Clean Sky II
The AIRFRAME ITD
From **Clean Sky** towards **Clean Sky 2**

- Greener Airframe Technologies
- More Electrical a/c architectures

- More efficient wing
- Novel Propulsion Integration Strategy
- Optimized control surfaces

- Integrated Structures
- Smart high lift devices

**Step changes in the “efficiency” of all airframe elements by the means of a systematic “re-thinking”**
Overall Clean Sky 2 Funding

Vehicle IADPs

Large Systems ITDs

Technology Evaluator (TE)
German Aerospace Center (DLR)

Fast Rotorcraft
AW A-H

Large Passenger Aircraft
Airbus

Regional Aircraft
Alenia Aermacchi

Airframe ITD
Dassault – Airbus D&S – Saab

Engines ITD
Safran – Rolls-Royce – MTU

Systems ITD
Thales – Liebherr

Eco-Design
Fraunhofer Gesellschaft

Large Air Transport
Evektor – Piaggio
AIRFRAME ITD Key Objectives

• Maturate technologies to be validated through integrated demonstrators mostly performed in IADPs:
  – Introduction of **innovative airframe architecture**
  – Introduction of technologies for **more efficient airframe**: drag, weight, cost, environmental impact, passenger well-being, maintenance, servicing, …
  – Enhancement of the **efficiency of the engineering & manufacturing process**: time-to-market and competitiveness against low-cost labour countries,
  – Full address of a technology issue from **modeling to certification ability**

• Serve **maturity up to TRL 6** of airframe technologies

• De-risk novel generation product in the prospect of a next game changing step by 2030+:
  – Support next generation bizjets and general aviation directly
  – Support Large a/c, regional a/c and rotorcraft directly and through IADPs

• Create Product differentiators

Supporting a 5 Product’s Segments Strategy Base
## Overall Technical Overview

<table>
<thead>
<tr>
<th>Focused Integrated Demonstrations</th>
<th>High Performance &amp; Energy Efficiency</th>
<th>High Versatility &amp; Cost Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovative Aircraft Archit.</td>
<td>Advanced Laminarity</td>
<td>Next generation optimized wing</td>
</tr>
<tr>
<td>Advanced Laminarity</td>
<td>High Speed Airframe</td>
<td>Optimized high lift configs.</td>
</tr>
<tr>
<td>High Speed Airframe</td>
<td>Novel Control</td>
<td>Advanced integrated structures</td>
</tr>
<tr>
<td>Novel Control</td>
<td>Novel travel experience</td>
<td>Advanced Fuselage</td>
</tr>
</tbody>
</table>

### High Performance & Energy Efficiency
- Investigate advanced engine integration & novel overall architecture
- Laminar nacelles; NLF smart integrated wing fitting the industrial environment
- High efficient multi-disciplinary flexible wing; fuselage changes in shapes, & structure
- Smart multi-function control surfaces & load & flutter alleviation
- Passenger friendly cabin; ergonomic & flexible, new volume utilisation
- Low cost composite structures
- Efficient architectural concept for turbopropeller high wing – composite nacelle & adaptive wing
- New structural paradigm for optimised integration of systems in airframe, electrical wing
- Novel composite fuselage & cabin; tailless or pressurized fuselage for rotorcraft

### Transverse Enabling Capability
- Novel Certif. Process
- Extended Laminarity
- More Efficient Wing
- Advanced Manufact.
- Eco Design
- Flow & shape Control
External interactions of AIRFRAME ITD

Technology insertion in future a/c concepts analysis WP 0.x

Innovative Aircraft Architecture
Advanced Laminarity
High Speed Airframe
Novel Control
Novel Travel Experience
Next Gen. optimized wing box
Optimized high lift configurations
Advanced Integrated Structures
Advanced Fuselage

Technology Streams

Interfacing & cross interaction management

IADP RA
IADP LPA
IADP Rcraft
ITD Systems

Regional a/c concepts
Rotorcraft concepts
Large Passenger a/c concepts
BizJet concepts
Small Air Transport concepts

IADP LPA
IADP RA
IADP Rcraft
ITD Systems

SAT Transverse act°

ITD Engine
ITD Systems
ECO
TE
Overall WBS and participants

5 Technology Streams

Leaders: **DAv, SAAB**
Participants: Airbus, Fraunhofer
1st CPs: 2 projects / 9 Beneficiaries

4 Technology Streams

Leaders: **Airbus S&D S.A.U. (CASA)**
Participants: Airbus, Alenia, AW, A-H, Fraunhofer, SAAB, Evektor, Piaggio
1st CPs: 4 projects / 24 Beneficiaries
**TS A-1: Innovative Aircraft Architecture**

### Objectives
- Demonstrate viability & assess potentiality of advanced aircraft configurations: explore concepts, identify potential showstoppers & confirm solutions
- Engine integration on rear fuselage, CROR, High Speed
- Facilitate certification: cost-effectiveness and time to market for innovations insertion

### Means & Enablers
- Large Wind Tunnel Test

### Partnership Framework
- Engine Supplier, Research Institute, PLM & engineering software provider, Aero-Structure Industry with track record in Eco Design, Material & Coating provider

### Timescale
- Highly optimised configurations: 2014-2018
- In-rupture configurations: 2017-2022
High Performance & Energy Efficiency

Objectives
- Demonstrate aero-shape concepts and architecture revision of N(H)LF Nacelles
- Demonstrate a NLF wing concept that can be manufactured, produced and maintained in an industrial environment
- Explore laminarity potential for “adverse” configuration: high lift wing
- Progress on advanced laminarity techniques in design (e.g. active shock control, hybrid flow ...), production and maintainability to extended application domain and operability

Means & Enablers
- Nacelle demonstrators
- Large scale NLF smart integrated wing

Partnership Framework
- Research Institute & Academia, Aero-Structure Industry, Nacelle Supplier

Timescale
- 2014-2018
High Performance & Energy Efficiency

Objectives

- Progress on the wing, fuselage and cockpit in an integrated approach for high performing aircraft (enlarged flight domain)
- Achieving new aero-structural design optima of composite wing by steering (i.e. shape/structure coupled optimization)
- Reshaping & and optimized system integration of front fuselage
- Efficiency of metallic fuselage: architecture with low density & multifunctional materials, multidisciplinary optimization (e.g. structure & noise), new volumes
- Cockpit setup capable to accommodate all next generation cockpit features
- Eco design for Airframe: green life cycle

Means & Enablers

- Representative wing box demonstrator
- Wind Tunnel Tests
- Dedicated structural components & partial fuselage demonstrator
- Sample and structural parts demonstrator for Eco Design

Partnership Framework

- Research Institute & Academia, Aero-Structure Industry, Material Provider, Equipment Supplier

Timescale

- Optimization/Local demonstrators: 2014-2018
- Radical concepts/Sub scale demonstrators: 2018-2023
High Performance & Energy Efficiency

Objectives
- Develop enhanced load alleviation function for gust loads
- Develop anti-flutter control law to gain flutter margin
- Develop efficient concept for multifunction control surfaces
- Develop integrated mobile surface, including EWIPS

Means & Enablers
- Flight test of new control laws
- Full scale ground demonstrator of smart mobile surfaces

Partnership Framework
- Research Institute & Academia, Mobile part manufacturer, Equipment provider

Timescale
- Short term demonstration batch: 2014-2017
- Extended demonstration batch: 2016-2022
TS A-5 : Novel Travel Experience (Cabin)

Objectives

• Passenger cabins have not been addressed within Clean Sky.  
  ⇒ Improve passenger comfort and ergonomy, safety and services, but also significant fuel efficiency through weight reduction & ecological benefit with environmental friendly materials  
  ⇒ Human engineering approach

• New seat arrangement and furniture & equipment concepts
• Purpose focused functionalities of cabin areas
• Local environment tailoring

Means & Enablers

• Dedicated digital and mock up studies
• Local/partial cabin items demonstrators

Partnership Framework

• Cabin system provider, Research Institute & Academia, Material Providers, Equipment Suppliers, Design centers, Social behavior analysts

Timescale

• 2014-2020
High Versatility & Cost Efficiency

Objectives

- Structural improvements for wing
- Better use of composite materials
- Optimization of the wing efficiency
- Morphing technologies
- Active load control

Means & Enablers

- Full scale wing, including components for IADPs
- Full range of calculation and simulation tools (CFD, FEM, dynamics)
- Sample, sub-components and full component ground tests

Partnership Framework

- Research Institute & Academia, Aero-Structure Industry, Material Provider

Timescale

- Item to be delivered to IADPs: 2014-2018
- Large scale demonstrators: 2014-2022

TS B-1: Next Generation Optimized Wing Box

WP B-1.1: Wing for incremental lift & transmission shaft integration

WP B-1.2: More affordable composite structures

WP B-1.3: More efficient wing technologies

WP B-1.4: Flow & shape control
**Objectives**
- Global aero structural optimizations
- Enhanced nacelle/engine integration
- Advanced high lift systems
- Progress on drag and integration for high wing with large turbo propulsors

**Means & Enablers**
- Wind Tunnel test
- Full scale wing and flap including components for IADP
- Sample, sub-components and full component ground tests

**Partnership Framework**
- Research Institute & Academia, Aero-Structure Industry, Nacelle suppliers, Engine suppliers

**Timescale**
- 2014-2018
TS B-3: Advanced Integrated Structures

Objectives

- More affordable, weight optimized structural components
- Native, optimized integration of equipment & systems in the structural design
- Manufacturing & assembly technology base

Means & Enablers

- Full scale hybrid integrated cockpit demonstrator with cockpit system integration
- Electrical wing demonstrator at bench facilities and delivery to IADP
- Anti-icing WT / Anechoic chamber testing, component manufacturing demonstrator
- Ground demonstrators consisting of central fuselage airframe subassemblies of metal fuselage and wing sections.
- System integration demonstrator for small a/c

Partnership Framework

- Research Institute & Academia, Aero-Structure Industry, Material Provider, Equipment Supplier

Timescale

- 2014-2020
TS B-4 : Advanced Fuselage

Objectives
- New concept of fuselage to support future generation of fast rotorcraft
- Integrated structural concept for composite fuselage with more global aero structural optimizations
- Optimized passenger cabin environment

Means & Enablers
- Full scale, flightworthy tail assembly fast rotorcraft demonstrator
- Fast rotorcraft pressurized fuselage demonstrator structurally tested on dedicated benches
- Full scale fuselage barrel demonstrator
- Small scale cabin set-ups & virtual demonstrators

Partnership Framework
- Research Institute & Academia, Aero-Structure Industry, Material Provider, Equipment Supplier

Timescale
- 2014-2018
Thank you for your attention