

Clean Sky and Clean Sky 2

Where we are



Innovation Takes Off

www.cleansky.eu

Not legally binding



Clean Sky : Innovation takes off

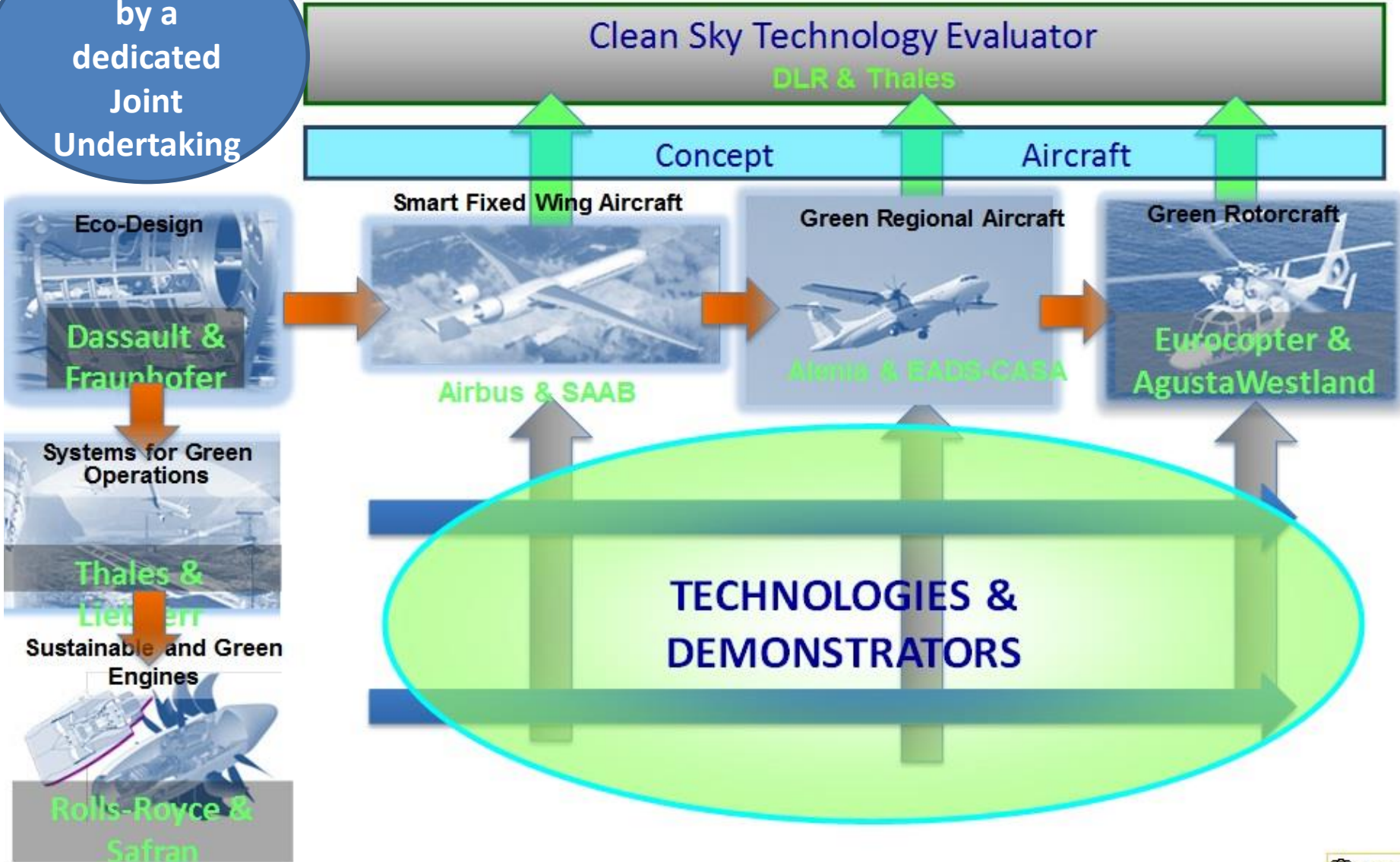
Europe's largest Aeronautics Research Programme ever

- One of 6 EC Joint Technology Initiatives: public-private funding and governance
- Integrated breakthrough technologies, up to full scale demonstrators
- Environmental objectives for CS1: CO2 and noise;
Environment and competitiveness for CS2
- **CS1** started in 2008 within FP7, up to 2017; continuation decision in 2014
CS2 in H2020, up to 2024
- CS1: 1.6 B€ budget; CS2: 4 B€
- Programme managed by a dedicated body: the “Joint Undertaking”



Clean Sky 1 technical organisation

Coordinated
by a
dedicated
Joint
Undertaking



Clean Sky 2 Programme Set-up

EU Funding
Decision 1.755bn€

Vehicle
IADPs

Fast Rotorcraft
Agusta
Westland
Eurocopter

Large Passenger Aircraft
Airbus

Regional Aircraft
Alenia
Aermacchi

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)

2020 / 2050 Environmental targets

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 CO₂ emissions by

- 50% by 2020
- 75% by 2050

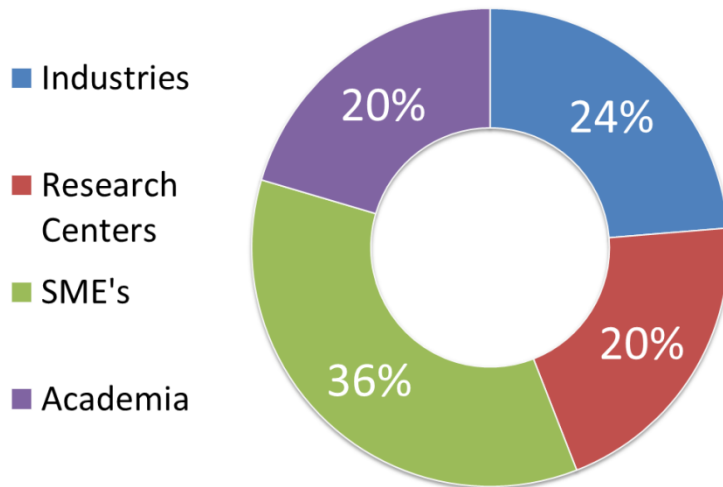


Vision 2020 and Flightpath 2050 targets are for new aircraft technology relative to 2000 performance

Clean Sky 1: an Innovation Chain of 600 entities

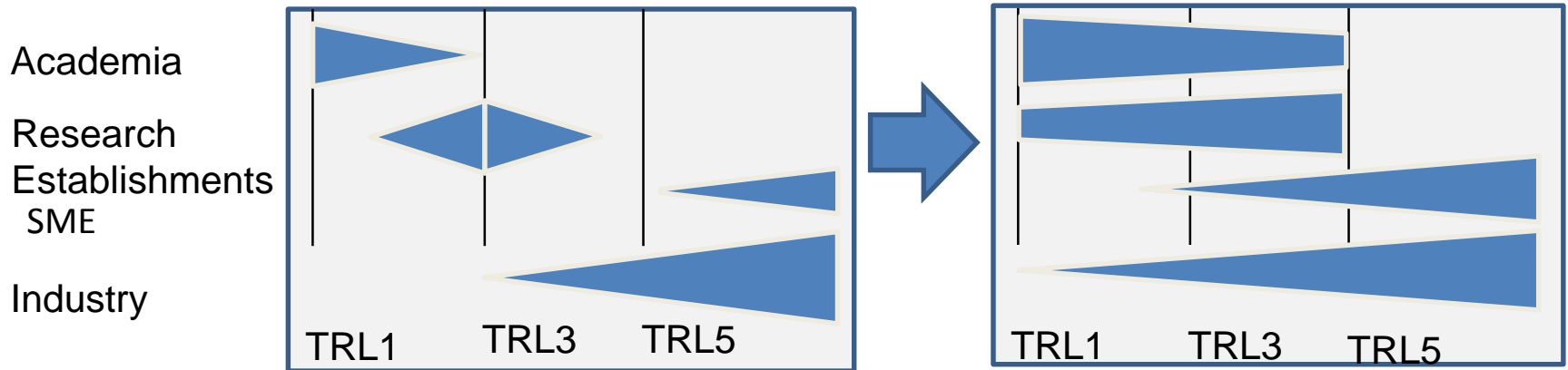
- 12 ITD leaders (16 in CS2)
- 63 Associates (“Core Partners” in CS2)
- > 500 Partners through Calls for Proposals

Calls for proposals
Participants per type of
Organization



The innovation chain

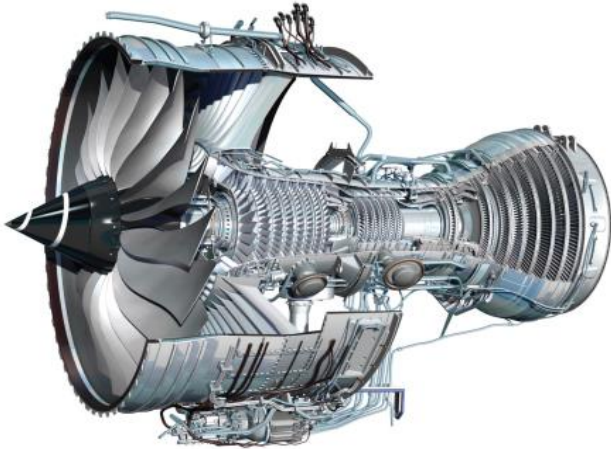
- ✓ How the aero innovation pipeline is evolving



- ✓ **How CS is striving to bring more SMEs to technological innovation**

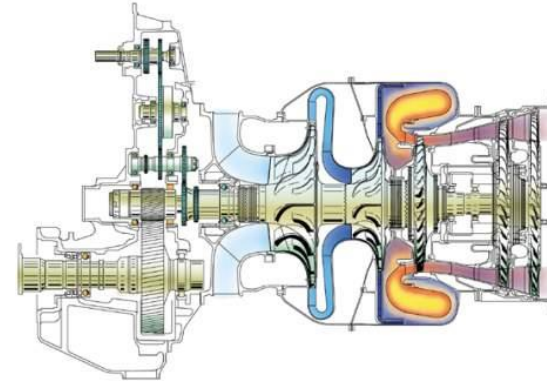
- Breaking the 3 barriers to innovation for new entrant SMEs: Financial / Technological / *Reputational*
- Focusing on precise topics and allowing applicants to run single
- Bringing a long-term strategic view
- Encouraging University or Research Org / SME teaming

3 Engines demonstrators tested



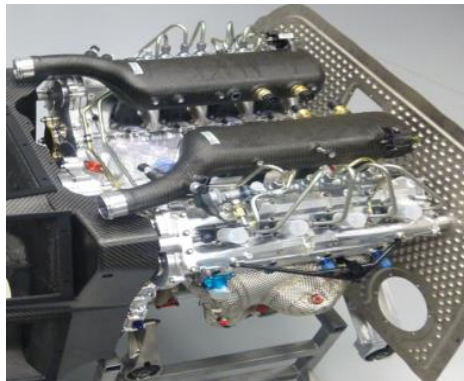
Large 3-shaft engine
Advanced Low Pressure Spool

**Flight tests in progress
started mid-2014**



Advanced turboshaft, 2000 hp
Fuel efficiency and Nox

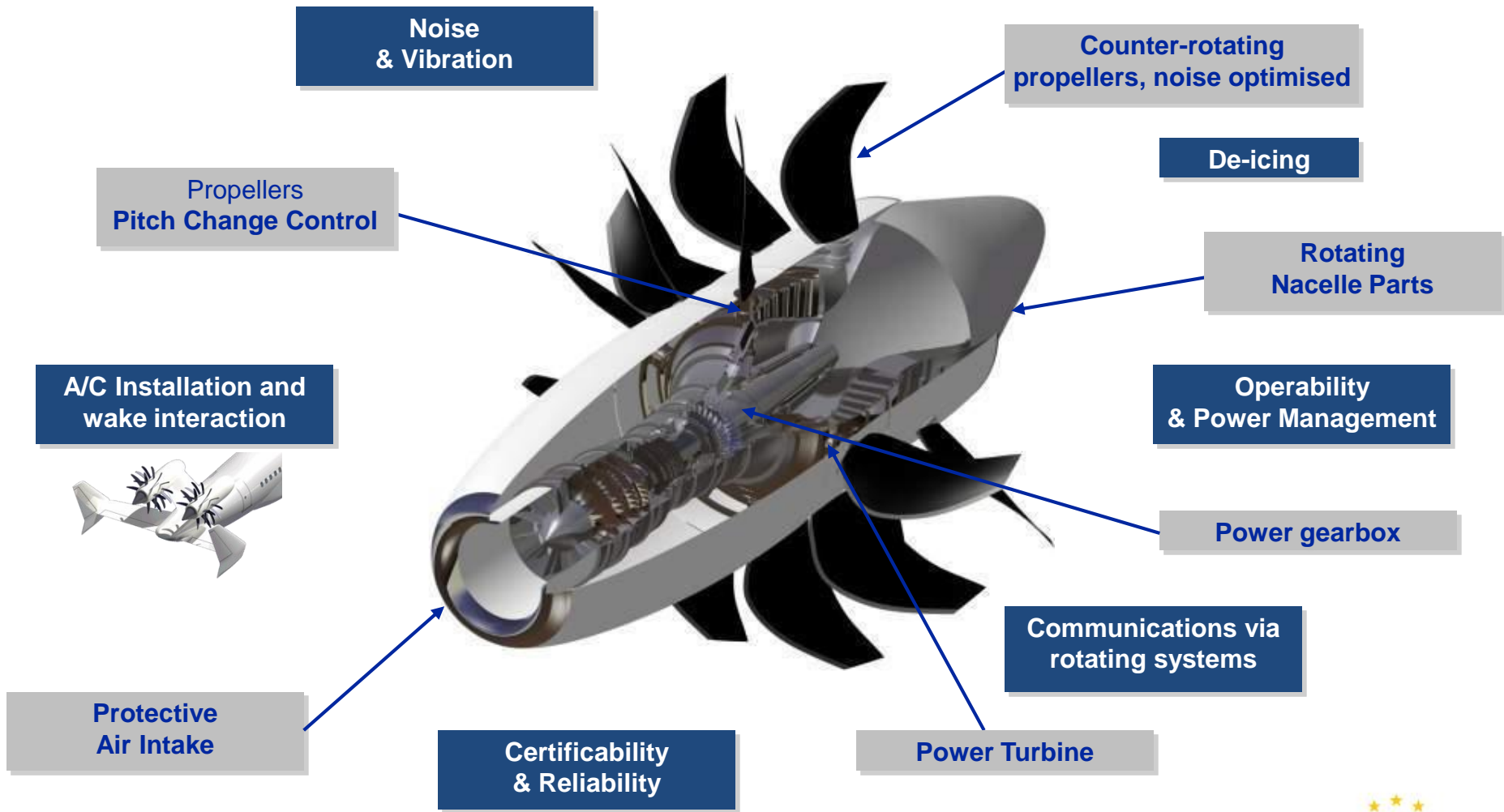
**Tests completed
New Product emerging from technology
development: ARRANO, selected for new
H160 helicopter**



High compression, Diesel engine
for light helicopters

**Ground tests performed – flight in
Sept 2015**

Contra-Rotating Open Rotor Ground demonstration in May 2016



Assembly started in Snecma Vernon

Clean Sky 2: Engines, one out of 7 full projects

Very High Bypass Ratio [VHBR] Architectures



Underlying technologies for VHBR engines with focus on the “Middle-of-Market” short range aircraft

VHBR technologies for the long range airliner market with Engine Demonstrator

Composites



Integration

Turbines



Transmissions

*Externals
& Structures*



*Control &
Power Systems*



Laminarity: The BLADE Project

Demonstrating an INDUSTRIAL feasibility

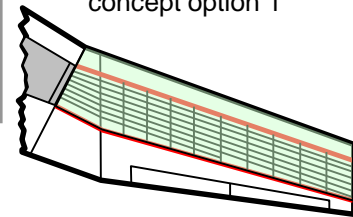
A340 flight test platform: Integration started in Tarbes

Natural Laminar Flow Wing

- Proof of natural laminar wing concept by WT testing
- Use of novel materials and structural concepts
- Large scale flight test demonstration of the laminar wing

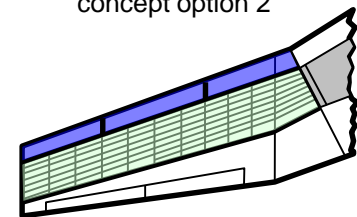
Starboard wing

Laminar wing structure concept option 1



Port wing

Laminar wing structure concept option 2



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



Smart Wing semi-assembly ground transportation (Aernnova)



Current manufacturing of the Smart Wing integrated upper panel (SAAB)

Laminar Wing aerodynamic layout and performance

Clean Sky 2: Large Passenger Aircraft

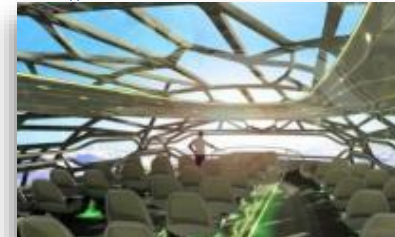
Large Passenger Aircraft Platform – Integration Topics

„Platform 1 - OAD“



Advanced Engine and Aircraft Configurations

„Platform 2 - OPD“

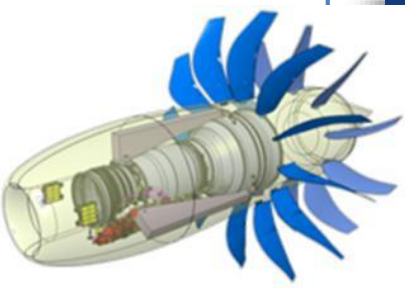


Innovative Physical Integration Cabin-System-Structure

„Platform 3 - OSD“



Next Gen. Electrical A/C Systems, Cockpit Systems & Avionics



Platform 1 Advanced Engine and Aircraft Configurations

- Open Rotor demo in flight**
- Advanced engine integration driven rear fuselage**
- Validation of dynamically scaled flight testing
- Hybrid laminar flow** control large scale demonstration
- Hybrid propulsion**

Platform 2 Innovative Physical Integration Cabin-System-Structure

- Integrated product architecture
- Pre-Production Line Technologies



Platform 3 Next Gen. Electrical Aircraft A/C Systems, Cockpits & Avionics

- Enhanced flight operations and functions
- Avionic backbone technologies development and integration
- Next generation cockpit ground demonstrator
- Next generation cockpit features flight demonstration
- “Pilot case” demonstrators



Regional: ATR-72 demonstration flight

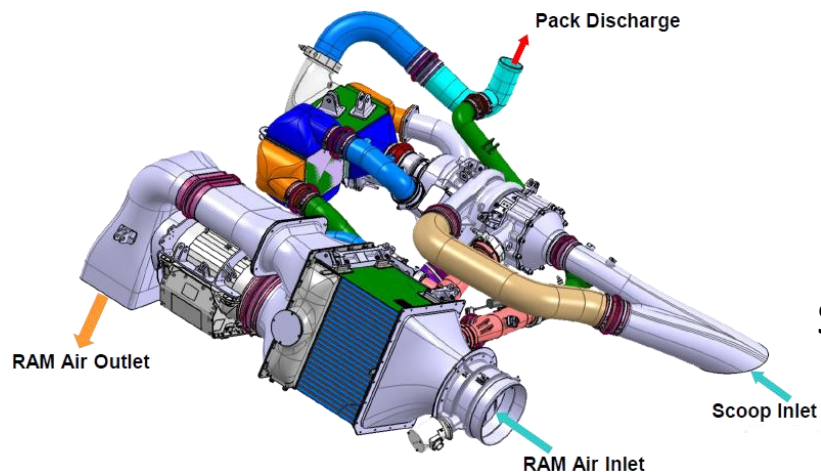
❑ Crown Fuselage Composite Panel

CFRP Crown panel mounted for acoustic and vibration demonstration, **scheduled 8 July 2015**

❑ Electrical ECS demonstration



CFRP Stiffened Panel mounted on Crown Fuselage

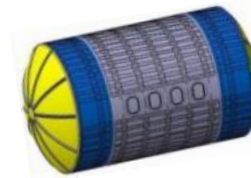
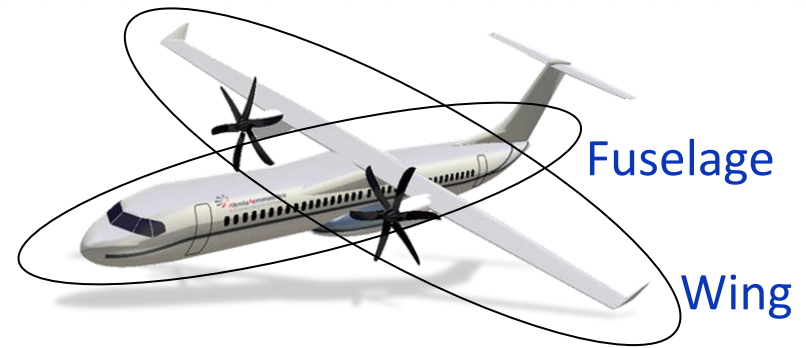
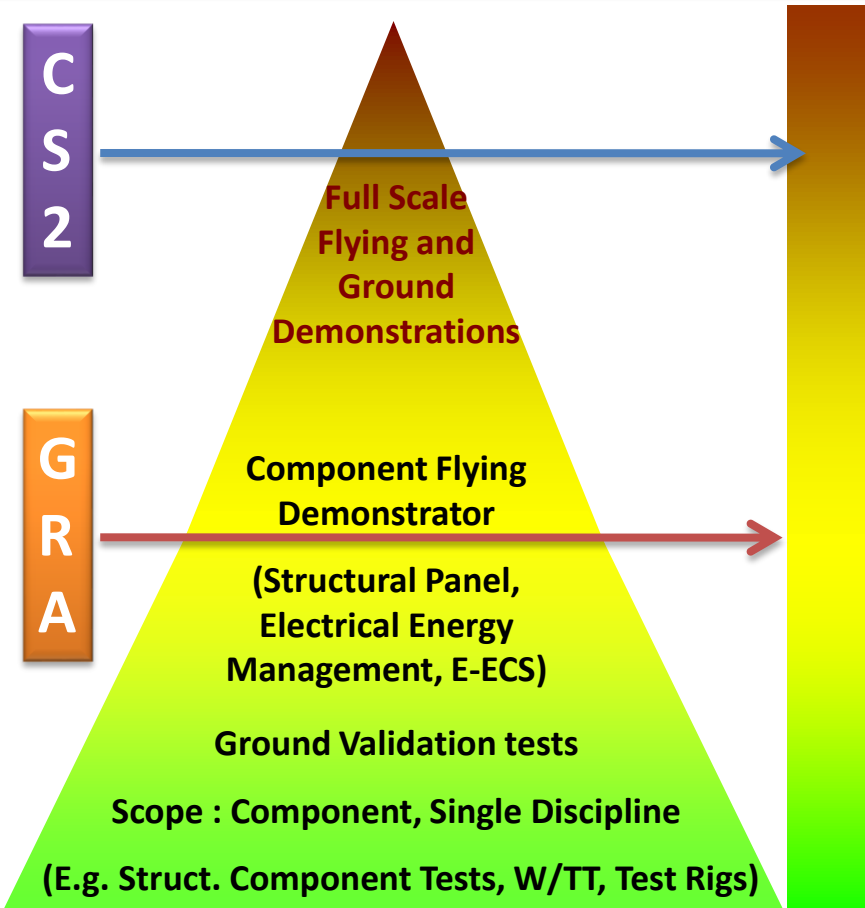


Scheduled in December 2015

Regional Aircraft

From *Clean Sky* towards *Clean Sky 2*

High Integration of Technologies at Aircraft Level



Fast Rotocraft IADP

Future *Fast Rotorcraft* and Mobility Solutions



Tilt-rotor

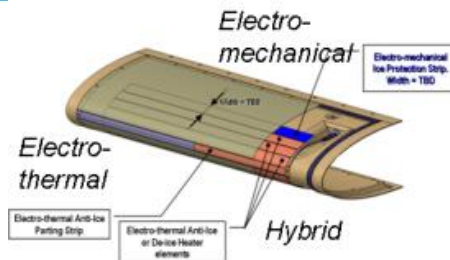
Compound

Market Requesting more *speed, range, capacity, productivity, efficiency and sustainability...*

Management of aircraft energy



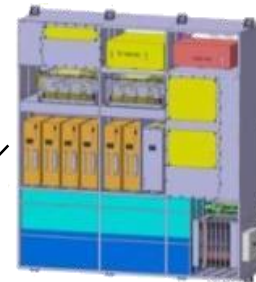
**Electrical ECS: A320
flight end 2016**



Electrical WIPS

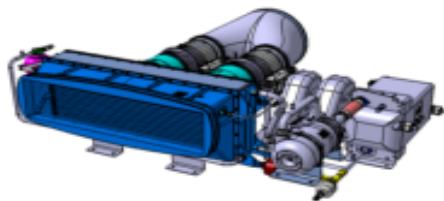


Engine Nacelle Sys

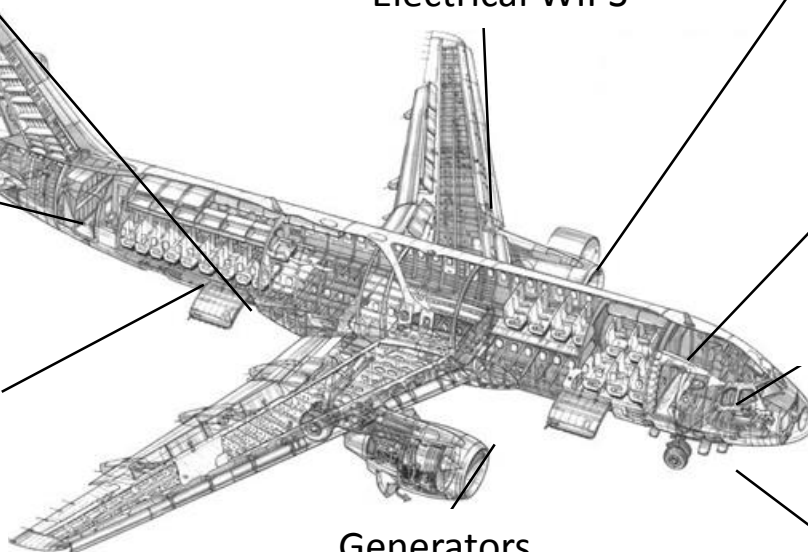


**Electrical
Power Center**

Load Management



**Vapour Cycle cooling
system**



Generators

Wiring System

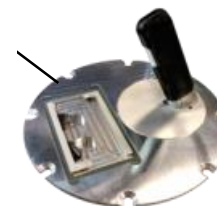
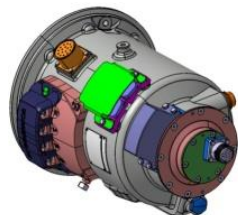


**Skin HX:
flight-tested
in 2014**



Ice

**Detection:
A320 flight
end 2016**



Clean Sky 2 Systems (1/2)

Avionics extended cockpit



Workload,
HSI,
monitoring

Computing I/O
Network
Sensors

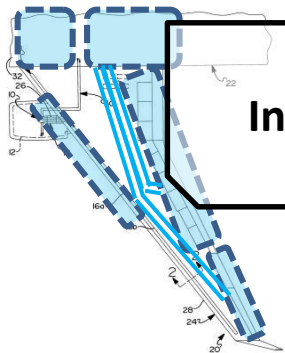
Functions



Flight
Management
Systems

Future Displays,
Head-up, Human
factors assessments,
eyes-out piloting...

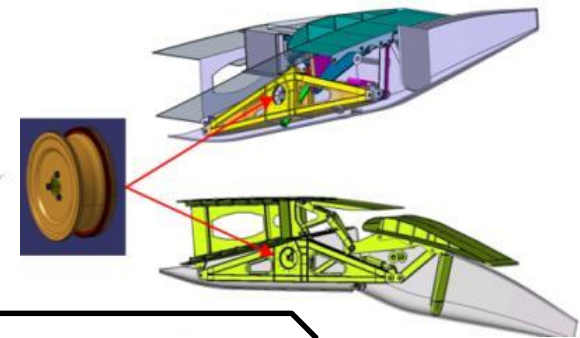
Innovative Electrical Wing



Smart
Integrated
Wing



Innovative
Electrical
Wing

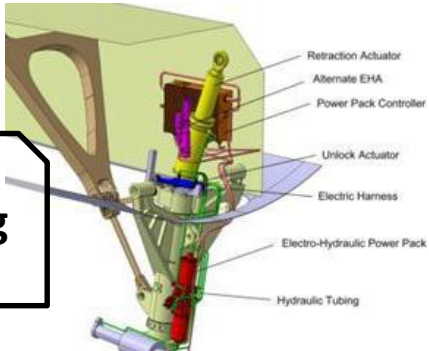


Flash FAL
Track

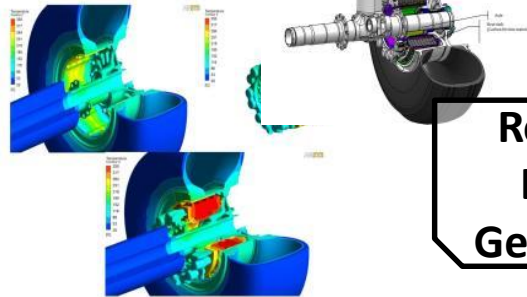
Clean Sky 2 Systems (2/2)

Landing Gears Systems

Electrical
Nose Landing
Gear



Main Landing
Gear

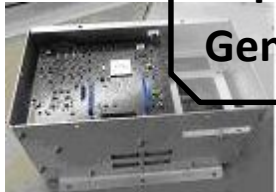


Rotorcraft
Landing
Gear System

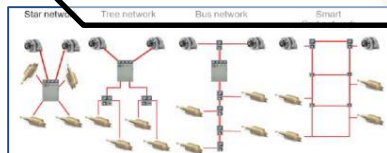


Electrical Chain

Power
Generation



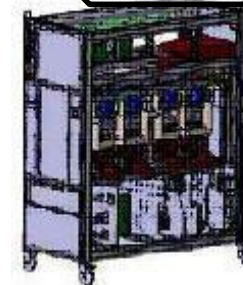
Power
Distribution



Conversion



Power
Management



Summary

Main areas – strategic focus

Clean Sky 1

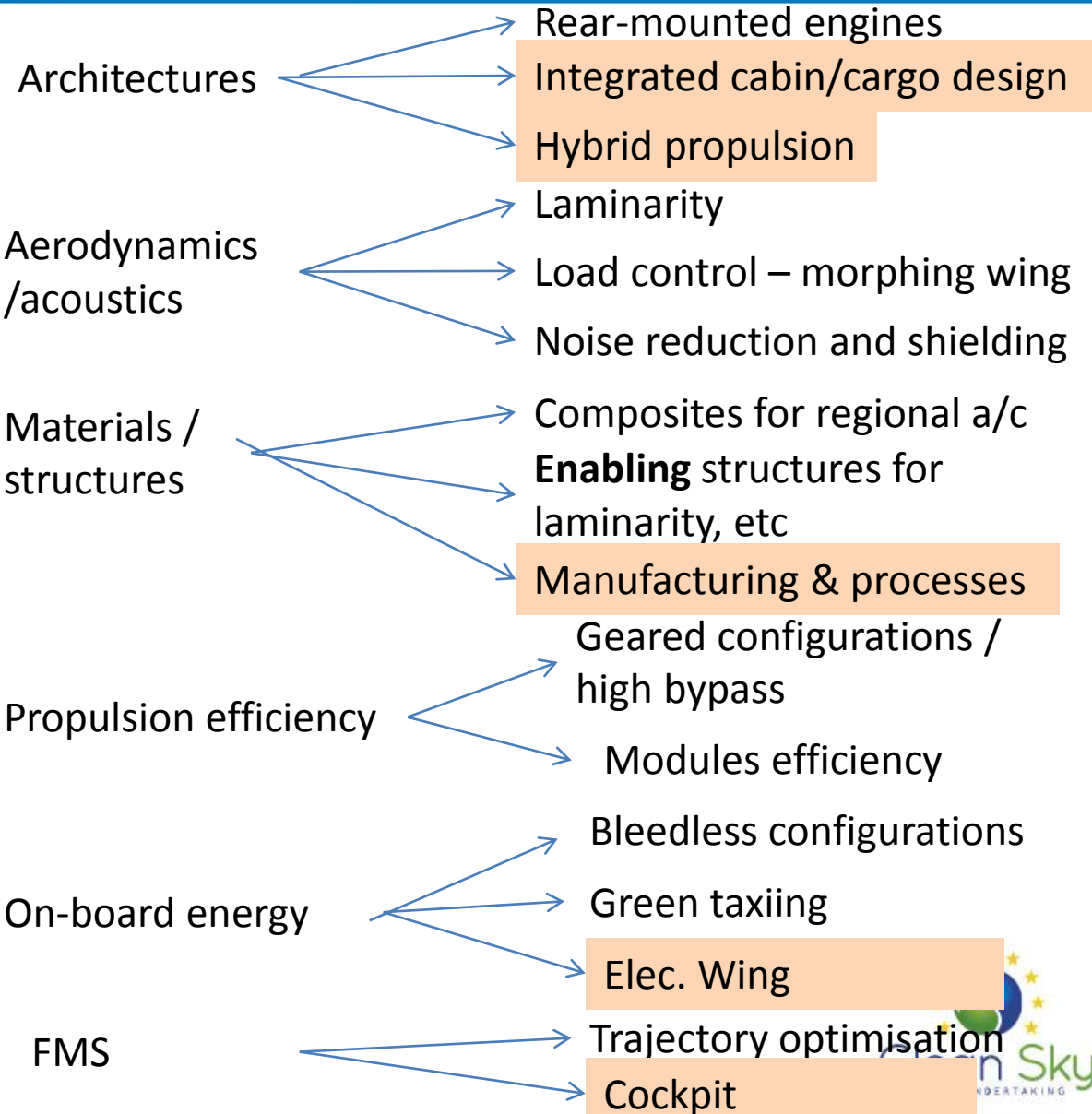
Environment, for:

- Short/medium range a/c
- Long range (engine only)
- Regional, turboprop
- Light/medium rotorcraft
- Business jets

Clean Sky 2 additions

Environment and competitiveness, for:

- Same as above, +
- Long range
- High-speed rotorcraft
- General aviation





Clean Sky 2 future prospects in short

- Most of the EU-funded aeronautical research goes through Clean Sky now – not limited to “high TRLs”
- Industry-led... but gives room to wide Research Org and Academia participation (already evidenced in the 1st Clean Sky 2 calls launched)
- Reflection started on how to better involve students
- Further efforts for involving SMEs, incl. new entrants (“non-aeronautical”)
- Synergies with Structural Funds

Clean Sky Joint Undertaking is widening its approach with a view of contributing to a deeper consistency of European research throughout the TRL scale, the type of organisations, the funding sources