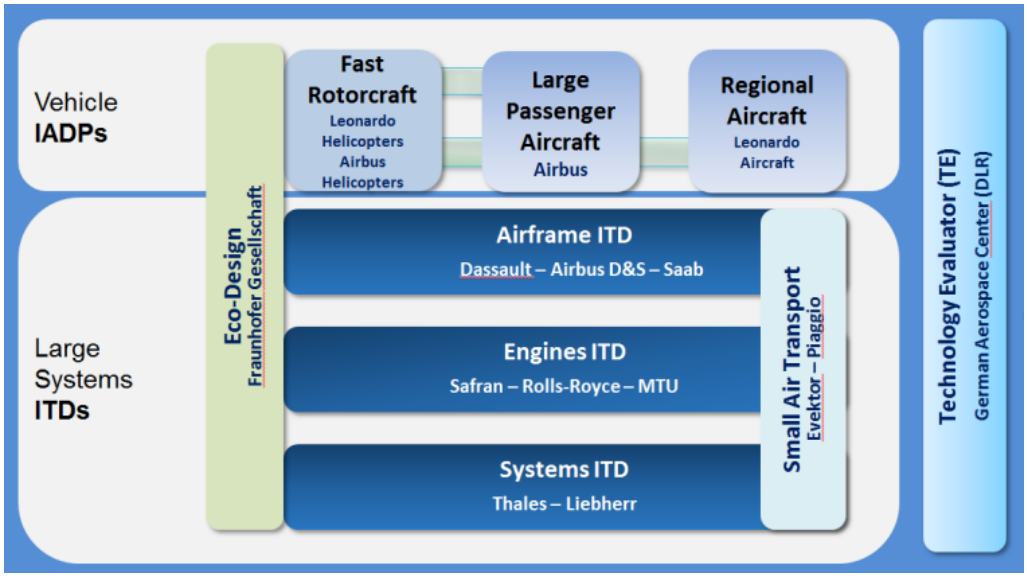
Clean Sky 2 - JOINT UNDERTAKING

Clean Sky is a Joint Technology Initiative (JTI) that aims to develop and mature breakthrough 'clean technologies' for Air Transport. By accelerating their deployment, the JTI will contribute to Europe's strategic environmental and social priorities, and simultaneously promote competitiveness and sustainable economic growth.

The Clean Sky 2 programme is jointly funded by the European Commission and the major European aeronautics companies, and involves an EU contribution (financial) from the Horizon 2020 programme budget of €1.755 bn. This is complemented by the In-Kind contributions from the Private members leading to a total public and private investment of approximately €4 bn.

The Clean Sky 2 programme consists of four different elements:

- Three Innovative Aircraft Demonstrator Platforms (IADPs), for Large Passenger Aircraft, Regional Aircraft and Fast Rotorcraft, operating demonstrators at vehicle level;
- Three Integrated Technology Demonstrators (ITDs), looking at Airframe, Engines and Systems, using demonstrators at system level;
- Two Transverse Activities (Eco-Design, Small Air Transport), integrating the knowledge of different ITDs and IADPs for specific applications.
- The Technology Evaluator (TE), assessing the environmental and societal impact of the technologies developed in the IADPs and ITDs;



The partners' activities will be determined through topics defined in the work plan and launched as calls for proposals via the EU Participant Portal. The 2018 Call for Proposal deadline for applications is **July 12th 2018**. The detailed topics descriptions are described in this document.

Large Passenger Aircraft - LPA

*The Large Passenger Aircraft IADP is focussing on **large-scale demonstration of technologies** integrated at aircraft level in 3 distinct 'Platforms' and as follows:*

- *Platform 1: "**Advanced Engine and Aircraft Configurations**": The major objective of Platform 1 is to provide the development environment for the integration of the most fuel efficient propulsion concepts into compatible airframe configurations and concepts targeting next generation aircraft.*
- *Platform 2: "**Innovative Physical Integration Cabin – System – Structure**": Platform 2 aims to develop, mature, and demonstrate an entirely new, advanced fuselage structural concept developed in full alignment towards next-generation cabin & cargo architectures, including all relevant aircraft systems.*
- *Platform 3: "**Next Generation Aircraft Systems, Cockpit and Avionics**" including advanced systems maintenance activities: In 2018 and 2019, the IADP LPA platform 3 activities will focus upon continuing the development and starting the integration and tests of the functions and technologies developed by the several Core partners in Platform 3 and in the ITD systems, within the Large aircraft Disruptive Cockpit, Regional aircraft Active cockpit and business jet ground demonstrators.*

Action	Topic	Topic Leader
IA	High Performance Electrical Components for Bleed Control	Safran
IA	Advanced Pitch Control Mechanism TRL4 Demonstration	Safran
IA	Oil Transfer Bearing for Advanced Pitch Change Mechanism	Safran
IA	Development and manufacturing of innovative tooling for composite parts	Aernnova
IA	Design and manufacturing of a large-scale HLFC wing model for a transonic WTT	ONERA
IA	Thermo-mechanical design validation of compact heat exchanger by thermal cycling life prediction	Liebherr
IA	Compact Matrix Air Oil Heat Exchanger	Rolls-Royce
RIA	Development of Measurement Techniques for Visualisation and Evaluation of Reverse Flow Interactions with Fan	Rolls-Royce
IA	Development of AC cabling technologies for >1kV aerospace applications	Rolls-Royce
RIA	Aerospace standard Lightweight SSPC for High voltage >1kA application	Rolls-Royce
IA	Innovative Power and data transfer solutions for nacelle	Airbus
IA	Development and execution of new test procedures for thermoplastic aircraft fuselage panels	Aernnova
IA	Generic added structures on shells made from thermoplastic sheet material	Diehl
IA	Micro mechanical characteristics of a PEKK Co-consolidation / welded joint for use in thermoplastic fuselages	Fokker
IA	Multifunctional Aircraft Power Network with Electrical Switching	Fokker
IA	Pilot monitoring in service data collection	Honeywell

The deadline for applications is July 12th 2018.

RIA: Research and Innovation Action
IA: Innovation Action

Regional Aircraft - REG

The REG IADP objective is to bring the integration of technologies for Regional Aircraft to a further level of complexity with respect to the achievements of Clean Sky Green Regional Aircraft (GRA). Retaining GRA outcomes, ***advanced technologies for regional aircraft*** *are being further developed and will be* ***integrated and validated at aircraft level****, so as to drastically de-risk their integration on future regional aircraft products.*

During 2018-2019, technical activities will be seamless continued from 2017 to cover further development of technologies, detailed definition of technologies integration into each demonstrator, design of demonstrators, laboratory testing and activities related to Wing Tunnel Tests (WTTs). For several demonstrators, the manufacturing phase will also start in this period. Core partners (CPs) will provide key contributions towards the maturation of relevant technologies as well as for the design and manufacturing of the full scale integrated demonstrators.

Action	Topic	Topic Leader
IA	Innovative recirculation / air treatment system	Leonardo Aircraft
IA	Full scale innovative pressure bulkheads for Regional Aircraft Fuselage barrel on-ground demonstrators	Leonardo Aircraft
RIA	High fidelity power effects aerodynamics at High Reynolds conditions in Regional turboprop configuration	Airbus Defence & Space
RIA	Laminar Flow robustness and Load control effectiveness evaluation for a Regional Turboprop wing	CIRA

The deadline for applications is July 12th 2018.

Fast Rotorcraft - FRC

The Fast Rotorcraft IADP of Clean Sky 2 consists of two separate demonstrators, the ***Next Generation Civil TiltRotor*** *(NGCTR) [leader: Leonardo Helicopters] and the* ***RACER compound helicopter*** *[leader: Airbus Helicopters]. These two fast rotorcraft concepts aim to deliver superior vehicle productivity and performance, and through this economic advantage to users.*

In 2018, topics will focus on NGCTR. NGCTR aims to design, build and fly an innovative next generation civil tiltrotor technology demonstrator. The configuration will go beyond current architectures of this type of aircraft and will involve tilting proprotors mounted in fixed nacelles at the tips of the wing.

Action	Topic	Topic Leader
RIA	Adoption of a "Digital Transformation" approach to improve NGCTR design and simulation	Leonardo Helicopters
IA	Certification by Simulation for Rotorcraft Flight Aspects (CSRFA)	Leonardo Helicopters
IA	Design, development and flight qualification of a supercritical composite shaft drive line for tiltrotor main drive system	Leonardo Helicopters
IA	Development of effective engine air intake protection system for Tilt Rotor	Leonardo Helicopters
IA	Engine exhaust wake flow regulator for Tilt Rotor	Leonardo Helicopters
RIA	Experimental characterization and optimization of the RH and LH Engine intakes configuration of the next generation Tilt Rotor	Leonardo Helicopters
IA	High efficiency full electrical low pressure Compartment Pressure Control System for tilt-rotor applications	Leonardo Helicopters

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Airframe - AIR

Due to the large scope of technologies undertaken by the Airframe ITD, addressing the full range of aircraft types, the ITD is structured around 3 major Activity Lines split into Technology Streams:

- *Activity Line 1: **High Performance & Energy Efficiency (HPE)**: the high-level objectives for the period 2018-2019 are: **Innovative Aircraft Architecture**: continuation of study of novel concepts of engine integration on rear fuselage, novel aircraft architectures, and progress on TRL for the UHBR concept; **Advanced Laminarity**: investigations on concepts and technologies for NLF and HLFC will be continued for the nacelle and the wing; **High Speed Aircraft** will be focused on the demonstration of benefits of a LPA wing and the design of the BJ root wing box demonstrator and of an innovative aircraft door; **Novel Control** project NACOR, GAINS and MANTA will concentrate respectively on design of control for load and flutter control, integration of WIPS on innovative control surfaces and study of innovative movables; **Novel Travel Experience** maturation of technologies and concepts for the ergonomic flexible cabin will continue. Development of the BJ cabin arrangement will be carried out (project CASTLE).*
- *Activity Line 2: **High Versatility and Cost Efficiency (HVC)**: the main objectives for the 4 major Technology Streams are: **Next Generation Optimized Wing Boxes**: to develop the detail design of new wing concepts improving performance; **Optimized High Lift Configurations**: to progress on the design and to freeze design of wing elements improving aero-efficiency of wing; **Advanced Integrated Structures** objectives: to develop a final design of systems with and optimization of the integration in airframe along applying structural advances; **Advanced Fuselage** objectives: to have detail design of new fuselage shapes and structures for rotorcrafts and more affordable, weight optimized structural components, looking for optimized integration of equipment & systems in the structural design.*
- *Activity Line 3: **Eco-Design**: the most promising technology will be developed to TRL 4 and large demonstrators design will start for a maturation of technologies to TRL 5-6.*

Action	Topic	Topic Leader
RIA	Composite mould tool based on 3D printing	SAAB
RIA	Innovative test rig for the investigation of gust loads in transonic flow conditions	ONERA
IA	In-Seat Ventilation & Supply for Personalized Comfort Control on Board an Aircraft	Airbus
IA	Full Scale Innovative Integrated Tooling for Composite Material Wing Box [SAT]	Israel Aircraft Industries
IA	Development and Optimization of Bonding Assembly Technology for a Composite Material Wingbox [SAT]	Israel Aircraft Industries
IA	Virtual-Hybrid-Real On Ground demonstration for HVDC & EMA Integration	Airbus Defense & Space
IA	Enhanced Low Cost Complex Composite Structures	Airbus Defense & Space
IA	Cold Spray of metallic coatings on polymer and composite materials [SAT]	PZL MIELEC
IA	Design of special welding head for FSW process with automatic adjustable pin and welding force control system [SAT]	PZL MIELEC
RIA	Evaluation and modelling of comfort driving parameters in a Cabin Demonstrator	Fraunhofer
RIA	Model based development of an innovative ECS air distribution system for ground testing with a Cabin Demonstrator	Fraunhofer
RIA	Bio contamination survey	Dassault Aviation
IA	Non destructive testing (NDT) of bonded assemblies	Dassault Aviation
RIA	Sizing for recycled carbon fibres to optimise adhesion in organic/inorganic composite materials	Fraunhofer
RIA	Development of an anaerobic digester prototype for aircraft use	Fraunhofer
IA	Development and evaluation of a manufacturing process for a lightweight aircraft wheel made of CFRP	Fraunhofer

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Engines - ENG

*As defined in Clean Sky 1, the objective of the **Sustainable and Green Engines (SAGE)** was to build and test **five engine ground demonstrators covering all the civil market**. The goals aimed at validating to TRL 6 a 15% reduction in CO2 compared to 2000 baseline, a 60% reduction in NOX and a 6dB noise reduction. This is roughly 75% of the ACARE objectives. Whereas some activities were delayed for the Open Rotor programme for example, the bulk of SAGE objectives remained on track and the demonstrator projects delivered very valuable results.*

In Clean Sky 2, the ENGINES ITD will build on the success of SAGE to validate more radical engine architectures to a position where their market acceptability is not determined by technology readiness. The platforms or demonstrators of these engines architectures can be summarized as below:

*- **Ultra-High Propulsive Efficiency (UHPE)** demonstrator addressing Short / Medium Range aircraft market, 2014-2023: design, development and ground test of a propulsion system demonstrator to validate the low pressure modules and nacelle technology bricks;*

*- **Business aviation/short-range regional Turboprop Demonstrator**, 2014-2020: design, development and ground testing of a new turboprop engine demonstrator in the 2000 thermal horse power range;*

*- **Advanced Geared Engine Configuration**, 2015-2020: design, development and ground testing of new compression system rigs and an expansion system demonstrator to validate key enablers to reduce CO2 emissions, noise and engine mass;*

*- **Very High Bypass Ratio (VHBR) Middle of Market Turbofan technology**, 2014-2018: development and demonstration of technologies to deliver validated power plant systems matured for implementation in full engine systems;*

*- **VHBR Large Turbofan demonstrator**, 2014-2021: design, development, ground and flight test of an engine to demonstrate key technologies for large engines;*

*- The **Small Aero-Engine Demonstration** projects related to Small Air Transport (SAT) will focus on small fixed-wing aircraft in the general aviation domain and their power-plant solutions, spanning from piston/diesel engines to small turboprop engines.*

*- **Eco Design**: Considering several demonstrator components this Eco Design work package has been outlined as a comprehensive work package concentrating on relevant engine manufacturing technologies.*

Action	Topic	Topic Leader
IA	Optimized UHPE flow path cooling design and testing using advanced manufacturing techniques	GE Deutschland
RIA	Prediction of High Frequency Vibrations in Aircraft Engines	Safran
RIA	Airflow characterization through rotating labyrinth seal	Safran
IA	Oil flow 4 channels regulation valves	Safran
RIA	Optimizing impingement cooling	Safran
RIA	Aerodynamic Surface Air Cooled Oil Cooler (SACOC) upgrade	Safran
RIA	Low NOx / Low soot injection system design for spinning combustion technology	Safran
RIA	Development and verification of microstructure, residual stress and deformation simulation capability for additive free-form deposition using multiple superalloys	GKN Aerospace
RIA	Probabilistic simulation of defect probability in titanium fusion processes	GKN Aerospace
RIA	VHCF material model for case hardened gear steels for application in an epicyclic power gearbox	Rolls-Royce
RIA	Development of design methodologies for thermal management and scavenge / sealing interactions in future ventless UltraFan bearing chambers	Rolls-Royce

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Systems - SYS

*As **Systems play a central role in aircraft operation, flight optimisation, and air transport safety** at different levels as they enable optimised trajectories, new aircraft configurations and improved performance-weight-ratios. The 2018-2019 period will see the maturation of many topics while some others will be ramped-up.*
Systems ITD's scope include virtually all major aircraft systems, ranging from cockpit and avionics to landing gears. It includes as well environmental control systems, wing ice protection and electrical power generation, distribution and conversion. Furthermore, flight control systems and actuation is addressed for small, regional and large aircraft alike. A joint focus of all activities is set on the increasing electrification of the systems to enable the future more-electric or full-electric aircraft. Additional work is done to create environmentally friendly technologies in particular in the area of material and processes.

Action	Topic	Topic Leader
RIA	Modeling of friction effects caused by surface contact with high pressure and rapid movement	Liebherr
IA	New grip generation for active inceptor	Safran
IA	Design and development of a long stroke Piezo Electric Actuator	Safran
IA	Health Monitoring for Electro-Hydraulic Actuator fluid	Safran
IA	Innovative RTM tooling for CFRP primary structural parts	Fokker Landing Gear
IA	Innovative quality inspection methods for CFRP primary structural parts	Fokker Landing Gear
IA	Innovative Composite Material Qualification Methodologies	Fokker Landing Gear
IA	Development of an optimized DC-DC converter for a smart electrical system	Safran
IA	Development of a HVDC current limiter	Zodiac Aero Electric
RIA	Air treatment system for airborne microbe removal from air circulation or chambers	United Technologies Research Centre
RIA	Improved Thermal Properties of Computing Platforms for Next-Generation Avionics [SAT]	Honeywell International
RIA	Development and testing of innovative Cr free anodic layers removal solution	Liebherr

The deadline for applications is July 12th 2018.

Thematic Topics - THT

*To integrate, demonstrate and validate the **most promising technologies** capable of contributing to the CS2 high-level and programme specific objectives, the CS2 technology and demonstration activity is structured in key (technology) themes, further subdivided in a number of demonstration areas. A demonstration area may contribute to one or more objectives and also may involve more than one ITD/IADP.*

Action	Topic
RIA	Innovative NOx Reduction Technologies
RIA	Cognitive Computing potential for cockpit operations

The deadline for applications is July 12th 2018.

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IA: Innovation Action