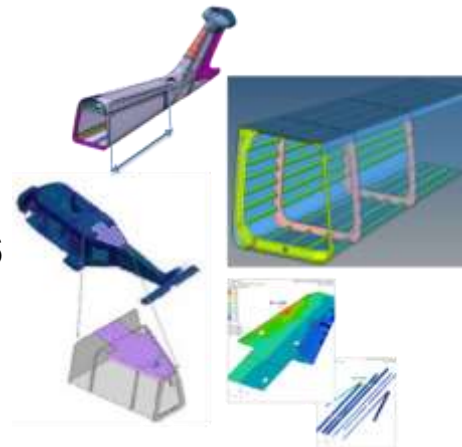
Clean Sky/GRC – Main Achievements

GRC-4 High Compression Engine and GRC-6 ECO-Design



Demonstrator Helicopter

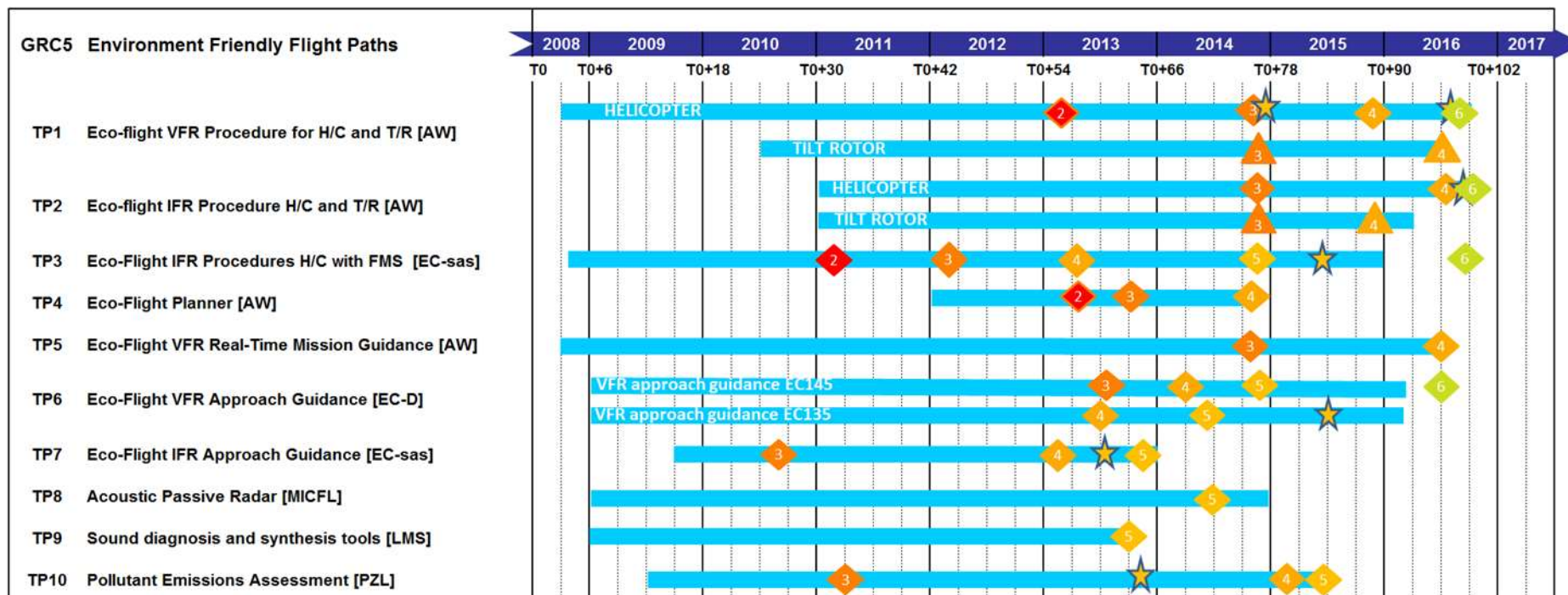
- Iron bird campaign from Nov 2013 to Feb 2014
- Ground tests in Feb-Mar 2015
- Maiden flight on Nov 6th 2015
- Flight tests until end of July 2016



TRL 6

Clean Sky/GRC – Main Achievements

GRC-5 Environmentally Friendly Flight Path



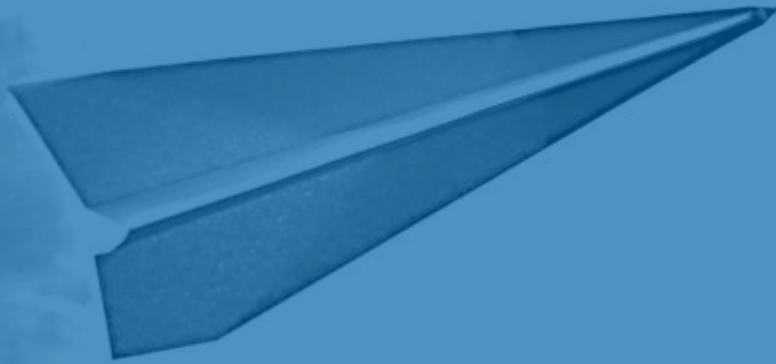


Back-up slides

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Thank you!



Innovation Takes Off



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Clean Sky 2